

Pixel Art

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When David Brandin took office as president of ACM in July 1982, he initiated his series of letters for the *Communications of the ACM*. The first letter introduced the

available in the Smalltalk-80[®] system [1, 2]. We use the term "pixel art" to name this kind of graphic art and offer here a description of the software graphics tools we use. The

and turns them into 8-bit samples. The user of the scanner controls the range of black-through-white tones that map onto the numbers 0 to 255 (i.e., the 8-bit representation). Half toning algorithms are applied to these samples in order to convert the 8-bits into 1-bit representations that can be manipulated with the Smalltalk-80 system. The example image was obtained by scanning a photograph of a young man sitting at a Xerox personal workstation. The original head was erased and replaced by a scanned image of David.

Smalltalk-80 Forms

The Smalltalk-80 system is an interactive, graphical programming environment. The system supports an object-oriented programming language in which the fundamental way to indicate that something should happen is by sending a message to an object. Graphical images are represented in the system as objects called Forms. A Form has height and width, and a bitmap which indicates the black and white cells or *pixels* of the image being represented. A basic message to a Form, referred to as BitBlt, supports a wide range of graphical operations [3]. The BitBlt copy operation involves two Forms, a source and a destination; pixels are copied out of the



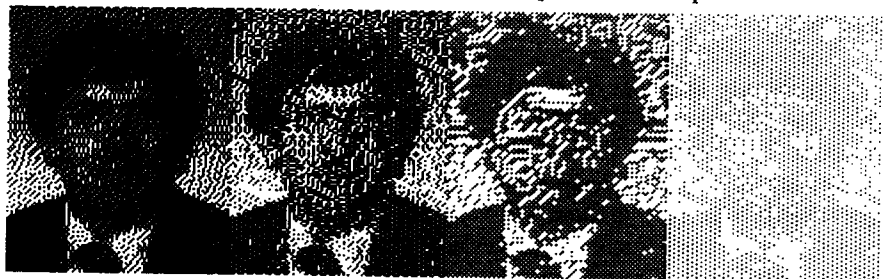
changes occurring in a number of areas that affect the ACM membership, notably the presidency itself. We graphically represented that transition with a series of pictures transforming an image of Peter Denning, past president, into an image of David Brandin. Each subsequent letter written by the President has been accompanied by a graphic that includes at least one image of David, like the one shown here.

























The graphics were created using experimental hardware and software developed at the Xerox Palo Alto Research Center. The graphics were done by combining images obtained by scanning photographs or illustrations with the freehand graphics

images of David Brandin shown in this letter will serve to illustrate the process.

Scanned Images

Photographs or illustrations used in creating images are scanned using an experimental, low-cost optical scanner designed by Joseph Maleson. The scanner samples gray levels



SOURCE	MASK	DESTINATION	COMBINATION RULE	RESULTING DESTINATION
			BIT-REPLACE (STORE)	
			BIT-OR (UNDER)	
			BIT-XOR (REVERSE)	
			BIT-AND/COMP (ERASE)	
			BIT-REPLACE (STORE)	
			BIT-XOR (REVERSE)	

source and stored into the destination according to a bit-wise combining rule. A third Form, referred to as a half tone or mask, may be used to fill areas of the source with a regular pattern in order to provide the effect

tion rule called "storing" that replaces any bit in the destination with the corresponding bit in the source. Manipulation of source, mask, and combination rule allows for many interesting visual effects.



of gray tone or texture. For example, if we take an image of David and mask it with different gray tones, we get the fading effect used in the July issue of *Communications*, as seen on page 861.

There are sixteen possible rules for combining each source element with the corresponding destination element. The original Trojan horse pulled by clones of David in the September issue of *Communications* was a small black horse; the larger white horse was copied into the scanned image using the combina-

Additionally, images can be rotated and scaled. Once the initial image of David sitting at the Smalltalk-80 workstation was created, scaled versions were computed. The scaled images were then combined as the source Form into the display screen area of the destination Form using the storing combination rule and no mask.

Toolbox

Actual manipulation of the scanned images created for the *Communications* president's letters was

done using Toolbox, a Smalltalk-80 drawing system designed for interactive image creation and editing [4]. Toolbox consists of a coordinated set of graphic tools that give the user access to Form construction options such as those described earlier. Five fundamental tool functions (point copy, repeat point copy, line, curve and block) comprise the basic graphical form vocabulary; each of these tools can be modified in its use by one or more of four sets of variables that can affect its Form source, color tone (mask), grid spacing, and combination rule. The user can draw an image and then select the image as the Form source ("brush") or as the color tone. With gridding turned on, a "wallpaper" effect can be created.

Based on the speed of execution and the range and depth of graphic language effects that can be created with the Toolbox system, we feel that similar systems will become another common graphic tool for professional-level designers and illustrators, as well as folks like ourselves,

typical of the "programmer-turned-artist."

References

1. Goldberg, Adele, and Robson, David. *Smalltalk-80: The Language and Its Implementation*. Addison-Wesley, forthcoming in 1983.
2. *Byte Magazine*, special on the Smalltalk system, August, 1981.
3. Ingalls, Dan. The Smalltalk Graphics Kernel, *Byte Magazine*, August, 1981, pp. 168-194.
4. Bowman, William, and Flegal, Robert. Toolbox: A Smalltalk Illustration System. *Byte Magazine*, August, 1981, pp. 369-376.

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