RHEINNER GUIDE

Display Subsystems for Production Imaging

Document Management, Imaging, and Workflow Technology Guide Series

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"The significant problems we face cannot be solved by the same level of thinking that created them."

Albert Einstein

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Introduction

The display subsystem is one of five component systems within any document imaging solution. Each subsystem (input, display, communication, storage, output) provides a specialized service to the imaging system and must be configured specifically to handle image data.

A display subsystem consists of a monitor, a controller board, the cable, possibly firmware on the controller board, drivers and any other software that is required to render an image on the screen. While each of the components of the subsystem has unique functionality, it is only in combination that the full image viewing capabilities can be appraised.

There is an extensive variety of monitors and controller boards commercially available for use with PCs, and a seemingly endless number of combinations of these products which can be generated to yield different results. However, there are few display subsystems, as defined above, that are truly appropriate for document imaging, especially at the production level.

This guide explains why document imaging* requires specialized display subsystems, outlines how to evaluate the features and functionality of such systems, and details how specialized displays can improve the overall effectiveness and productivity of the imaging user.

** Except where otherwise noted, the discussion about document imaging throughout this guide pertains to the use of images generated from black and white business documents on 8.5 x 11-inch paper.*

Image Display Challenges

High Resolution Image Creation

When images are created by a scanner, a piece of paper is passed through the scanner where a bright light reflects off the paper and onto a sensor, the CCD (charge coupled device). The CCD produces a stream of electrical signals with values proportionate to the intensity of the light. The electrical signals are then converted into binary numbers, or a series of ones and zeros, for use by the computer. The series of ones and zeros has horizontal and vertical dimensions in a grid-like manner and is referred to as a bitmap. Images in this form can be stored and processed by the computer.

The bitmap image generated by the electronics of the scanner contains all of the information available for the image. By increasing the scan resolution, more information can be captured from the original paper document.Capturing the best quality image, or the one that most closely represents the original document is desirable because all subsequent processing, viewing and printing of the image will be limited by the scan resolution of the captured image. No amount of subsequent image enhancement will add information that was not originally captured during the scanning process. Still, reducing image file storage size and the associated expense are attractive reasons for scaning at lower resolutions.

Most display subsystems are, in fact, incapable of faithfully displaying all of the captured information from the original paper image. In other words, most display subsystems can not display an image at the same resolution at which it was originally scanned. For this reason the display subsystem is often considered the weak link in the imaging solution. Scanning at the highest possible resolution is still desirable, however. Display subsystems for production imaging have several methods for compensating for their lower display resolution that will help to provide the best quality image even if all of the captured information can not be displayed.

Interpreting Document Content: Bitmaps vs. Encoded Data

The display subsystem must have imaging-specific functionality to allow the user to view even a high-quality laser-printed document that has been scanned. With lower-quality scanned documents (such as those received via a fax machine), or when documents contain handwriting, tiny fonts or intricate diagrams, the need for a properly-configured image display subsystem becomes even more critical.

The vast majority of data stored in computers is non-image data that is related to general purpose computing. It is encoded data which means it is stored in a sequence of ones and zeros, each of which has special significance and can be understood by the computer. Encoded data can be used directly with word-processing, spreadsheet, database and other non-image applications without human interpretation.

While image data is also represented to the computer as a sequence of ones and zeros, an image is not encoded information and, by definition, the computer can not interpret image data. The ones and zeros that represent an image to the computer are used differently than the other information in the computer. They represent the appearance of markings on the paper rather than the meaning of what was on that paper. When a stored image is displayed it can be interpreted by the user in much the same manner that a piece of paper is interpreted by the reader. Since the primary tool for determining the content on an image page is the human eye, having the appropriate display subsystem is vital to the success of the imaging solution.

Image File Size and Compression

Files containing image data are typically far larger than encoded data files used in general purpose computing. A single-page word-processing document, for example, might take up 2-3 KB of storage space. The same page when captured as a scanned image might require an entire megabyte (1 MB).

Because of its large file size, displaying, printing and sending an image over the network takes longer and requires more resources than for a page stored in an encoded way. As a result, images are generally compressed for storage and network communication, and uncompressed for viewing and printing. Since images are so large, decompression of images has been an important performance-related aspect of preparing a stored image for rendering to the display.

Display Subsystems in a Windows Environment

The majority of imaging software available supports standard user interfaces, particularly Microsoft Windows (Windows 3.x, Windows NT and Windows 95). Windows, in turn, manages the display devices through the use of drivers.

Since Windows is the primary interface in use on workstations, most display subsystems for production imaging are Windows-compatible. For any display subsystem with a driver that conforms to Windows conventions, support should be straightforward. This standardization removes the significant burden of device support from the application software developers.

Some of the Windows desktop objects, such as icons, tool bars and menu bars, are actually bitmaps that decrease in size as display resolution increases. While the resolution of the object does not change, the object is mapped to a smaller portion of the screen as screen resolution is increased. This reduction in icon size can make interacting with Windows 3.x through the mouse or the keyboard very difficult, and, in some cases impossible. Both Windows 95 and Windows NT overcome this limitation by enabling the user to scale these desktop objects in the control panel.

The requirements for high resolution displays to satisfy production document imaging needs have challenged the current capabilities of user interfaces and PC technology. As a result there is often an undesirable tradeoff between Windows compatibility and high resolution. As resolution increases, Windows must draw a significantly greater number of pixels than are needed for ordinary VGA displays. This increase puts greater demand on the PC bus to send more pixels to the display controller board which often results in unacceptably slow image rendering. In response, some display subsystems operate at lower, less challenging resolutions and attempt to compensate for reduced image quality by using scaling algorithms to convert high resolution images to the lower resolution of the display for viewing. This alternative, however, is not ideal for production imaging. Instead, PCI-bus PCs with fast effective data transfer rates are strongly recommended for imaging applications.

The Role of a Display Subsystem in Production Imaging

The selection of a display subsystem is frequently assigned a lower priority than selecting the input or storage subsystem for a production imaging environment. However, while there may be fewer variables to consider in making a display decision, the display is one of the key subsystems of the imaging solution and must be evaluated separately for document imaging applications. The display subsystem is the point of interaction between the end user and the imaging solution and, as such, is the most visible component of any imaging solution. If the display subsystem is inadequate and does not meet the needs of the specific imaging application, it can impact the acceptance and success of the entire system. The issue becomes even more paramount in a production imaging environment where user productivity and viewing comfort have a direct impact on the number of transactions that can be handled in a specific time period.

All document imaging systems have common characteristics: they involve the conversion of paper-based information into a digital format, and they require the integration of specialized subsystems to accomplish the capture, storage, retrieval, viewing and output of the resulting document images. Beyond that, document imaging can be deployed in a variety of environments, ranging from a setting where users require infrequent or occasional access to documents, to an environment in which users require constant and uninterrupted access to a high volume of document images. The latter is commonly referred to as a production imaging environment.

A production imaging system converts substantially higher volumes of paper-based information to digital format, and therefore requires more robust subsystems, peripherals and application software to perform the various functions associated with the capture, storage, retrieval, viewing and output of those document images. Another characteristic common to many production imaging installations is their strategic importance to the organization. These systems are often deployed for critical business processes like insurance claims processing, accounts payable or loan origination. These are high volume, transaction-oriented, mission critical applications and the images must absolutely be available to the users because the company’s livelihood depends on it. As a result, production imaging applications place substantial demands on the computing platform, the imaging application software and on each of the imaging subsystems, including the display subsystem.

In many production imaging environments, users spend a high percentage of their work time on the system and their work is highly dependent on accessing and reading document images. The quality of the images, availability in a timely manner, and the ease with which users can work with those images, dictates user satisfaction and productivity.

The determination of whether or not to select a specialized display subsystem for production imaging should be made on the basis of the activity that takes place at each individual workstation, and not only on the basis of the total scale of the system. While the volume of documents, and the number of users is relevant, the most significant factor with respect to display requirements is the amount of time that is spent viewing images on screen. Naturally a greater volume of images in the system implies that more total user time is spent viewing images and a greater percentage of each individual image operator's day is spent viewing images. The greater the degree to which the workstation is dedicated to image viewing, the more important it is that a display subsystem specifically designed for production imaging be utilized.

Components of an Imaging Display Subsystem

Monitor

The most visible part of the display subsystem is the monitor itself. The monitor consists of a physical display tube (also called the bottle or the glass) that houses an electron beam, a yoke, coils, and circuitry at the back. The electron beam is generated by an electron gun in the neck, or narrow part in the back, of the monitor tube. The coils surrounding the neck of the tube are used to focus and deflect the beam to sequentially scan, horizontally and vertically, over the entire inside face of the tube. The inside front of the tube is coated with a phosphor material that emits light to create the image when it is excited by an electron beam. The phosphor is continuous white for a black and white or grayscale monitor, and in color triples or triads consisting of red, green and blue spots, for a color monitor.

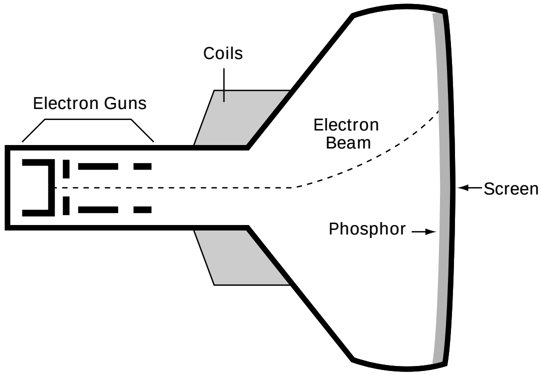


Figure 1: Monitor Components

Monochrome Monitors: Monochrome is a class of monitors that includes black and white, or bitonal, and grayscale displays. A monochrome monitor contains a single electron gun which illuminates a continuous phosphor painted or deposited on the inside of the tube or the glass. Whether the monochrome monitor is black and white or grayscale depends on how many different levels of intensity the electron beam has. If there are only two levels, on or off, then it is a black and white monitor. If there are many levels, then it is a grayscale monitor.

The internal structure of a monochrome monitor is fundamentally different from a color monitor. A monochrome monitor has a single electron gun that produces a single, narrow electron beam. This beam scans a screen that is uniformly coated with, typically, paper-white phosphor.

Color Monitors: Color monitors are more complex than monochrome monitors. A color monitor contains three electron guns, each of which emits a beam to correspond with the primary colors of red, green and blue (RGB). (The beams themselves have no color.) The coils around the neck of the tube shape the three beams into one converged beam which is then deflected to scan the screen. Before reaching the screen, the converged beam passes through a shadow mask which separates it into its three constituent beams so that each illuminates dots of a single color. Instead of a continuous white phosphor coating as with a monochrome monitor, the color monitor screen is covered with a pattern or alternating RGB phosphor dots. The mixture of the intensity to which those three colors have been excited creates the blend, and thus the variety of different colors that is visible.

Provided the hardware is capable, either a grayscale or a color monitor can display grayscale images using grayscale algorithms on the controller or in the driver software. On a color monitor, gray-levels and black and white are simulated by mixing the intensity of the RGB colors.

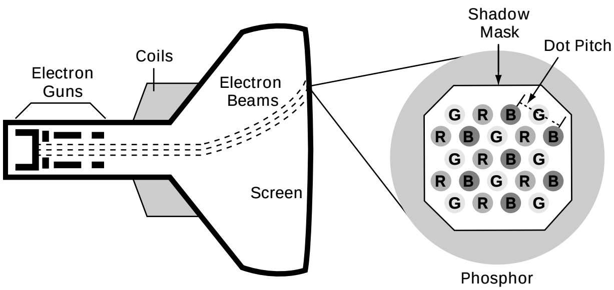


Figure 2: Shadow Mask

Controller Board/Display Adapter

The monitor controller board, sometimes called the display adapter, is a printed circuit board that fits into a slot on the motherboard, or bus, inside the PC and controls the generation and sequencing of information to be displayed by the monitor. Most office PCs use VGA or Super VGA controllers with standard 13-inch or 14-inch monitors. When a high resolution display controller is placed into the system it normally replaces such a controller board if it is already present. The main purpose of the specialized board is to provide either additional imaging functionality or to handle the greater number of pixels that are required to display an image on the screen. Built-in imaging features may include:

- Windows acceleration: improves the performance of the Windows operating system for the movement of large data files.
- High resolution: increases the pixel count to display as much of the original image information as possible.
- Decompression: images must be decompressed for viewing. In the past, performing this function on the board has helped save CPU cycle time and alleviate PC bus traffic. With today's fast processors, savings from hardware decompression are questionable, and, depending on the processor, software implementations may even be faster.
- Scaling: modifies the information contained in the image for placement in the display window designated by the viewing software.

Boards can be differentiated by the type of PC-bus technology they support. The type of bus the PC has determines, in part, the functionality and the performance of the system as a whole. Older PCs will often have an ISA bus with a 16-bit interface. Newer boards are designed for the PCI bus with 32-bit processing that allows the boards to take full advantage of high-performance Pentium chips.

Cable

The third display subsystem component is the cable. The quality of the cable is very important because the cable is one of the areas where the signals are most subject to being modified or interfered with in some way. A number of problems with monitors can occur when inferior or lower quality cables are used. Using a cable that is different from the one provided with the system is not advisable.

Software Drivers

Software drivers are required to instruct the PC operating system on how to address the board. The drivers communicate with the board which, in turn, drives the monitor. Drivers are typically provided by the board manufacturer and a different driver is needed to support each client operating system, for example, MS Windows, OS/2 or SCO UNIX.

Even though Windows drivers are provided, the application software developer may still have to incorporate some new functionality or make some program changes in order to take advantage of the full functionality the display subsystem offers.

Viewing Software

Image viewing software is generally purchased and configured as part of the image application and not with the display subsystem. It is discussed here as part of the display subsystem because of the interdependence between subsystem hardware and software. The potential need to address display subsystem functionality directly through image viewing software, as opposed to through Windows, makes the choice of a display subsystem more dependent on the application software than it should be. As the number of users demanding high-quality image viewing increases, direct support for specialized display subsystems for imaging will likely be incorporated into Windows.

The following application software capabilities are generally provided for flexibility in image viewing:

- Correction and enhancement—the ability to remove anomalous data and artifacts picked up during scanning.
- Annotation—attaching highlights, markers, free-form text, notes and other indicators to the image for reference.
- Image manipulation—zoom/pan, scroll, rotate.
- Select area viewing—configuring the display to automatically view predetermined areas of the page to avoid scrolling and zooming.
- Dual-page viewing—the ability to show two images side-by-side or the viewing of an image next to a database or other application window.

Display Subsystem Evaluation Criteria

While it is important to understand the monitor and controller features and options that are available, a feature-for-feature comparison should not be used exclusively to evaluate display subsystems. The final selection of an image display subsystem should take into consideration the types of documents that will be viewed as well as the other uses for the documents within the system. Other application issues such as who needs access to the documents, how often, for how long and for what purposes are also important considerations. Certain display subsystem capabilities may be important in some applications but not others, and some combinations of features can not be obtained in one display subsystem.

Document Types

While all images are represented to the computer as bitmaps, there are several distinctions in document type that impact the display selection. The type of image is determined at the time of creation (through scanning) and is dependent on the capabilities of the input device. The type of information on the page, storage space, scan time and other resource constraints are factors in determining which type of image to generate.

Bitonal images are pure black and white images distinguished by tiny, evenly-spaced black dots that represent data. These images are represented to the computer purely in terms of zeros and ones signifying black or white on the page.

Grayscale images are produced when shades of gray are substituted for black or white data to more closely simulate the appearance of the original paper. The dots on a grayscale image represent a spectrum of gray shades, as well as black and white, to provide more detail on the image. Grayscale images are generally easier to read than bi-level because character edges are smoother producing a cleaner outline. Grayscale images are often considered to have another dimension, that of depth, because more information is need to represent the shades of gray to the computer. The number of gradations in the shades of gray must be recorded. The number of gradations can be stated directly or by number of bits. The number of bits follows an ordinary binary scheme where two bits represents four shades of gray, four bits represents sixteen shades of gray, and eight bits represents 256 shades of gray.

The effect of grayscale can be achieved through a grayscale capable display subsystem *even if the image itself is bitonal rather than grayscale.* In production imaging environments with mostly black and white original documents, bitonal images are used more often than grayscale. The additional information that must be stored with the creation of an original grayscale image can be prohibitive. Grayscale images are often desirable when the original documents are photographs.

Color images are derived from color originals and must be distinguished from bitonal or grayscale images *displayed* on a color monitor. Color photographs, illustrations, graphics etc. must be scanned in color to create a color image. The key factor about color images for displays is the number of bits used to represent the resulting images on screen. Some color monitors use four bits to produce sixteen colors, a result that is not very useful in reproducing colors on images. At least 8 bits, resulting in 256 different colors, is generally required to display a color image.

User Needs and Display Functionality

The display subsystem should be selected on the basis of its applicability to the problem at hand, and how well it is designed to accommodate specific user needs. Rather than simply comparing features of display subsystems, the display selection process should consider three main categories of user needs: Image Quality/ Readability, User Comfort, and Performance. Each monitor or controller feature will fit into one or more of these categories.

Image Quality and Readability

The display of an image on the screen competes with looking at the original piece of paper. If it is significantly more difficult to see or read the image on screen, the users may revert to using paper, thus reducing the productivity and effectiveness of the imaging system. Another consequence of poor image quality is the additional time required to zoom, pan or scroll the image on screen in order to read information from the image. The optimal image viewing environment displays the image on screen in as close to its original document form as possible. This means retaining as much of the original information as possible and displaying the full image at as close to its original size as possible.

Retaining the original information from the paper is first a function of scanning. The display can only use information that has been captured by the scanner. The amount of information that can actually be used by the display for viewing purposes is a function of resolution and scaling methodology. The size of the image on screen is a function of monitor screen size. These capabilities are inter-related and must be supported in both monitor and controller to achieve the optimal benefit.

Resolution: Resolution may refer to either the density of dots, dots per inch (dpi), on an image or the number of pixels that a monitor can display. Image resolution is measured in dots per inch (dpi) or literally, the number of dots in a one inch space on an image or a printed page. An image always has a single, fixed resolution determined at the time of scanning and the number of dots per inch horizontally and vertically is usually the same. (This may not be the case with a fax machine.) The resolution of the original scanned image may never be increased, however, it may be decreased or converted from a higher to a lower resolution for display purposes. This conversion applies only to the display and does not impact the resolution of the original image.

The resolution of a display is something completely different from the resolution of the image itself. Display resolution is measured in terms of the number of horizontal pixels and the number of vertical lines the monitor can produce. Pixel is a graphics term derived from the phrase, picture element. A picture element is the smallest unit that can be displayed; it is the spot of light created when a monitor's electron beam is cast upon the display screen. The maximum physical space on the monitor that the pixels and lines occupy can usually be modified up to the maximum determined by the physical size of the monitor itself. The greater the number of pixels, the higher the resolution and the better the image will look on screen. A greater number of pixels may reduce performance, however, due to the movement of larger quantities of data. The term pixel refers only to the display, not to the original document or the image.

While most monitor manufacturers use a dpi measure to describe their products, this number generally refers only to the horizontal pixels per inch the monitor can produce, not the number of dots from the original image that can be seen. As a result it is somewhat erroneous to discuss display resolution solely in terms of dpi. It is more accurate to discuss display resolution in terms of a horizontal by vertical pixel count, such as 1024 x 768, 1600 x 1200, or 3456 x 1248. A resolution of 1024 x 768 means that the monitor can produce 1024 pixels horizontally across the viewable portion of the screen, and there are 768 pixels in the vertical viewing area. It is also accurate to say that the monitor can produce 768 horizontal lines of 1024 pixels each. The higher the pixel count, the higher the resolution, and the more information from the original image can be illuminated on screen.

If an 8.5 x 11-inch page is scanned at 200 dpi, it will contain (200 * 8.5) x (200 * 11) bits of information or 1700 bits horizontally x 2200 bits vertically. Assuming one bit per pixel for display purposes, it is clear that not all of the bits from the original image can be accommodated on a display with 1024 x768 resolution, for example. It would be possible to show a portion of the image, or some information would have to be removed for display purposes. As more information is removed, the image that is displayed becomes less and less a true representation of the original page and, as as result, becomes far less readable. Characters will not appear fully formed or will have a jagged appearance, and handwriting and drawings will appear as nonsensical markings on the page.

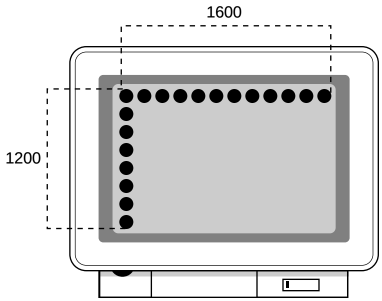


Figure 3: Screen Resolution

The resolution of color monitors is often measured in terms of dot pitch in millimeters. A common dot pitch is 0.28 millimeter. Dot pitch measures the distance from the edge of one color of the triad to the edge of the same color on the next successive triad on the screen. A .28 millimeter monitor represents about 83 dpi, which accounts for the "fuzzy" look of color monitors.

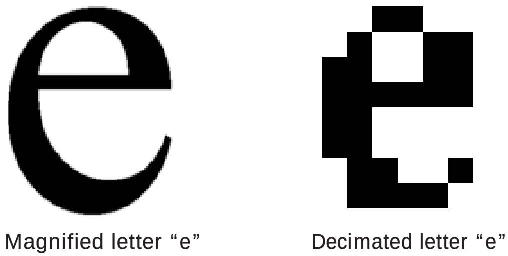
Scaling

As mentioned previously, the scanning process usually generates more information for the image than monitors are capable of displaying. Thus the image must be scaled down in some way in order to be displayed. Scaling is the function of modifying the resolution of the image as scanned and stored, to the resolution that is required for the current display situation. Scaling is a time-consuming function and, depending on the algorithm used and whether it is implemented in software or through the board, it may impact the performance of the display subsystem.

The idea of scaling is in direct contradiction with the need to retain as much of the original information from the image as possible. As a result, there are methods of scaling which enhance image appearance on screen while still reducing the amount of information needed for use by the display. The method used for scaling strongly affects the visual appearance of the image on the screen. Regardless of the method used, however, the less scaling required the better the image readability, and the higher the resolution of the display the less scaling will be required. Scaling is used for display purposes only and does not impact the size or information contained in the original image file.

The most simplistic method of scaling is decimation in which data is simply discarded prior to viewing. Decimation makes the image less readable than it was originally because there are fewer ones and zeros to represent markings on the page. Thus the characters on the page appear to have jagged edges where data has been removed for viewing. Decimation is the only option available if the monitor is a black and white monitor with exactly two options for each pixel on the screen. For example, using an image scanned at 200 dpi and a display with 100 lines in each dimension, decimation will throw out every other dot and every other line in order to view the full page on screen.

Figure 4: Decimation

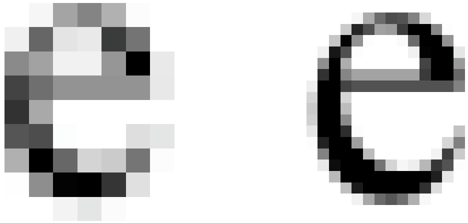


The other common method of scaling is scale to gray. Rather than simply discarding unusable information, the original information is analyzed to determine whether it is primarily dark or light. The dots and the lines that remain are assigned shades of gray based on the percentage of original information that was back or white. The use of gray shades provides a better approximation of the original information. This conversion is only possible with a grayscale monitor or a color monitor able to display shades of gray (which is typical functionality for a color monitor.)

For example, consider scaling a 200 dpi scanned image, comprised of two dots on each of two lines, to a 100 dpi image for the display screen. Through the scaling process the two dots and two lines must be converted to a single pixel. Each dot represents one bit of information represented to the computer as a one or a zero, which will appear as black or white. In converting to a single pixel, the goal is to maintain as much information about the original scanned image as possible. Scale to gray provides more choices for each dot, so instead of just black or white, shades of gray may be used. If all four dots are black, the resulting pixel will be black also. If two dots are black and two are white, the resulting pixel will also be a shade of gray that is midway between black and white. If one dot is black and three are white, the resulting pixel will be a lighter shade of gray, or 25% gray.

If the scanned image was 300 dpi originally, the scaling would convert three dots by three lines to a single pixel. Similarly, if the image was scanned and stored at 400 dpi, the scaling would start from four dots by four lines.

Figure 5: Scale to Gray



100+ resolution 200+ resolution

Screen Size: The display size published in product specifications is generally the diagonal measure of the screen. Typically a portion of the screen (included in the measure) is covered by the plastic bezel and is not available for viewing. A 19-inch monitor may only have a 17.5-inch diagonal measure based on what is actually visible. Another measure of display size is based on the horizontal by vertical image viewing area or the portion of the display where an image can actually be displayed. This measure is more reliable in evaluating the monitor for image viewing purposes and it is more closely related to screen resolution.

For example, a monitor that measures 19 inches diagonally may have a viewable screen area that measures 14 inches horizontally by 10 inches vertically. If the resolution is 1600 x 1200, the effective number of dots per screen inch would be approximately 120 x 120 as follows: 1600/14 =120 (rounded up); 1200/10=120. Dots per screen inch is not the same thing as dots per inch (dpi) used to measure image resolution, however these measures are often used interchangeably.

For image viewing purposes, the viewable screen area is determined by the precise specifications set by the display manufacturer and is generally somewhat smaller than the portion of the screen that the user can physically see. While it is possible to expand or stretch the image to cover more of the screen, this is not advised because it may distort the image due to the curvature of the glass. (This type of distortion may be minimized, but not entirely eliminated, with a flat profile screen.)

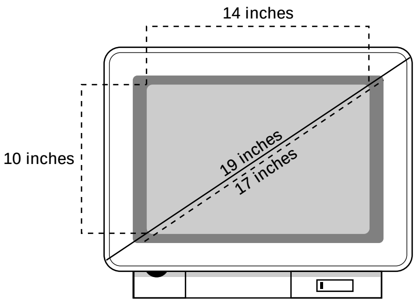


Figure 6: Viewable Screen Area

Physical Comfort of Users

In addition to improving image quality and readability, a display that is physically large enough to display the image at close to original size and at a resolution that is readable at normal distances will have an obvious impact on user productivity. An image that is more easily seen and read will improve reading speed and user satisfaction with the system. High resolution, scale-to-gray and large image size also impact the physical comfort of the user by reducing eyestrain.

Naturally, the eyes are the part of the body most affected by monitor viewing. As the use of PCs and color monitors have increased, so has the incidence of computer-related vision problems. In 1995, over 15 million people were treated for “computer vision syndrome”, making it as critical a work-related medical issue as the more-publicized carpal tunnel syndrome. Among the most common computer-related vision problems are eyestrain, exhaustion, headaches, blurry vision, and tired or burning eyes. These vision problems often go hand in hand with headaches, neck and back fatigue and other stress-related symptoms. Each of these, in turn, reduces worker productivity and can lead to viewing errors.

Personnel is among the most expensive resources within a document imaging system and ensuring the physical comfort of the imaging end users can have a significant impact on productivity and return on investment. Additional display subsystem features designed specifically to improve the physical comfort of the users include anti-glare screens, flat profile screens and high refresh rates.

OCLI: OCLI is an anti-glare coating that reduces reflection on the screen caused by office lights or sunlight. The anti-glare coating, which is permanently applied to the surface of the screen, is designed to diffuse reflected light. Without OCLI the image operator must sit directly in front of the monitor to avoid screen glare. An anti-glare screen allows for greater viewer comfort and mobility. Many display subsystems include OCLI as a standard feature now.

Flat Profile Screen: Monitor screens that are completely or nearly flat when viewed from the side are becoming more prevalent today. These screens help to reduce the glare and reflection from overhead lights and other light sources. Perhaps more importantly, however, flat profile screens allow the user to view the screen from a wider range of positions without seeing any distortion. With rounded screens, the user must view the screen straight on, rather than at any angle in order to avoid distortion or parallax. Not only does the flat screen improve user mobility, but it also makes it possible to utilize more of the viewable screen area.

On monitors with rounded or convex screens, information on screen becomes distorted as it is placed closer to the corners of the screen. On this type of screen, the best image location for optimal readability and the least amount of eye strain is exactly in the middle. The best place to sit to view these screens is exactly in front of the monitor. This center viewing stipulation hinders the user's ability to arrange the screen for optimal application performance. For example, if the application calls for multiple windows open on screen along with an image, the need to place an image in the center of the screen reduces the options for user interface design.

Refresh Rate: The refresh rate, also called the vertical scanning frequency, is the rate at which the screen is redrawn. The refresh rate is measured in Hertz (Hz). The Video Electronic Standards Association (VESA) has determined that a refresh rate of 70 Hz or greater is optimal to minimize flicker and reduce operator eye stress and fatigue. The impact of increasing refresh rates beyond 70 Hz is insignificant if even perceptible. The typical refresh is barely visible to the human eye, however, there may be visible screen flicker if the monitor uses interlaced refresh. Interlacing means that every other line is redrawn during the screen refresh as opposed to refreshing all lines simultaneously.

The refresh rate does not take place in a complete vacuum. Many office environments are illuminated by fluorescent lighting, and fluorescent lighting has its own refresh or pulse rate that can either be in sync or out of sync with the refresh rate of the monitor. If the refresh rate is quite close, there can be a very disturbing visual effect for the monitor viewers. In addition, many monitors have the ability to run at multiple resolution levels. The fastest refresh rates published for the monitor may not be available at the highest resolution the monitor can achieve. It is important to determine the refresh rate the monitor achieves at the resolution it will be run.

The Work Environment: In addition to selecting a display subsystem that provides that optimal combination of features for viewer comfort, it is important to evaluate these features in the actual setting in which they will be used and to ensure that other environmental conditions promote visual comfort for system users. Monitor placement should enhance eye and postural comfort. The recommended range for monitor distance from the eyes is between 18-inches and 30-inches, and the top of the screen should be between eye level and 15 degrees below eye level. As the monitor height is lowered, the top of the monitor should be tilted away from the user's face. In addition, users should be encouraged to take regular breaks away from the display screen and refocus on distant objects while working at the display, both of which will help reduce eyestrain.

Display Subsystem Speed: Bringing an image to the display screen involves a diverse series of activities, most of which have nothing to do with the display subsystem. Often bringing an image from storage to the local CPU dictates how long the user waits for the image, rather than the rate at which the display subsystem operates. While it is not technically correct to attribute all speed-related issues to the display subsystem, the passage of time while the user waits for an image to appear on screen is often attributed to the performance of the display subsystem. Understanding the capabilities of the display subsystem that do impact speed will help focus evaluation efforts in the appropriate areas.

Render Speed/Flip Rate: Render speed and flip rate are terms that are often used throughout the industry to refer to various aspects of display subsystem performance. Because these terms are ill-defined, it is important to ascertain exactly what the manufacturer is referring to when using either term. If this is not done, any resulting comparison will be invalid.

For the purposes of this guide, render speed is the time required to scale an image and place it in the image viewing area assigned by the viewing software.

The speed is generally measured in seconds or sub-seconds and will vary depending on the size of the file, and the manners in which scaling and decompression are implemented. The process of rendering an image is essentially transparent to the user.

Flip rate measures the time that it takes to page through a collection of images, or in essence, “turn pages” from one image to the next. Flip rate, like render speed, is a function of software as well as hardware performance. All other things being equal (image size, hardware, software, etc.) the flip rate, or the time that it takes to page from one image to the next, is the measure by which users judge the performance of the imaging system. Therefore, it is critical to ensure that users do not spend time waiting for the next image. However, the normal human eye blink is about .20 seconds. An image flip rate that is faster than the blink of an eye won’t really make a difference to most users.

Display subsystem manufacturers often include speed and performance benchmarks in their product specifications. At trade shows they may demonstrate flip rates far greater than would be useful for almost any application. The most useful method for evaluating speed and throughput is to test real images with the software and display subsystem to be used.

Compression: An image is generally stored in compressed format in a file with a file header containing descriptive information. When a request is made to display an image, the image is read from the file system and brought to the local computer to which the display is connected. The file header must be decoded to determine the compression format, the resolution, whether there are any overlays or other information associated with the image. The file is then decompressed and scaled for viewing. Compression/decompression algorithms may be built into the controller board or handled entirely through software. Either way, decompression does impact the render speed.

Software decompression is becoming more prevalent today and with the CPU speeds available now, and continually faster processors becoming available, the performance differences between handling this function in hardware on the controller versus in software are negligible, if any. For use on older equipment with 386 or slower 486 processors, there will often be an advantage to using hardware decompression. With a Pentium processor, any hardware speed advantage will be undetectable. In fact, the software decompression may even be faster.

Sample Application Needs

Given the diversity of potential document imaging applications, there is no single best display for all document imaging applications. Instead, it is important to match application requirements with the appropriate display features. When conducting this evaluation, consider the types of documents in use and how each individual interacts with the imaging application.

Full Page Viewing

Many imaging applications are designed to show a full page image in one window and a data entry screen in another window. This arrangement is commonly used for such activities as image indexing, data entry from images to an application, and terminal emulation for connection to a legacy application.

If the image information needed is always located in a small section of the image, the viewing of a full page image at once may not be necessary. In such cases, the application software can be configured to automatically show only that portion of the image on the screen. The full page will be required when the information on the image could be on any portion of the page. Under these circumstances, placing the full image on screen improves productivity by reducing the user's need to scroll up or down.

Full page viewing involves both depicting the whole image on screen, and displaying the image as close to the original size as possible. When the need exists to see the whole image, a 19-inch diagonal screen is a minimum. Only a 19-inch or larger display provides enough vertical display area to show approximately 11 vertical inches. If the image is reduced in size to fit the entire page on a smaller screen, it may be impossible to read. This is true regardless of screen resolution.

Information Reading

The need to read information on screen is distinguished from simply looking for a pattern such as the presence of a signature or a check mark in a box. While image readability is largely a subjective consideration, studies have demonstrated the productivity benefits of both scale-to-gray technology and high resolution on reading speed.

The most effective way to determine whether the display subsystem is acceptable for reading is to view several of the actual documents that will be used in the application. In general, the higher the resolution of the display subsystem, the better it will be for reading image information on screen. The size of the display also plays a significant role in image readability. If viewing two display subsystems of different sizes but of equal resolution, the larger display will generally be more readable.

Navigation (Work Process)

Some workflow or process-oriented applications make use of color as a means to navigate through a "folder" of images. Additionally, colors may be assigned to different types of documents or folders as a mean of categorization. For example, in a university admissions office, red indicates a new applicant, green indicates an acceptance, blue indicates missing SAT scores, and green indicates an applicant in need of financial aid.

If the application makes use of color in these or similar manners, a color monitor is often required even if all the images are black and white or grayscale. The newest grayscale technologies today have incorporated very accurate color mapping algorithms so that it is still possible to detect differences in color on a grayscale-only display. However, this works well for up to five discrete colors. When the image application itself makes many colors an integral part of a process, a color display is recommended.

Color Images

Viewing color images in color *requires* a color monitor. (The images must first have been scanned in color.) In document imaging the use of color images is rare, although there are instances, particularly with photographs where color may be utilized. More often, however, color photographs are used to generate grayscale images. The viewing of such images is not necessarily enhanced through a color display subsystem.

While color displays are rarely an absolute requirement (because most images are bitonal or grayscale), the demand for color displays is strong. Color is often perceived as newer, more powerful technology than black and white.

Multiple Applications vs. Dedicated Image Viewing

For those who use multiple desktop applications yet also need to view images, color displays are a frequent request. Again, color is often chosen on an emotional basis rather than on its technical merits. In these situations, weigh the relative time spent viewing images vs. other applications against the cost differential between color and grayscale technology to determine which type of monitor is most appropriate. And consider the realistic requirement for color in non-image applications. After all, most spreadsheet and word processing applications have no definite need for color. The more time spent viewing images, the more consideration that should be given to a high-resolution, grayscale display.

The spot size created on a color monitor is larger than that of a black and white display. The larger spot size means that fewer pixels will fit into any given area, thus effectively reducing resolution. In addition, because a color monitor has three electron beams that converge through a shadow mask, the color triads created tend to overlap, causing a fuzzy appearance. Images will not appear as crisp on a color display as they will on a monochrome display. A monochrome monitor produces higher resolution than the same size color monitor and yet generally costs significantly less.

If the primary use of the monitor is to view images, a high resolution grayscale monitor makes the most sense. The more time that is spent viewing images, the greater the productivity gains that can be realized by providing a display subsystem designed for that purpose.

Implementation Issues

Monitor/Board Combination

Display subsystems typically consist of a board-cable-monitor combination, including a driver. The monitor and the board, particularly with color subsystems, are often sold separately so it is important to be sure that the right combination is obtained. The monitor must be compatible with the board, the board must be compatible with the PC bus, and the software drivers must be compatible with the operating system and the viewing software. A monitor may be compatible with a particular board but not support all of the features.

Generally, manufacturers publish the highest level of performance their products are able to achieve. It is critical to determine whether the published level of performance will actually work with the combination of components selected. For the monitor/controller combination, the lowest common denominator will determine the performance. The board may be capable of certain functions that the monitor does not support or vice versa. The features of the controller and of the monitor should be matched. For example, the refresh rate of the display controller must be sustained and sustainable by the monitor.

The selection of a grayscale display subsystem is generally more straightforward than for color products since the monitor and board must be tightly coupled in order to achieve the level of precision, high resolution and clarity required for imaging applications. While the monitor and board may be sold separately according to a price list, each is designed exclusively to work with the other and can not be used with a board or monitor from another vendor.

Screen Savers

Due to the high phosphor intensity, the potential for screen burn is a much stronger possibility with display subsystems for production imaging. Adding screen saver software to a high resolution grayscale display is essential to maintain optimal performance and prevent screen burn.

Software Support

Most imaging applications require a mix of different types of displays, i.e. high resolution color, high resolution grayscale, and SVGA. Chances are the appropriate combination of boards and monitors will be produced by several different manufacturers. Each board will have specific drivers and will operate differently with respect to the viewing software. Each of these drivers will have to be accessible to the operating system or the image viewing software.

Even if every workstation has the same display subsystem and only one driver is required, it is important to determine whether the application software fully supports all of the features available. If not, the image software developer may have to make changes to the viewing software or else the display subsystem may operate at less-than-advertised capacity. In other words, some of the features may not be utilized due to poor or lacking implementation of the software support.

Software vs. Hardware-assist

Display-related functions such as scaling, decompression and Windows acceleration may be implemented entirely through software (managed by the CPU) or with hardware assistance (managed by the controller). If implemented in hardware, the software must be configured to make use of the features.

Hardware-assisted features can provide performance benefits, particularly for older or slower processors. With a high-end 486 PC, the advantage gained by these functions implemented in hardware is not significant, but it can make a marginal difference. With a Pentium processor the software implementations reach parity and with newer, faster processors continually becoming available, software implementations actually achieve performance advantages over hardware.

Summary

As the point of interaction between the user and the imaging system, the display subsystem is the most visible component of an imaging solution. If the display system is inadequate, it will impact the acceptance and success of the entire system. A specialized, high-resolution image display subsystem can boost productivity and comfort for most any imaging user, and can be a critical necessity for the production imaging user who is continually retrieving and viewing document images.

Case Study

Shawnee County, Kansas District Court

Using imaging, Shawnee County, Kansas District Court Employees collect higher rates of child support than the national average. Document Technologies' EasyRead 240 Displays improve the viewing of these electronic child support case files.

For the attorneys, paralegals and other employees who work on child support cases for Shawnee County District Court, moving to a more efficient electronic working environment was an easy transition, thanks to Document Technologies Inc.'s (DTI) super high-resolution displays.

Since early 1995, twenty-eight Topeka, Kansas-based child support case workers have migrated from using paper case files to a system with electronic folders and digital images. With multiple forms, court files, and images to access, DTI's EasyRead 240 displays enable the case workers to view the equivalent of two 8.5 x 11-inch documents at once. The display's 3456 x 1168 resolution provides superior readability because of its 240 dot per inch (dpi) image with scale-to-gray enhancement.

The Application

District Court child support enforcement employees are responsible for handling more than 8,000 cases, some of which date back more than 20 years. When an individual needs to collect child support money, the District Court office contracts with local social and rehabilitation services to give the person access to various enforcement services.

A typical enforcement case might work like this: If a legally obliged individual who is not paying child support is found to be employed, income withholding is instituted to automatically deduct a specified amount of money from the person's paycheck. However, if there is no employer, the individual is ordered to go to the local hearing office and explain to a judge why the support isn't being met. If the person fails to appear and plead the case, child support enforcement issues a bench warrant.

Christine Myrick, manager of Shawnee County District Court Trustee's Office, and project manager for the pilot imaging project, says the cases often go nowhere. However, if child support enforcement does issue a bench warrant, the non-paying individual can be cited for contempt and ordered by the judge to go to jail. "We really want to collect money for children of the State of Kansas in Shawnee County," Myrick says.

To achieve this goal, Shawnee County moved to imaging. In the child support enforcement department, Myrick's group now has an HP/9000 computer as the server, with twenty-eight clients running Microsoft Windows on 486 HP Vectras with DTI displays. In early 1995, Windows was installed to replace the DOS setup, and an imaging system, OPEN/image, was added to the existing system.

As of October 1995, not all of the child support case files are on-line. Shawnee County District Court plans to enhance the current imaging system by scanning and indexing even the oldest child support case files. (Myrick says if they scan and index in-house, the work could take about a year. If they follow up on the bids to outsource the work, it could be done in as little as three to six months. The County is still deciding whether to scan in-house or use a service bureau.)

Currently, each PC on the child support enforcement group's network can access the court computer and call up multiple screens, such as a forms window that enables case workers to type in a few fields onscreen, and print out court bench orders. Each employee can customize his or her view, depending on whether the bench order forms or electronic case files are used most often.

For instance, Myrick says she prefers the court computer and images on the left side of her screen. "If I'm talking on the phone, I can click on an icon and it will bring up a case folder," she says, "and I can click on the document I want to call up."

Employee Productivity

Because of the volume of cases that are followed up, some of which are decades old, worker productivity is crucial to success in this government office. With the previous system—plain vanilla DOS machines running WordPerfect—many employees, including Myrick, had complained of headaches and eye strain at the end of the day.

The imaging integrator for Shawnee County took into account the work that would be done and the hours case workers would spend using the computer, and recommended EasyRead 240. Myrick still wasn't totally convinced that getting rid of the color monitors would benefit the employees, and went to a site in nearby Nebraska where she was able to compare various types of monitors at the installation to DTI's EasyRead 240. "The other displays just didn't have the resolution," Myrick says.

Four EasyRead 240 displays were initially purchased for the pilot, and were set up in a conference room where Windows training was being given to the group. With 14-inch color monitors side-by-side with the DTI's, Myrick said everybody wanted to use the color.

"We had gone from DOS to Windows, and color was attractive to them," she says. "I don't think any of us wanted to give up color, but once people saw the difference with images on EasyRead and color, there was no comparison. EasyRead was better."

Myrick was also convinced, and ordered EasyRead 240s for everyone. She was surprised how quickly the staff adapted to the scale-to-gray displays. Also, the child support enforcement workers didn't complain of headaches or eye strain. "Even though they aren't color, you can adjust the grayness, brightness, and such. I don't get any complaints about them at all," she adds. "I would recommend these to anyone buying an imaging system, and in fact have done so."

Although Myrick anticipates it will take one year before Shawnee County District Court sees a savings from employee productivity, the Court has already seen a rise in monthly child support collections. They are now collecting 62% of the current child support due each month; the national average is 50% per month.

Using imaging, Myrick says they hope to increase the collections. And using Easyread 240s will add to that return on investment. "The biggest obstacle is that people don't want to give up color because it is pretty. But when they see the resolution is so good, they usually get over that," she adds. "Nobody [at Shawnee County Courthouse] minds the change at all."

Glossary

Accelerator board—A printed circuit board added to a PC to increase its performance.

Acuity—Keenness or sharpness of perception.

Algorithm—Prescribed set of mathematical steps which is used to solve a problem or conduct an operation.

Aliasing—Condition when graphics, either constructed with lines (vectored) or dots (bitmapped), show jagged edges under magnification.

American National Standards Institute (ANSI)—A standard-setting, non-governmental organization, which develops and publishes standards for "voluntary" use in the United States. Standards set by national organizations are accepted by vendors in that country.

Anti-aliasing—Blending techniques that smooth the jagged edges of computer-generated graphics and type. A common anti-aliasing technique is to fill the pixels between the jagged ends with levels of gray (or color) to soften the edge and blend it smoothly into the background.

Anti-glare—An adjective used to describe the monitor screen that has been treated, coated or covered with a transparent substance that reduces the glare or reflection on the screen from office lights or sun light. See OCLI.

Bit map—Representation of characters or graphics by individual pixels, or points of light, dark, or color, arranged in row (horizontal) and column (vertical) order. Each pixel is represented by either one bit (simple black and white) or up to 32 bits (fancy high definition color).

Bit-mapped font—A set of dot patterns that represent all the letters, characters and digits in a type font at a particular size.

Bit-mapped graphics—Images which are created with sets of pixels, or dots. Also called raster graphics. Contrast with vector graphics.

Bit-mapped image—Representation of image data where each pixel has a corresponding memory element.

Black and white scanner—Scanner that interprets scanned data as black or white, but with additional software, can perform electronic screening, dotting or dithering to produce simulated gray scale pixel configurations.

Brightness—The balance of light and dark shades in an image.

Cathode Ray Tube (CRT)—The glass, vacuum display device found in television sets and computer terminals.

Compression—A software or hardware process that "shrinks" images so they occupy less storage space, and can be transmitted faster and easier. Generally accomplished by removing the bits that define blank spaces and other redundant data, and replacing them with a smaller algorithm that represents the removed bits.

Computer Vision Syndrome (CVS)—The eye equivalent of carpal tunnel syndrome, CVS is the term for computer-related vision problems, such as eyestrain, exhaustion, headaches, blurry vision, and tired or burning eyes.

Contrast—The range between the lightest tones and the darkest tones in an image.

Controller—A hardware-software device that facilitates communications between a host and one or more devices.

Decompress—To reverse the procedure conducted by compression software, and thereby return compressed data to its original size and condition.

Device drivers—Small programs that tell the computer how to communicate with a particular types of peripheral devices.

Digital Scanner—Optical reader that scans and converts images into digital form.

Display—A device utilized for viewing images and data in a computing environment. Also used to refer to the visual presenation of data.

Dithering—Simulating gray tones by altering the size, arrangement or shape of background dots.

Document—A collection of data, organized into some logical order and presented on paper.

Document retrieval—The ability to search for, select and display a document or its facsimile from storage.

Dot pitch—The distance of one phosphor dot in a CRT to the nearest phosphor dot of the same color on the adjacent line.

Dots per inch (dpi)—A measurement of resolution and quality. Measures the number of dots a printer can print per inch both horizontally and vertically. A 600 dpi printer can print 360,000 (600 by 600) dots on one square inch of paper. More dpi means higher resolution and greater detail.

Easy scale—A Windows DLL that provides high quality scale to gray and N:M scaling for any bitonal image on all monitors when implemented in the viewing software.

Electronic image gray scaling—Activity outside or in scanning that accurately senses, differentiates and encodes intermediate shades between black and white in photographs and half tones.

Electronic imaging—Electronic techniques for capturing, recording, processing, storing, transferring and using images.

Enhanced Graphics Adapter (EGA)—A display technology for the IBM PC. It has been replaced by VGA.

Flat profile screen—A screen that appears almost entirely flat or with little to no convexity when viewed from the side. These screens reduce reflection, glare, and distortion that that may occur as information is displayed closer to the corners of the screen.

Flip—The technological equivalent of the turn of a page.

Gray scale—The spectrum, or range of shades of black an image has. Scanners' and terminals' gray scales are determined by the number of gray shades, or steps, they can recognize and reproduce. A scanner that can only see a gray scale of 16 will not produce as accurate an image as one that distinguishes a gray scale of 256.

High resolution (Hi-res)—Basically, any image that is displayed in better quality by increasing the number of dots, or pixels per inch than normal. Usually refers to better quality computer displays, but can describe printer quality as well.

Horizontal scan frequency—The number of video lines written on the screen every second (left to right). The higher the horizontal scan frequency, the higher the resolution and/or the refresh rate.

Icon—The basis of a graphical user interface. An icon is a picture or drawing of a device or program which is activated, usually with a mouse, to access the device or run the program.

Illuminance—(1) Measure of light falling at a given point on a surface: the rate at which luminous energy (quantity of light) is received by a unit area, expressed in foot-candles (lumens per square foot), lux (lumens per square meter) or photo (lumens per square centimeter). (2) Luminous flux received by a surface.

Image—Digital representation of a document, picture or graphic.

Image resolution—The fineness or coarseness of an image as it was digitized, measured as dots-per-inch (dpi), typically from 200 to 400 dpi.

Imaging—Recording “human-readable” image—pictures, images, motion, text, etc., into “machine-readable” formats, i.e. microfilm, computer data, videotape, OCR output, ASCII code, etc.

Incident light—Light which strikes an object, distinguished from the light absorbed by, reflected from or transmitted by the object.

Indexing—A method by which a series of attributes are used to uniquely define an imaged document so that it may later be identified and retrieved.

Luminance—Luminous flux emitted from a surface (ISO). Former term: photometric brightness.

Magnification—Apparent enlargement.

OCLI (Optical Coating Laboratories, Inc.)—The primary manufacturer of anti-glare treatments for monitor screens. The company name has become synonymous with its product.

Page scanner—Scanner that primarily reads and digitizes ordinary business size documents.

Pan—To view a different part of a page that has been overscanned (is off the borders of the screen).

Phosphor—Substance which glows when struck by electrons. The back of a cathode ray tube face is coated with phosphor.

Pixel—Derived from the word Picture Element. Also called a Pel. When an image is defined by many tiny dots, those dots are pixels. On the printed page, each pixel is one dot. On color monitors, though, a pixel can be made up of several dots, with the color of the pixel depending on which dots are illuminated, and how brightly.

Random Access Memory (RAM)—The primary memory in a computer. Memory that can be overwritten with new information. The “random access” part of its name comes from the fact that all information in RAM can be located, no matter where it is, in an equal amount of time. This means that access to and from RAM memory is extraordinarily fast. By contrast, other storage media, like magnetic tape, requires searching for the information, and therefore takes longer.

Raster display—The most common type of display terminal. Uses pixels in a column-and-row array to display text and images.

Readability—The degree to which an image on screen is clear and the content discernible to the average human eye at normal viewing distances.

Red, Green Blue (RGB)—The primary colors, called “additive” colors, used by color monitor displays and TVs. The combination and intensities of these three colors an represent the whole spectrum.

Reflected light—Light that has been deflected from a surface, not having been absorbed or transmitted.

Reflective contrast—Degree to which marked and unmarked regions of an optical medium can be distinguished. NOTE: usually by differences in the light reflected or transmitted by them.

Refresh—The phosphors at each pixel of a CRT which are stimulated by a charge from an electron gun glow only briefly. They must be renewed frequently in order for the image to appear stable. This renewal is called refreshing.

Refresh rate—Measure of how often the image on a CRT is redrawn; often expressed in Hertz (Hz). Typically 60 times per second, or 60 Hz, in the United States.

Resolution—(1) Measure of imager output capability, usually expressed in dots per inch (dpi). (2) Measure of halftone quality, usually expressed in lines per inch (lpi). The higher the resolution, the greater amount of detail may be shown. If a resolution is agreed upon as a standard, it is called a graphics standard.

Scaling—Technique using an algorithm to convert a bit-map of one density into a bit map of another proportional density. Scaling usually involves enlarging or contracting an image.

Scan—To convert human-readable images into bit-mapped or ASCII machine-readable code.

Scan rate—Number, measured in times per second, a scanner samples an image.

Scan size—Dimensions (length and width) of the part of a document that can be digitized.

Scan time—Total time to convert text or graphical information to electronic raster form.

Scanner—(1) A device that optically senses a human-readable image, and contains software to convert the image to machine-readable code. (2) Device that electro-optically converts a document into binary (digital) code by detecting and measuring the intensity of light reflected or transmitted.

Scanner threshold—Setting that determines whether a pixel is white or black.

Screen—Series of dots (may also be series of lines or other pattern) used to represent continuous tone artwork.

Scroll—Controlled vertical or horizontal movement of an image such that, as new data appear on the reader screen or display at one edge, other data disappear at the opposite edge.

Scrolling—The image constantly rolling (moving up or down) on the display.

Shadow mask—A thin sheet of metal with tiny holes located inside a color monitor behind the phosphor. The three electron beams inside the monitor must shoot at the monitor's phosphor through a shadow mask to achieve color clarity or keep the three colored dots from overlapping or bleeding into each other.

Tagged Image File Format (TIFF)—A bit map file format for describing and storing color and gray scale images.

Vertical scan frequency—Same as refresh rate, expressed in Hertz (Hz).

Video Display Terminal (VDT)—Generic, slightly inaccurate, name for any display terminal.

Video Electronics Standards Association (VESA)—A consortium of manufacturers that establishes and maintains industry-wide standards for controller boards and monitors.

Video Graphics Array (VGA)—Standard IBM video display standard. Provides medium-resolution text and graphics.

Windows—A Microsoft operating system that features multiple screens and a graphical user interface (GUI).

Workstation—A single-user microcomputer or terminal, usually one that is dedicated to a single type of task (graphics, CAD, scientific applications, etc.).

Zoom—To enlarge a portion of an image in order to see it more clearly or make it easier to alter.

Ergonomic Benefits

Issues that effect worker well-being and satisfaction are:

Increased Productivity

Workers will obtain up to 26%, or more, improvement in reading/viewing documents for information

Less Eyestrain and Discomfort

Benefit of 240 dpi resolution

The eye "accommodates" with less effort and quicker to images that are clearer and have sharper edges

Flat profile screen with OCLI anti-glare coating

Provides less glare, reflection and parallax to provide more viewing comfort and less visual distraction

Increased Worker Well-being

Less physical stress and more comfort in the worker environment will likely provide less down-time and better morale

EASY READ 240™

Clearly Superior

EasyScale

Software scale-to-gray engine

- Highest Quality Scaling for Maximum Readability
- Scale Any Bitonal Image
- Fast Scaling Software
  - Fastest high-quality scaling in software
  - Faster than hardware solutions
- True N:M Scaling Flexibility
  - 1 to 8192
- Windows DLL
  - 16 and 32-bit
- Works on ALL DISPLAYS
- Complements Existing Imaging Libraries and Toolkits

The EasyScale algorithm implemented in Viewer software will improve image rendering speed, accuracy and fidelity for all displays.

dti

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RHEINNER GUIDE

This Technology Guide is one of a series of guides, written by The Rheinner Group and published by ATG, designed to put complex document management, imaging, and workflow concepts into practical and understandable terms. Each guide provides objective, non-biased information to assist in the internal education, evaluation and decision making process. This Technology Guide, as well as the other Document Management, Imaging, and Workflow Technology Guides in the series, are available on ATG's Web Site.

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