Kodak Photo CD

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TOPIC ---

This article provides an overview of Kodak Photo CD technology.

DISCUSSION ---

Kodak Photo CD is a technology for transferring 35mm film images to CD-ROM discs, making the images fully accessible to computer graphics applications. A Photo CD foreign file translator and a revised CD Remote application are included with each Performa equipped with an AppleCD 300i.

Note: QuickTime and Photo CD are required. The QuickTime and Photo CD extensions must be placed in the System Folder in order to view the images on a Photo CD. Because QuickTime has Photo CD support, any application that can open a PICT file can open a Photo CD file.

The AppleCD 150 and AppleCD SC Plus drives also support Photo CD, but what sets AppleCD 300i apart is its ability to read multiple sessions of Photo CD images. A reference used for some of the information that follows is "Photo CD: A Planning Guide for Developers" (August 1991 revision).

The Kodak Photo CD planning guide lists the following as benefits of Photo CD technology:

- Rapid retrieval and display of images.
- High-quality continuous-tone printing. Near optical-quality hard copy is possible with the equivalent of 2000-line resolution digital images.
- Consistent and optimum image quality.
- Support for a wide range of colors. The original scan from film records 36 bits per pixel of color information.
- Support for current and future television formats. Five resolutions of each image are stored, with the base resolution excellent for today's televisions. The 4x base resolution is ideal for high-definition television.

- Image duplication without degradation. With digital images, the copy is identical to the original.

- Powerful image manipulation. Powerful applications such as Adobe Photoshop are able to seemlessly work with Photo CD images.

A Photo CD session consists of all of the images contained on one roll of film (whether it is 12, 24, or 36 exposures). Until now, CD drives were able to read only one session. Kodak recently introduced equipment with the ability to encode several sessions of images onto one disk, and new CD drives (including the Apple CD 300) are being introduced that can read those sessions. A single Photo CD can now hold up to 100 images. The projected cost for developing a 24-exposure roll of 35mm film and pressing the Photo CD is about $24. The customer receives a Photo CD, the image negatives, and if desired, prints or slides of the images (the prints or slides will cost an additional $4 to $5). With the next set of pictures, the user would take in both an undeveloped roll of film and the once-used Photo CD. The CD would then be encoded with the new images and returned.

Film to CD

A high-speed scanner converts the images on the roll of film to digital data of 2048 lines of 3072 pixels with a depth of 12 bits per each primary color (a total of 36 bits per pixel). Each image is represented by 18MB of information. Next, a Sun SPARCstation is used to adjust the digital file for color and density and compress it (with no loss of image information) to an average of about 4.5MB.

Each image is represented in five different resolutions. The base resolution is 512 x 768 pixels, sufficient to display the image on a television or computer monitor. The 4base and 16base images are created by successive interpolation and correction schemes between pixels. The 4x and 16x representations are useful for displaying the images on high-definition television systems or printing on high-quality devices at thousands of lines per inch. The lower resolutions are useful because they can be quickly retrieved (less data to move around) and displayed as thumbnail representations of the images, indexes, and icons.

The five resolutions stored for each image and some uses for each are:

- Base/16 128 lines of 192 pixels image thumbnails, icons

- Base/4 256 lines of 384 pixels display of multiple images or slide shows

- Base 512 lines of 768 pixels normal display media

- 4Base 1024 lines of 1536 pixels high quality display

- 16Base 2048 lines of 3072 pixels high quality hard copy output

The 4Base and 16Base resolutions are stored as residuals which record the differences between the pixels at the next lower resolution. Huffman

encoding is also used to further compress the 4Base and 16Base resolutions of each image. The complete data for an image is stored in something called an "Image Pac". The information is stored on a CD-ROM using the CD-ROM XA Mode 2 form 1 sector format. This standard is call the Orange Book and was developed by Sony and Philips. Refer to the Sony/Philips specification called Recordable Compact Disc Systems "Orange Book" for details on the standard.

What's On a Photo CD?

When the gold-colored Photo CD comes back from the photofinisher, the user can place it in the AppleCD 300i and the system will mount the disc just like a hard disk or floppy disk volume. The Photo CD volume will have the name "PCDnnnn", where PCD stands for Photo CD and the four numbers identify the photofinisher. The name cannot be changed. If the user double-clicks the Photo CD icon, the system opens up the volume and displays photos folders, a Kodak folder, a "Slideshow" file, the Slideshow Viewer application, and a Photo CD folder.

Each resolution folder contains a file for every image on the disc at that specific resolution (such as 768 by 512). The Photo CD folder contains technical information about each of the images. The Slideshow file and Slideshow Viewer application allow the user to browse the images as a slide show.

If the user opens one of the resolution folders, a numbered icon for each image on the CD is displayed. Each icon is a thumbnail image of the image contained within the file.

If the user double-clicks on the icon, the system presents a dialog box asking if the user wishes to view the image in TeachText. TeachText displays the image (if enough memory is available) and allows the user to copy and paste the image into the Clipboard, Scrapbook, or any other document.

The Photo CD Viewer application displays one image at a time with window controls that allow users to automatically play each image, scroll to a specific image, or incrementally scroll through the images.

Photo CD Technology

A Photo CD image is a rectangular array of square pixels in a 3:2 aspect ratio that matches ratio of 35mm film. Pixels represent colors encoded with Kodak's PhotoYCC color-encoding scheme. Each pixel is separated into an 8-bit luma (brightness) component and two 8-bit chroma (color) components. PhotoYCC encoding was chosen because it provides the proper dynamic range (ratio between the minimum and maximum intensities attainable) and color gamut needed for high-quality color printing. PhotoYCC encoding can be easily converted into RGB information. PhotoYCC encoding also allows for a very efficient data compression schemes. To facilitate efficient video display, Kodak based the PhotoYCC scheme on

video standards. PhotoYCC is based on aspects of CCIR Recommendation 601-1 and the international recommendation for high-definition television production, CCIR 709.

Conversion from the 36 bit per pixel RGB scan to PhotoYCC is accomplished in three steps. First, a nonlinear transformation is applied to the image signals. Next, the transformed values are converted to one luma and two chroma components. Finally, the three components are converted to 8-bits per component data.

Note: Although the Photo CD Image Pac format contains definitions for larger-format film, initially only 35mm film will be supported.

Apple Software

A Photo CD file system translator, and a new version of CD Remote, understand the Photo CD format.

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