The Incredible Electronic Animation Machine

A computer system called

by E.J. Tajchman

Anything is possible. Today we can even animate multiple characters in full color with lip sync over a painted or live background and see the finished scene the same day. That may have been impossible a few years ago but not any more. An electronic animation system named CAESAR enables an animator to do just that.

The CAESAR system employs a mapping technique that requires only artwork and some instructions to produce the desired animation. Usually the instructions will be verbal. "Arnie needs more emphasis in that arm swing. Make the arm longer just as he stretches it out." With statements like this a director can control the animation of Arnie, a character in a 60-second television spot. He can judge the animation during its production because it is displayed in either real time or slow motion playback on a television monitor.

An animator/operator will respond to the instruction by directing CAESAR via the control panel to make the requested change in the image. Within seconds the director will know if these changes have created the desired effect in the animation. He can view the animation in full color and decide whether any other changes are necessary. This is possible because CAESAR's electronic-animation system has features that allow an animator to see the final results of his imagination within hours or days instead of the usual weeks or months.

One key feature of the CAESAR system is the method of using artwork as the input and storage medium for the detailed image information. The artwork can be stored on a piece of film or in a digital frame-store memory. Many animation specialists claim that only the ideas in an artist's mind are required to produce animation. But a computer cannot read an artist's mind. In some manner, the details of the imagined scene must be communicated to the sytem, as it can only work with the data given to it. The artist might be able to create the punched cards, magnetic tape or use some other means of digital communication to program the image into the system. Artists, however, are usually not programmers. They express their ideas best with drawn pictures.

Say an artist draws a logo, a symbol, or a figure; that's the image he or she wishes to animate. Pure digital computer animation systems require a programmer to extract the details of the image and arrange them in the proper form for the computer. Even then, it can be very difficult to communicate all of the important characteristics of the image to the system as the programmer may not appreciate the fine points of the artist's drawings. Also, an artist may not draw in a manner that is easily transferred by mathematical equations. If the image cannot be described by equations, then a point-by-point description may be necessary. This type of interface between the artist and the computer is tedious and time-consuming at best, and even then may not be satisfactory. And since the artist usually will draw the desired image anyway to describe it to the programmer, it is advantageous to use the drawing directly to program the image.

The drawing is prepared for the CAESAR system input by an artist who first dismembers the character so that each portion of it that is to move independently of any other portion is drawn in an isolated view. These isolated portions—as many as eight are possible—are arranged vertically and converted by a photographic process to high-contrast artwork.

Color-coding is achieved by assigning different scales of gray to areas that are to have independent colors. The CAESAR system discriminates each particular shade of gray and an operator can assign any color to that area. Areas with different gray scales can have different or identical colors. Different gray scales merely identify areas whose colors can be arbitrarily selected. This means that color can be changed during a sequence. A particular shade of gray can be coded red at the beginning of a scene, later jumped to blue, then shifted to yellow by the end of the sequence.

Another CAESAR feature is the operation of a subsystem called "Overlap." This provides a real-time solution to the hidden-line problem. It makes it possible for a character to move an arm in front of its face without producing image interference where the two sections overlap.

A method of controlling a blanking window applied to the input video makes it possible to have, say, seven mouths, displayed horizontally, drawn on one section, but to have only the chosen one visible on the composed character. Since the blanking parameters are controllable, the operator can display any particular mouth on any specific frame. This feature can be used with any and all of the sections containing the character's features so that a clenched fist can be substituted for an open hand, a side view for a frontal view of a head, and so forth.

To produce an animated sequence,

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CAESAR is conquering new worlds for video graphics

the animator first composes the necessary key frames directly on the system by varying the control parameters; size, shape, position, center and angle of rotation, type and amount of shaping function, and color of each portion of the character are independently controllable. First the desired parameter must be selected with a switch. Then the parameter value can be varied by turning a knob and the effect viewed on a television monitor. Instant visual feedback helps the animator decide the optimum parameter values needed to create the correct key frame. Up to eight key frames, with the animator specifying the time interval between them, can be constructed at one time. These key frames can be instantly recalled and checked for relative positions. After the animator has reviewed the key frames, modifying them when necessary, and is satisfied with them, he pushes a button to let CAESAR procede to compute the "in betweens." The video frames between the key frames are now filled in by the computer. In just seconds the action is ready to view.

The CAESAR system is in daily use as an animation tool. Video productions created on it run the gamut from startling abstract effects used in television commercials, to full character animation used in all types of productions, and on to the precise graphic manipulation needed for industrial training.

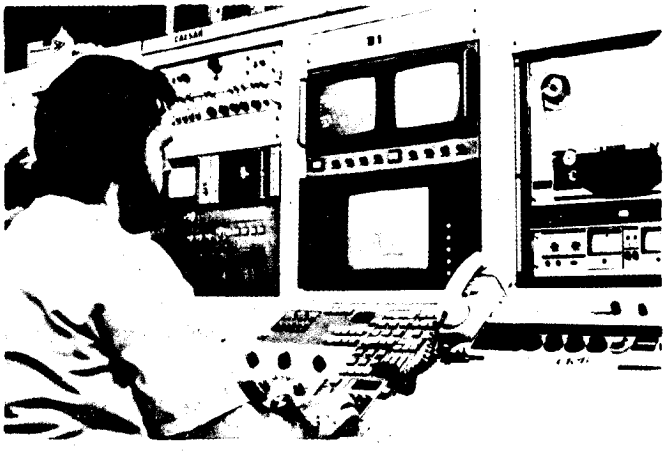
Production usually begins with a storyboard, a "script" drawn by an artist that looks very much like a comic strip. Each panel of the storyboard illustrates the key visual elements present in a particular scene. After the storyboard is approved by both the director and the client, the process continues with the generation of a written script. A sound track is then produced from the script at a sound studio where the different voices, sound effects and music are all mixed and recorded on magnetic tape. If the production is to include lip sync, the sound track must be "read." This process results in the bar sheets that indicate the precise time at which each syllable of each spoken word occurs.

During this time, an artist/animator will analyze the storyboard and generate the artwork required to produce the animation. Several different backgrounds may be required and are prepared in full color. The animated characters for each scene are then prepared on gray-scale artwork. At least one piece of input artwork is required for each scene. If several characters are involved in the scene then a separate piece of artwork may be required for each of them.

Now the actual production of animation can begin. A scene is selected and the proper artwork set into place. Gray-scaled artwork defining the animated character is used as the system input. Full-color art scanned by a color tv camera, video from a VTR, or another animation system output can supply the background video.

An animator now creates an animated sequence by building a series of key frames, using the technique previously discussed. The director has an opportunity to control the animation by inserting himself into the

Animator Dave Holman operating Computer Image's CAESAR (below), to produce "Stomach Serenade," an animated program about food poisoning. Arnie, the singing germ, and his legions (bottom), are created by using a mapping process to combine artwork elements.



Computer technology produced these animated drawings of a food-poisoning victim as disaster strikes (left) and as his headache overwhelms him (below). Photos courtesy Computer Image Corp., which holds patents on the Animac, Scanimate and CAESAR systems.

feedback process. Lip sync can now be added by specifying which one of up to seven different mouth shapes should be used at the times specified shape will appear on the character and will track the animation already constructed. The sound track itself is used as a timing source.

After the director is satisfied with the completed animation, the sequence of the character keyed over the background video is recorded on videotape. If more than one character is desired, additional characters can be keyed over the composite scene in successive passes. A single scene can contain from one to ten or more passes. This process continues until all of the scenes required for the production have been recorded on videotape.

The production is completed by using videotape editing techniques to combine the many scenes together in the proper order. Two or three VTRs, a time-code system and a modern television switcher are used for this process. After the editing process is complete the production is ready for use in videotape form.

Electronic animation, especially the CAESAR system, has enabled many producers to reduce the time required to complete an animated project. Buzz Potamkin, Executive Producer at Perpetual Motion Pictures, says the time required to produce a conventionally animated 30-second spot is seven to nine weeks on a normal schedule and three to five weeks on a rush schedule. The normal schedule for an electronically animated 30-second spot is much shorter. Of course, there is no change in the time required for the design and track development stage, which can take three working days. However, the remaining phases—layout, animation, ink and paint, and completion to tape—can all be shortened. Because of the animation technique used, only a limited amount of artwork needs to be prepared. Allowing one to two days to produce the animation with CAESAR, a total of one week for the production of a 30-second spot is reasonable.

The technology employed by the CAESAR animation system has been under development since 1956. Lee Harrison III, now chairman of Computer Image Corp., started dreaming about automating the production of animation as soon as he received his degree in Fine Arts. He began creating such a system after earning an Engineering degree in 1959. Implementation of these ideas became the goal of Computer Image Corporation, which he founded in 1967.

Electronic animation has enabled producers to reduce the time required to complete a 30-second spot from nine weeks to a single week.

Since then, three major animation systems have been developed; Animac, Scanimate and CAESAR. Animac, the granddaddy system, used analog computer technology and generated great excitement and a few commercial productions. However, its programmability and image quality were not adequate for wide commercial use. All images were internally generated in two- or three-dimensional space.

Scanimate is the second-generation system. An Emmy was awarded in 1972 by the Television Academy for the development of Scanimate. It has become a commercial success and is in operation at Computer Image Productions in Denver, Image West in Hollywood, Dolphin Productions in New York City and at Far East Laboratories in Tokyo. The Scanimate system is a hybrid, utilizing analog computer and television technology in a mapping process to produce animation. The procedure used to produce animation with Scanimate is similar in many ways to the one used with CAESAR. What differs is the way the operator controls the system and the type of animation attempted.

Inclusion of a digital computer in CAESAR makes its operation simpler, and enables precise timing and positioning of the animation and the production of long sequences. Experience gained while creating animation for a broad array of clients has proven that this combination of three technologies has given birth to a computer animation system of great power and versatility.