TECHNOLOGY

Ivars Peterson reports from San Francisco at the spring meeting of the Institute of Electrical & Electronics Engineers Computer Society

Paint by electron: A digital paint box

Now an artist can use a stylus and video screen as naturally as a paintbrush and canvas. Recently developed at MCI/Quantel, the digital paint box is designed to produce high-quality images while the electronics is as unobtrusive as possible.

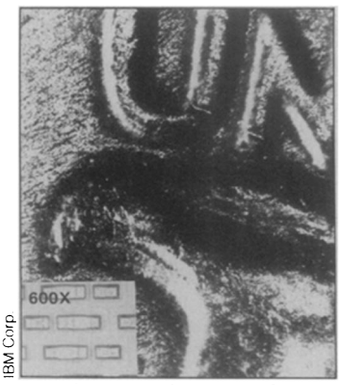
One significant improvement on previous systems is the use of a pressure-sensitive stylus that responds to the artist's hand. A greater pressure of the stylus on a touch tablet produces a thicker or more opaque stroke on the video screen. In addition, the system has better resolution so that curved lines and edges do not appear jagged.

Whereas earlier systems presented only a limited number of colors for the artist to use, the digital paint box tries to reproduce the full color triangle of hue, illuminance and saturation. The computer driving the system displays a set of colors at the bottom of the screen, but the artist can create new colors in a special mixing area. The procedure is remarkably similar to mixing paints on an artist's palette. The new colors can be stored electronically and recalled for later use. At the same time, the artist can select various brush and pencil widths and modes according to whether an oil-paint, water-color, chalk or other effect is desired.

George Hamilton of MCI/Quantel says the system will be particularly useful for creating television graphics. It is also a photo-retoucher's dream because colors can be picked up from pictures on the screen and used to fill in or remove parts of images. "You can't tell if it has been retouched," Hamilton says.

If artists take to the digital paint box as they did to oil paint, then the paint-splattered artist's smock may disappear.

A chip in time saves power



IBM Corp

As designers of integrated circuit chips pack more and more logic into smaller spaces, dissipating heat and cooling the package become major concerns. Engineers at IBM's East Fishkill Facility are developing high-speed, low-power, closely packed memory cells to improve the performance of random access memory chips used for storing information in computers. Using memory cells called complementary transistor switch cells, the researchers can increase the speed and reduce the power consumption of a memory chip, while doubling the density of the memory cells making up the chip.

In the photograph, the array of memory cells, magnified 600 times, is dwarfed by a U.S. quarter, magnified only 100 times. Hundreds of the memory cells can fit on the eagle's beak.

Usually, a memory chip consumes a constant amount of power at all times, whether or not it is needed for a particular operation. The IBM scientists were able to reduce power requirements by calling for a high voltage only for the selection of arrays and a lower steady-state voltage when the selection was complete. Other improvements were achieved by using new circuit arrangements that combined the read and write functions, and faster support circuits that reduced the time needed to read stored information.

The researchers predict that the type of multi-use, minimum component circuits they have developed will become attractive when future large computer systems require more dense but easily cooled random access memories.

BIOLOGY

Hermit crab goes house-hunting

A hermit crab grasps, rolls and probes empty gastropod shells before choosing one for a home. What determines its selection of a new residence? Karen Anne Mesce of the University of Oregon proposes that the shell exploration and selection are triggered by a single inorganic substance — calcium. In laboratory experiments she gives hermit crabs of the species *Pagurus hirsutiusculus hirsutiusculus* (Dana) a choice between two objects. They consistently exhibit exploratory behavior toward (and choose to inhabit if the shape is suitable) the object releasing the most free calcium. For example, all the crabs tested chose uncoated shells over shells covered with a thin layer of sealant. They also preferred plaster replicas of shells (made of highly soluble $CaSO_4 \cdot H_2O$) over natural shells (composed of only slightly soluble $CaCO_3$). But when the seawater was nearly saturated with $CaSO_4 \cdot H_2O$ to reduce calcium solubility, the hermit crabs selected the natural and the plaster replica shells equally. Mesce says in the Feb. 19 SCIENCE, *"Pagurus hirsutiusculus* lives in an environment where adequate shells are scarce. Sensitivity to calcium may enable this species to locate partially buried shells, thus increasing the number of shells available for habitation."

Control of transplanted genes

Now that biologists can move selected genes from cells of one organism to those of another, a major concern is how those genes are regulated. In its new environment, does a gene take up residence within a chromosome and direct synthesis of its product in an appropriate way? At the recent conference on Cell Proliferation, Cancer and Cancer Therapy sponsored by the New York Academy of Sciences, Richard Axel of Columbia University described experiments transferring human genes into animal cells in laboratory culture. With a recently developed technique for selecting cells that have taken up foreign DNA, Axel says biologists "can introduce any gene into any cell."

A human gene can go into a chromosome of an animal cell, Axel finds. In his experiments, DNA containing the human growth hormone gene inserts into the short arm of rat chromosome number 11. It resides at a site different from that of the rat's own growth hormone gene.

The piece of DNA transferred contains all the information necessary for putting the gene under control of hormones. The DNA segment — consisting of the human growth hormone gene, with its intervening sequences, as well as 500 nucleotides on one side and 300 nucleotides on the other side — was more active in mouse cells in the presence of glucocorticoid hormones, which trigger the gene's activity in human pituitary cells. Experiments with shorter segments of the human DNA demonstrate that the controlling sequence resides in the 500 nucleotide region adjacent to one end, the 5′ end, of the gene. This control stretch is not effective if it is moved away from the growth hormone gene.

Experiments with human and mouse hemoglobin genes, performed with Tom Maniatis of Harvard University, also have shown that the site for regulating gene expression lies within the first few hundred nucleotides flanking the 5′ end of the gene.

The most intriguing aspect of these experiments, according to Axel, is that a transplanted gene may be expressed in host cells where the endogenous gene is never active. For example, the human but not the mouse growth hormone gene responds to glucocorticoids in mouse fibroblast cells (cells that do not normally produce growth hormone). Axel suggests that genes are under two levels of control. One type, long-term regulation, occurs during development, and the second occurs in response to transient signals. "The endogenous gene has been turned off by its exposure to developmental history," Axel says. "In contrast, the new gene is introduced in an 'on' configuration."