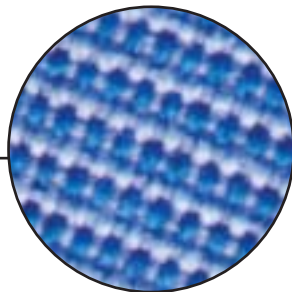


Elements of the Computer

The Bitmapped Image

Digital photographs and many other computer images are bitmapped, a grid system whose squares (pixels) are represented by one or more numbers that determine color, brightness, and various other characteristics of an image. The dataset for these images is mapped onto a grid on a computer screen or used to control the action of a printer. The greater the number of pixels, the greater the resolution and clarity of the image; the larger the number assigned to each pixel, the greater the number of colors that can be represented. The process of digitizing a photograph entails creating a grid and filling it with pixels.

When presented with this grid, we do not see the individual pixels: Our eyes blend them together to create a seamless, continuous-tone image. The concept of using squares of color or even numbers to create an image has developed since antiquity. The image's success depends on the squares of color remaining small enough that the viewer's eye will not be able to see each individual square, but rather blend them together.



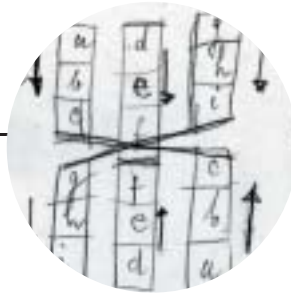
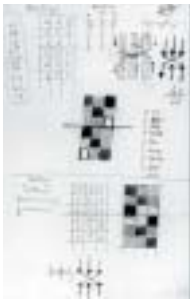
1. Throughout antiquity we can see proto-bitmaps in mosaics—small tiles of solid color—that blend to form a continuous tone image when viewed from a distance.
2. In the early nineteenth century, scientist Michel-Eugène Chevreul, the director of the Gobelins tapestry factory of Paris, had a profound effect on the Postimpressionist painter Georges Seurat, through his discovery of optical mixing. By weaving a garment from threads of two different colors, Chevreul found that the garment's color would appear to be a blend of the two: The eye could not resolve the individual threads, instead blending them into a third. Seurat, who was also familiar with the current thinking in the field of physics concerning the properties of light, used a method of painting that applied small dots of color to the canvas, in essence allowing the viewer's eye to mix the colors, rather than mixing paint on the palette. This blending in the eye is the basis for the color halftone and for the three-color cathode-ray tube monitor (CRT). The link between fabric and imagery continued into the twentieth century, as SciTex, a company that had developed machines to create fabric, marketed one of the earliest digital-imaging systems in the 1980s.



3. In the player piano, keys are activated based on information encoded in a disk. Different combinations of notes are encoded as number on the disk. This is a means of recording a sound by encoding discrete elements, which are later interpreted by the player piano and played back. Note that there was probably no "sound" present when the disk was created, merely the musical notes of the score, which can also be thought of as a discrete notational system that can be copied flawlessly.

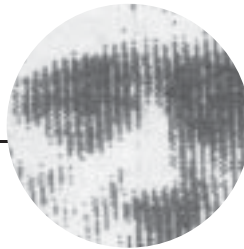
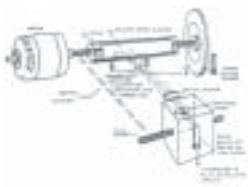


4. Late in the nineteenth century, a process for transmitting images over the telegraph was created. In this process, a scanner moves over the image and sends an electrical pulse over the wire depending on whether the image is dark or light at a particular point. At the other end of the wire, a device darkens paper based on whether it senses a pulse. This can be thought of as the first digital image, though no provisions were made for storing it virtually, for recording the electrical pulses so that the image could be reconstructed at a later time. This would not happen until the late twentieth century.



5. Paul Klee describes a technique for painting in which a grid is drawn and letters corresponding to colors are placed in the squares of the grid. An image can then be constructed from this grid.

6. In 1951, Craft Master releases the first paint-by-numbers kit, which proclaimed, "Every man a Rembrandt." The kit contained paints and a template for a painting. Users would apply the paint inside predrawn lines. In effect, the numbers on the image encode color, a latent image that the amateur painter would complete.



7. One of the first digital images was created with a drum scanner constructed by Russell Kirsch and his colleagues at the National Bureau of Standards in the 1950s.

8. An image of Venus by the Magellan space probe. Temperatures on Venus can reach nearly 1,000 degrees Fahrenheit, making it impractical to place a camera on the planet's surface. This image was "constructed" from numerical data collected by a probe and transmitted back to Earth. Scientists then used the information to create this "photograph" through the process of ray-tracing: using imaginary rays of light to create a photographic image of a virtual object. Unlike a photograph, which this image clearly resembles, there was no "decisive moment." But it does encode time: The data were collected over a long period, mapped onto a grid, and then reconstructed.

