1. pinters: inkjet, laser, falta complementar algo tal vez, con el libro
2. plotters
3. digital camera (digital film)
4. scanners
5. sensores remotos
6. monitores, falta complementar con el libro
7. Virtual reality devices (casco, guantes, lentes, etc), tengo todo impreso

HP Printers

http://www.homeandoffice.hp.com/hho/us/eng/printer_basics.html?role=&preview_date=

printer basics

Here's a brief introduction to the different types of printers available and a guide to getting your printer up and running.

types of printers & how they work

inkjet
The most common type of printer found in homes today is the inkjet printer. This printer works by spraying ionized ink onto the paper witmagnetized plates directing the ink to the desired shape. Inkjet printers are capable of producing high quality text and images in black and white or color, approaching the quality that is produced by more costly laser printers. Many inkjet printers today are capable of printing photo-quality images. Bear in mind that the special ink used by inkjet printers is apt to smudge on common copier paper, so remember to buy paper specifically manufactured for inkjet printers.

laser
Laser printers provide the highest quality text and images for personal computers today. Like standard copy machines, they operate by using a laser beam to produce an electrically charged image on a drum, which is then rolled through a reservoir of toner. The toner is picked up by the electrically charged portions of the drum, and transferred to the paper through a combination of heat and pressure. While full-color laser printers are available, they tend to be much more expensive than black and white versions and require a great deal of printer memory to produce high-resolution images. Also, be warned that many specialty papers, such as iron-on transfers, are not suitable for laser printers as the heat used in the transfer process could damage the paper and gum up your printer.

daisy-wheel and dot-matrix
More popular a decade ago but still in use today are daisy-wheel and dot-matrix printers. Like a typewriter, the daisy-wheel printer has a plastic or metal wheel on which the shape of each character stands out in relief. A hammer presses the wheel against a ribbon, which transfers the image of that character to the paper. Daisy-wheel printers cannot print images and are very limited in the fonts they can print, but produce high-quality text. Dot-matrix printers also work with ribbons, but use a number of pins to create the character images, providing the ability to print simple images and a larger range of fonts, though of a poorer quality than the daisy-wheel. Both types of printers tend to be noisy, but they print quickly and have the ability to print carbon copies, of which neither laser printers nor inkjet printers are capable.

all-in-one
The final type of printer to be mentioned here is the multifunction or all-in-one printer. Many home office users prefer the space-saving convenience of an all-in-one device which combines

the functions of printer, scanner, copier and fax into one machine. All-in-one printers can be either inkjet or laser based.

INKJET

inkjet printer buying decisions

What are the advantages of inkjet printers?

- Affordable
- Many of today's versions can print photographic images, and laser-like text that come very close to the quality of more expensive laser printers.

Page per minute (ppm)

Inkjet printer speeds vary greatly, depending on whether you are printing straight black text, mixed black text and color graphics, or colorful photographs (as you might expect, text prints faster than photos).
You can find inkjets that will print black text at 5 ppm and those that print at 17 ppm.
Color documents can be printed at 2 ppm on up to 14 ppm.

Resolution

Several inkjet printers provide a color resolution of up to 2400 x 1200 dpi (dots per inch). "Dpi" refers to the number of dots of ink that the printer can lay down in a line one inch long. This measure of text and image quality provides a standard for comparison: the general perception is that the higher the number, the sharper the output will be.

However, this is not always the case. It is not only the number dots, but is how the dots are placed – the quality, accuracy and precision of the dot placement is just as important.

Up to 2400 x 1200 dpi (on premium photo paper) as well as Enhanced Color Layering Technology from PhotoREt III – (Resolution Enhancement Technology). PhotoREt III is an alternative print mode for 2400 x 1200 dpi, but prints much faster and with visibly the same exceptional print quality. This technology produces brighter, crisper, more realistic colors and sharper details.

With color layering, drops are precisely layered or blended-within the space of a single drop to create more color for each dot. Also, more drops of ink are packed into each printed dot. More levels of color create more accurate colors with fewer dots per inch.

Connectivity

- Parallel and USB interfaces.
- Sharing a printer in a network environment
- Printers allow you to print directly from your digitalcameras memory card –no PC required.
- Using wireless (infrared) connectivity. This "beam and print" connectivity moves information faster than a serial connection and is comparable to a USB connection.

Entry Level

- up to 8 ppm black/5 ppmcolor
- up to 600 x 1200 dpi (on premium photo paper)
- print e-mails, color documents & more

High Performance

- up to 17 ppm black/14 ppm color

- up to 2400 x 1200 dpi (on premium photo paper)
- direct photo printing from your digital camera"s memory card
- high volume, cost saving features, and networking capabilities

- auto-duplexer unit standard in the hp business inkjet 2600dn
- prints up to 13 x 19 in (A3+) on a wide variety of media from plain and photo paper to transparencies
- high-speed printing powered by dual processors (167/160 MHz) and a large 48 MB on-board memory

LASERJET
Entry Level
- up to 15 ppm, 1200 dpi
- low cost professional results
- personal printing from your desktop
- 8 MB standard memory, 133 MHz processor

High Performance
- fast 19-ppm print speed, instant-on fuser, 8 MB standard memory, 133 MHz processor and a 40,000 monthly duty cycle deliver high performance for small workgroups
- true 1200-dpi printing at full engine speed provides superior print quality
- instant-on fuser eliminates warm up time and prints the first sheet in less than 15 seconds (less than 26 seconds when using the built-in duplexor

All-in-one
Printer/Scanner/Copier/FAX
- sheetfed design for copying/scanning and network capabilities
- up to 12 ppm with FastRes 1200 dpi print resolution
- 33.6 K faxing with up to 300 page storage
- up to 2400 x 1200 dpi and 36-bit color scanning

Color Flatbed
- flatbed design for copying a variety of documents
- up to 11 ppm black/8.5 ppm color printing, up to 2400 x 1200 dpi (on premium photo paper)
- creative color copy features for wallet-size photo & posters

COLOR PRINTERS
LaserJet
- up to 9 ppm color
- up to 600 x 1200 dpi
- up to 24 ppm black

Large printers (plotters)

- Production speeds of 52 m(2sq)/hr (560 ft(2sq)/hr) at 600 dpi on coated paper and 5.4 m(2sq)/hr (58 ft(2sq)/hr) at 1200 x 600 dpi on glossy media.
- Ultimate photo image quality using six inks, color layering technology and 1200 x 600 dpi on glossy media.
- Fast!
- Ink flexibility: printer can handle both dye-based inks and UV fade-resistant inks and the user can easily switch between the two.

- Great media flexibility: rolls and sheets up to 1.5 m (60 in) wide: coated, glossy, back-lit, opaque vinyl, canvas and more.
- Unattended printing with 680-cc cartridges, printheads lasting for at least 700 cc, 45.7-m (150-ft) media rolls, remote display and optional take-up reel.

Scanners

As the digital age progresses, scanners have become a more regular feature of the home computing environment. Unfortunately, they have a reputation for being difficult to set-up. But this isn't necessarily so. Whether you're interested in scanning photos and artwork to share with family across the country, or in creating a digital archive of important business papers, this guide will help introduce you to the process of installing and maintaining your scanner.

Another important distinction between scanners concerns how they connect to the computer. Scanners can connect in three different ways: USB, parallel, or SCSI interfaces. While USB and parallel interface scanners are easier to install, SCSI (pronounced "scuzzy") interfaces can provide scans at three to ten times the speed.

http://www.homeandoffice.hp.com/hho/us/eng/scanner_basics.html?role=&preview_date=

Types of scanners

First, you need to know what kind of scanner will best suit your needs.

flatbed: Most popular in homes today. Flatbed scanners look something like a small copy machine, with a pane of glass upon which you lay the object that you wish to scan. Flatbed scanners are ideal for people who intend to scan a wide range of items, such as photos, books, documents, and even 3-dimensional objects. An automatic document feeder (ADF) can be added to some models to ease scanning multiple pages.

sheet-fed: Excellent for scanning large numbers of loose, individual sheets, but cannot handle bound documents or photographs. Excellent for scanning multiple pages for document management (like invoices or receipts) or for editing in a word processor

film scanners: Excellent to scan slides, negatives, or transparencies, you should consider a film scanner. These are specially designed with a much higher resolution than other scanners, and are not suitable for other media. If you will only occasionally scan film, then you can get a transparency adaptor for your flatbed scanner.

handheld: Handheld and pen scanners are capable of scanning two to five inches at a time. While useful for scanning small images or passages of text, they are difficult to manipulate when capturing whole pages.

Specifications

When you begin comparing scanners, you'll notice a lot of attention paid to resolution and bit depth.

optical resolution: Resolution is a measurement of the numbers in dots per inch (dpi, also referred to as ppi, or pixels per inch) of the sharpness and clarity of an image. A scanner with 300 dpi resolution can capture an image with 90,000 dots (the smallest identifiable part of a picture) per square inch. Three hundred dpi is suitable for scanning most graphics and text, especially if it's for the Web. But if you are going toprint what you scan, look for something higher, like 600 or 1200 dpi.

hardware resolution: This number is usually given in two numbers, the horizontal and the vertical. The first number is the same as the optical resolution. The second number tells you how small the steps are that a scan head's motor can take while scanning down the page. In general, you can ignore this number.

interpolated resolution: This is sometimes referred to as maximum or enhanced resolution, and is usually a very high number. Using interpolation, the scanner can generate intermediate values based on known values. For example, a scanner with an optical resolution of 300 dpi and an enhanced resolution of 4800 dpi will actually capture 90,000 dots, and then based on the value of each of those dots, add 15 dots between each of those known values, yielding a higher resolution.

bit depth: Bit depth refers to the number of bits used to capture each dot. The higher the number, the more color gradations will be visible. In general, a 24-bit scanner will be suitable for most tasks such as scanning photographs, drawings, and text, particularly for the Web. A 30-bit or 36-bit scanner is best for scanning film or transparences and for professional photographic work.

speed: Most manufacturers list speed among their desirable specifications, but in actuality – unless you are going to scan hundreds of pages at a time – speed should not be a major consideration.

Because quality optics and image optimization algorithms contribute significantly to the output of a scan, it is possible to get a higher quality image from a 300 dpi scanner than a 600 dpi scanner. It's like projecting a film onto a screen: it doesn't matter how high the resolution is if the lens is out of focus.

Ease of use

Perhaps more important than the numbers describing a scanner's capabilities is the ease with which you can use it. It doesn't matter how high a resolution your scanner can reach if you can't figure out how to make it scan, or how to optimize your scans for a particular use. Today's scanners come with a variety of means to make scanning easy. Here are some of the features you should look for.

software: Most scanners ship with software of some sort, but there are two things you should be sure of.

First, the software should be appropriate to your needs. Some software is better for scanning images; others are better for scanning text. Make sure you get one that does what you want it to do. If you are going to be scanning text that you want to edit in your word processor, make sure you get optical character recognition (OCR) software, which translates the scanned images of your text into individual characters.

Second, make sure you are comfortable using the software. While some programs may be intended for novice users, others may be too complicated to figure out with a three-inch thick manual. If possible, give the software a test drive to make sure it suits your level of expertise. Good software will make it easy for you to get your image from the scanner into your desired application in as few steps as possible.

interface: The type of interface you use to connect your scanner to your computer can have an effect upon performance. SCSI interfaces, while the most difficult to install, are usually quicker than parallel interfaces, and have been the traditional first choice for most scanner users. In the past few years, however, USB ports have become more and more common, delivering similar speeds as SCSI ports but with much easier installation. As Firewire ports become more common on home computers, there will be more and more scanners available with this super-fast interface as well.

LCD interface: An LCD menu allows you to change settings directly on your scanner instead of on your computer.

one-step buttons: More and more scanners are featuring buttons that allow you to complete routine tasks in one step. Just put your photo or other object on the glass, press a button, and the scanner will automatically perform a scan at optimum settings for the desired destination, whether it is the Web, e-mail, or your printer.

http://www.homeandoffice.hp.com/hho/us/eng/scanner_basics_part_two.html

DIGITAL CAMERA (PHOTOGRAPHY)

http://www.homeandoffice.hp.com/hho/us/eng/spotlight_on_digital_photography_article_two.html

Getting started

Here are things to consider:

1. **Resolution.** The higher the resolution of a digital photo, the larger it can be displayed or printed without losing image quality. A camera's resolution is determined by pixels--the more pixels, the higher the resolution. For example, a 2.5-megapixel (MP) camera can create 2,300,000 pixels (up to 3.3 MP). You'll want a camera with at least 1-megapixel resolution for optimal image quality. (Definition: In graphic design, an image containing a very large number of pixels, a million or more. Megapixel images have a lot of detail and make very large files. 2400 x 1200 pixles = 2.880.000 pixels = 2.75 MP)

2. **Built-In Memory.** Most digital cameras come with built-in memory. Many of them also support some form of removable storage. If you only have built-in memory, when that memory becomes full, you'll have to unload the photos into your computer before you can begin shooting again. With removable storage, you can simply insert a fresh memory device card and keep on shooting--a definite advantage.

Some digital cameras allow you to directly connect the camera to your computer via either USB or serial cable. Other cameras use memory cards, disks, or sticks to store photos and can make them directly available to a laptop computer or desktop machine with an appropriate reader.

You can also beam images directly to a printer and print out your photos (no PC required), courtesy of infrared technology.

when should i use a scanner instead of a digital camera?

A scanner is the tool of choice when you have an existing photograph or image-such as crayon drawings, slides, or business documents. Scanners work best with two-dimensional items, although you can also scan relatively flat items. Once you've scanned an image into your PC, the image is available for enhancement and manipulation as if it was originally created on your computer!

Recently (February 2002)New Cheap FOVEON improves considerable image resolution and storage for digital cameras.

DIGITAL FILM

http://www.homeandoffice.hp.com/cgibin/printerfriendly.cgi?in=SNF2/spotlight_on_digital_photog
aphy_article_eleven.html

Film's future in a digital world

Digital cameras have revolutionized the world of photography. Now anyone with a digital camera, PC and printer has the equivalent of a color darkroom and photo lab in their own home. And even though it's still evolving, digital technology has already surpassed traditional film photography in many ways.

Has the digital photography revolution left film in the dust? Film still has the upper hand where quality is concerned. But for many people who have made the switch to digital, the advantages far outweigh the shortcomings. And with the rapid advances in digital technology, a future where digital photo quality rivals that of film is probably not too far away.

Come along as we look at emerging trends and take stock of film's role in the future of photography.

film vs. digital

The digital camera has already dramatically changed the way we document our lives, and the way we capture images of the things we value most—children and family, life's milestones, everyday and special occasions. Digital photography is perfect for preserving, and instantly sharing, those slices of life that come and go so quickly.

Still, there is no question that conventional film is able to produce sharper images and more detail. Simply put, the more pixels you have, the higher the resolution and the better the image quality. High-end consumer digital cameras still only capture five to six million pixels. Although the resolution of a piece of film is harder to quantify, it's closer to 20 million pixels!

closing the quality gap

How long will it take for digital cameras to catch up to film with regard to quality? The pictures you can get today with most 3+-megapixel cameras are already pretty astonishing, and a 5+-megapixel consumer model just hit the market. With the escalating pixel races, we'll probably pass the magic 8-megapixel barrier within two years—which means that by then, perfect 16-by-20 prints will be possible from digital images without enhancement.

Of course, these megapixel models will have a mega price tag as well. And it will still be a while before those prices begin dropping. Another question to ask as the pixel count keeps climbing is: How many pixels does a person really need? For the everyday clicker, an 8-megapixel camera is probably overkill when you can produce an astoundingly good 8x10 photo with a 3+-megapixel model.

beyond pixels: the future of digital color

Engineers believe that the science of color holds the key to higher quality. "In the past," says Howard Taub, director of the printing and imaging technology program at HP Labs, "the quality of digital photography has been inferior to film. HP Imaging Technology will change all that. By automatically adjusting the camera for each individual scene, it's like having a custom photo lab in your camera. Conventional photography can't do that." The result is clearer pictures from ewer pixels.

advances in "digital film"

Next to its superior quality, film's flexibility is its other great advantage. And there is a wide variety of film speeds and types available. But advances are also being made in the flexibility of "digital film," opening up a whole new world of creative options for digital shutterbugs.

Film is sold according to its different speeds, or ISO ratings: The higher the ISO number, the higher the film speed or sensitivity to light. Sensors in digital cameras are just like film in that they also have a "speed." Most digital cameras today offer a nominal speed of about ISO 100.

The dream of using different speed "films" in digital cameras is now a reality, as more high-end models allow a photographer to choose from a broader range of equivalent ISO values. It's like being able to shoot with slow film (ISO 100) or fast film (ISO 400, 800 and higher). It's even possible to set different speeds (or swap from B&W to color) from shot to shot—something that would require changing film in a traditional camera.

hybrid products

Some people just can't choose. They want it all. Film, digital, the whole enchilada. Thus the contrast between digital and film cameras is beginning to blur with the emergence of hybrid products that combine the two technologies. A parade of new products is arriving at technology shows, including a mix-and-match of camera/printers, camera/video players, camera/MP3 players, and now film/digital cameras.

Look at these, for example:

- A digital camera that "prints" on standard Polaroid film by projecting the image onto the raw film.

- A film-based camera that lets you preview photos on LCD—and dispose of the ones you don't like before the film is processed—combining two of digital photography's finest features into a film format.

- A 35mm camera that contains a secondary imaging system for digital photography. Shoot digital one moment, choose film the next.

- "Silicon film" that allows you to adapt a 35mm camera into a digital camera by popping in an adapter.

A film-based camera that, when the film is processed, scans and creates a digital copy of the photo. The image on the actual film is destroyed—but a digital copy remains. There's even a similar product that leaves the film image intact!

the wave of the future or just a fad?

For consumers who still prefer traditional cameras because of their familiarity and top quality—but are intrigued by the digital possibilities—these mix-and-match cameras can be a comfortable way of adjusting from film to digital. But hybrid products are only able to provide the best of both worlds to a point. The convenience comes at a cost.

Many of these film/digital hybrids are twice the weight of others, have an equally hefty price tag, and devour storage space. And even if you wanted to run out and buy one of these fancy new products, you couldn't—many are in the prototype stage and have yet to become available in the U.S.

And many a traditional photographer is already enjoying both worlds by incorporating a scanner into the photography setup. This way, traditional photos can simply be scanned into a PC for a digital makeover, shared with friends, or archived on CD.

the big picture

Digital photography will probably not replace film photography for a long time. For now, film remains an important part of the photographic process, and it may never fade away. It's clear that digital cameras still have limitations that prevent them from being used for every situation.

But digital photography is still a young technology, and it is moving forward at an increasingly rapid pace. With its continued advancement will come the freedom to expand artistic capabilities far beyond what is possible today with traditional film. This is truly an exciting time to be a photography enthusiast.

MONITORS

http://www.homeandoffice.hp.com/cgi-bin/printerfriendly.cgi?in=SNF2/monitoring_monitors.html

Monitoring monitors

size and resolution

Size isn't everything when it comes to computer displays, but it's a good place to start. Displays are measured in diagonal inches (from corner to corner diagonally), though because there's an area around the edge of the screen that can't be used, actual viewing area is usually one or two inches less than the listed size (manufacturers are required to list both total and viewable measurements).

When you are deciding which size monitor to purchase, be sure to consider the space available on your desk: the larger the screen on the unit, the more desk area it will take up. A typical 17" monitor is about 17 inches deep, though manufacturers do everything they can to reduce the footprint" (amount of desk space required) of their monitors in an effort to make a more efficient use of space.

Equally as important as the size of a monitor is the resolution it is capable of achieving. *Resolution* is a measurement of the pixels (individual dots of light) that make up the entire display area. Larger monitors are capable of reaching higher resolutions, but most can be reset to lower resolutions if desired (you might want to change your resolution if the objects on the screen are difficult to discern, or to simulate the conditions on a smaller screen). The higher the resolution, the more information can fit on screen, and the sharper the images will be.

A high resolution can be handicapped by a low refresh rate, however. Refresh rate, measured in Hertz (Hz), refers to the number of times the screen is redrawn each second: the higher the number, the less the screen will appear to flicker. While a resolution of 1024 x 768 is optimal for most mainstream work (and the maximum resolution available on a 17" monitor), the refresh rate should be at least 75 Hz. Higher resolutions require a higher refresh rate of 85 Hz or more.

CRT vs. LCD

If your budget allows it, you might be considering one of the sleek new flat-panel displays. Flat-panel or LCD (liquid crystal display), the same technology used in notebook displays, has several advantages over traditional CRT (cathode ray tube) displays. Besides being ultra-stylish, they are easier on users' eyes, take up less space, and use less energy. However, even though prices are beginning to drop, they remain significantly more expensive than their CRT counterparts (at least $400 more in US (2002)).

In addition, LCD monitors are generally less flexible than CRTs. LCDs use rod-shaped molecules that bend light to produce an image, rather than electron guns that light up the phosphors on the viewing area of a glass tube. Because of this difference in technology, LCD monitors are restricted to only one optimal resolution: lowering the resolution results in a reduced-screen area and blocky images. Refresh rates are generally irrelevant, as they should already be set according to the display's resolution.

An important detail to check when shopping for flat-panel displays is whether the interface is digital or analog. Since most computers are equipped to convert digital information to analog information for display on CRT monitors, LCD monitors have been built to convert the analog signal back to digital. This digital-to-analog-to-digital conversion results in some signal loss, and thus an imperfect picture. Choose a flat-panel monitor with a digital interface, if possible, though you will also need to purchase a special graphics adaptor. The HP Pavilion fx75 15" Flat Panel Display features a dual interface, allowing you to use either a digital or analog signal to connect to your computer.

Note: "Flat display" monitors are not the same thing as "flat-panel display" monitors. While the latter refers to LCD monitors, the former refers to CRT monitors with a flat screen, like the HP Pavilion mx75 17" monitor. The flat screen produces less glare than a traditional CRT screen, helping to reduce eye strain (you should still be sure to look away from the screen every few minutes).

needs and cost
(US, first quarter 2002)
Monitor prices vary widely, from under $200 for a low-end budget model, to $1000 or more for a large-screen flat-panel display. With all the choices available, it's impossible to declare a "best option" for all users. The monitor you select will depend greatly upon your own requirements and budget.

Expect to pay between $250 and $500 for a good 17" CRT monitor like the HP Pavilion mx70, suitable for most mainstream users. Decent 19" CRTs fall within the upper range of the same price spread, and provide 30 percent more screen area. The extra display area makes it easier to read text-heavy Web pages or spreadsheets. The HP Pavilion mx90 19" short display takes up less space than other 19" models, but provides desktop publishers and graphics producers the high-quality resolution they require.

Professional graphic designers working with CAD or DTP software will benefit from an even larger CRT display. Good 21" monitors start about $750 and go up to about $1500. Presentation and home entertainment displays can be found at sizes of 29" or larger. While the former feature high resolutions and refresh rates – and prices starting at $2500 – the latter can start at under $800. The lower resolution (generally 800 x 600) is similar to that of standard televisions.

Flat-panel monitors are great for people who have limited space, like to make a stylish statement, and have extra money in their budget. A 15" flat-panel display will cost at least $400 more than its 17" CRT equivalent. In addition, the flat-panel may require the purchase of a compatible graphics adaptor, not included in the purchase price. Eighteen inch flat-panel displays are available, but current prices in excess of $3000 put them out of reach to the average user.

IBM T-220 HIGH-RESOLUTION MONITOR FACTS
http://www.llnl.gov/llnl/06news/NewsReleases/2001/NR-01-08-03b.html

There are 9-million pixels on the 22" screen.
This is the largest flat-panel display in the world by pixel count.
Livermore expects 10 more for the three weapons labs.
IBM spent $10 to $20 million on the development of the initial unit.
One quarter of the 22" screen has the same 1920 X 1024 pixel count as a current high-resolution monitor.
Displays 100-million-zone 3-D graphics in lieu of room-sized screen, bringing the display from the theater to the desktop.
This is true digital video or DVI.

3D MONITOR

To summarize, these are some of the key elements of displaying a 3D scene using a two dimensional display:

- *Geometric Perspective*
- *Color Intensity and Contrast*
  In a landscape, objects that are far from the viewer show less intense color and contrast than objects that are close up. The atmosphere absorbs and scatters light from distant

objects, reducing (or "attenuating") the color and contrast, often adding a soft blue or gray sheen. Because we know the color of most objects, our brains automatically use this color change to create a sensation of depth. Painters call this technique aerial perspective.

- *Stereoscopy*
- *Focus*

  Like a camera or telescope, your eye must focus on objects to perceive them clearly. The eye achieves focus by using muscles to change the shape of the lens, or cornea, to directlight on to the retina, the array of light-senstive cells at the back of the eye.

  When you focus on objects at moderate and long distances, the cornea is minimally deformed, while it is highly deformed to focus on near objects. Even without stereoscopy, the brain interprets this change in focus as an indication of distance.
- *Occultation*

  When one object is placed in front of another so that the object at the rear is hidden from view, it is occulted. If you move your head side to side, you may see the edges of the hidden object as your perspective changes. Many animals move their heads side to side in an almost rhythmic ashion in an attempt to identify possible threats behind nearby objects.
- *Touch*

  Touching an object can quickly reveal information about its 3D shape, consistency and properties.

Of these elements, geometric perspective and stereoscopy are the most important for creating a visceral perception of three dimensions on a two-dimensional display. Let’s take a look at how the DTI 3D monitor adds stereoscopic capability to an otherwise normal display.

The DTI 3D Monitor in Detail

Out of the box, DTI’s 2015XLS monitor is an unspectacular device. In size, shape, and appearance, it is no different than the traditional 15-inch flat-panel LCD monitors that you see all the time on computers, point-of-sale systems, and everywhere else. The monitor supports a standard desktop resolution of 1024x768 pixels

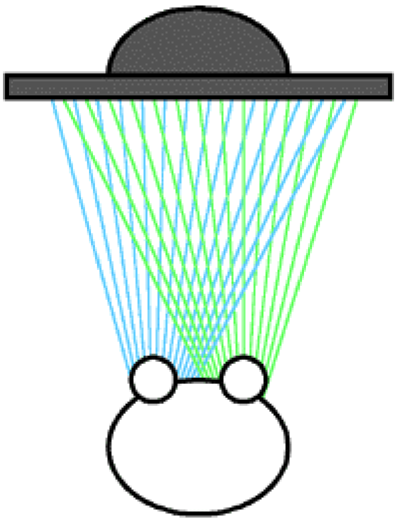
DTI’s patented secret is a thin layer of special plastic between the lighted back panel and the LCD panel, which DTI calls "parallax illumination". This layer can direct the light rays from the backlight to the left and right eyes to

Left	Right	Left	Right	Left
Left	Right	Left	Right	Left
Left	Right	Left	Right	Left
Left	Right	Left	Right	Left

create a stereoscopic view. Here’s how it works.

Using vertical lenses which are activated when the stereoscopic layer is turned on, the DTI monitor projects alternate columns of the image into the left and right eyes. The sterescopic layer may be activated from the front panel controls on the monitor, or via a standard serial port connection to the back of the monitor; DTI includes the serial cables you need to make it happen.

If you were able to see the light beams from overhead, the result would look something like this:



Directing the light rays with the parallax illumination technology results in two distinct stereoscopic images (called a "stereoscopic pair"), one directed at the left eye, and one at the right. The result is, in a word, shocking. The DTI display can project 3D images which literally appear to float right in midair, like an object suspended from a string right in front of your face.

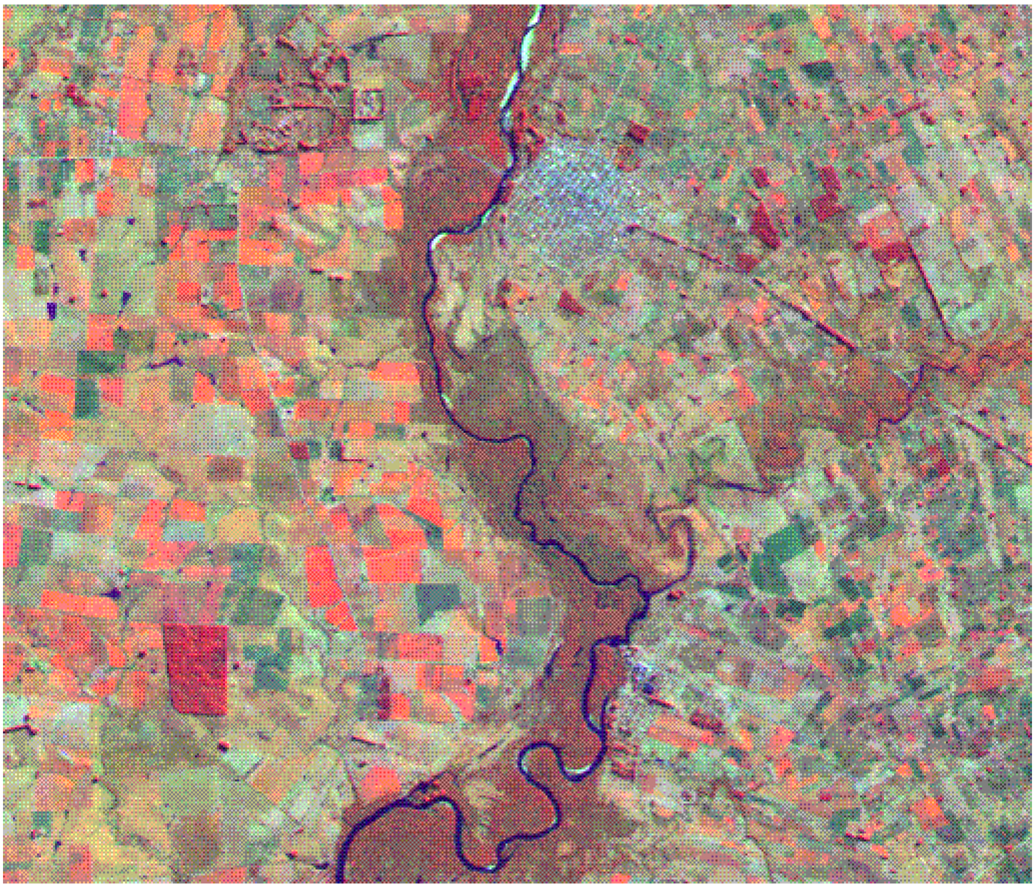
SENSORES REMOTOS

Complementar con las transparencias del curso de SIG

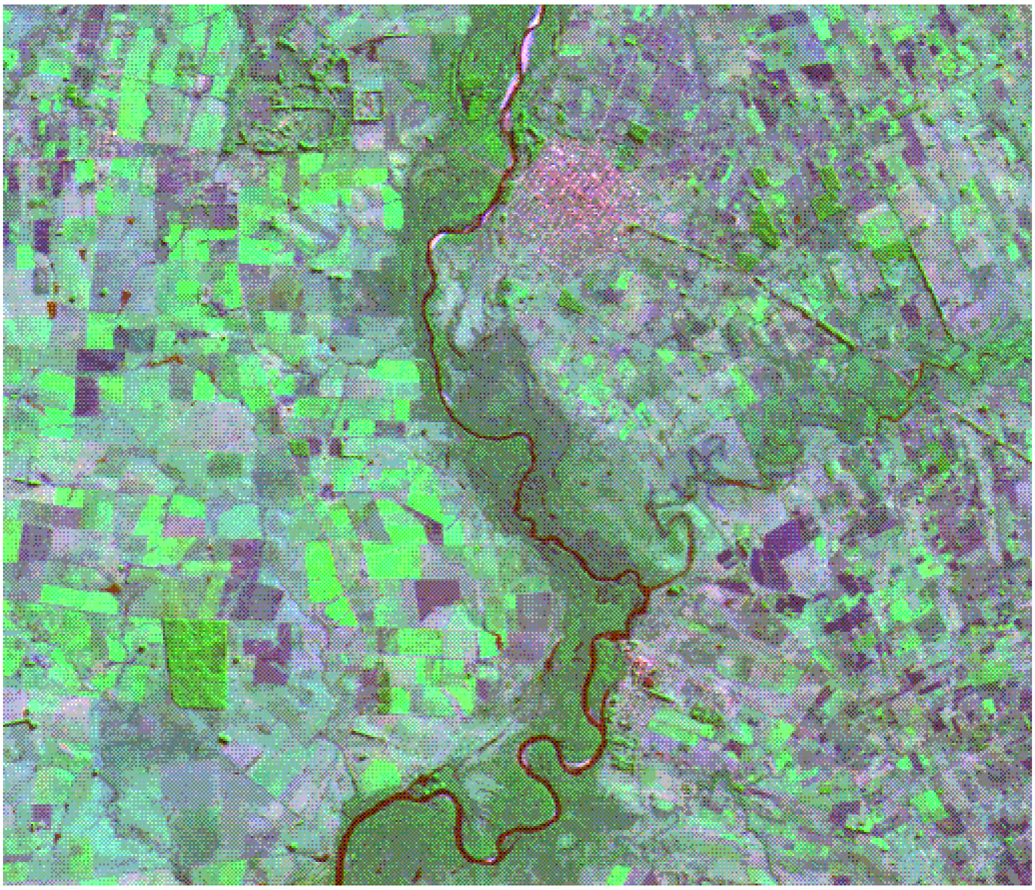
El **SENSOREAMIENTO REMOTO o Percepción Remota** es la adquisición de datos sobre un objeto o escena por medio de un sensor que esta alejado del mismo. Las fotografías aéreas, imágenes satelitales y radar son ejemplos de datos provenientes de sensores remotos.
Las imágenes provenientes de sensores remotos Estos se alojan en satelites (hasta a 36000 KM de distancia) o aviones.

Los sensores pueden ser pasivos o activos. Pasivos captan longitudes de onda del espectro electromagnético. Captan el reflejo de los rayos electromagnéticos emitidos por el sol. Activos emiten una microonda y captan su rebote.

Existen sensores que trabajan con rayos laser, haciendo un barrido del terreno permiten su reconstrucción mediante un DEM (en inglés Digital Elevation Model).



Landsat TM 5, bandas 4 3 5 (RGB)



Landsat TM 5, bandas 3 4 5 (RGB)

Los satélites de hoy día llegan a una resolución de 1 pixel de imagen = 60x60 cm de terreno.

IKONOS

Dispositivos de REALIDAD VIRTUAL
Realidad Virtual
An artificial environment created with computer hardware and software and presented to the user in such a way that it appears and feels like a real environment. To "enter" a virtual reality, a user dons special gloves, earphones, and goggles, all of which receive their input from the computer system. In this way, at least three of the five senses are controlled by the computer. In addition to feeding sensory input to the user, the devices also monitor the user’s actions. The goggles, for example, track how the eyes move and respond accordingly by sending new video input.

To date, virtual reality systems require extremely expensive hardware and software and are confined mostly to research laboratories.

The term virtual reality is sometimes used more generally to refer to any virtual world represented in a computer, even if it's just a text-based or graphical representation.

Virtual Reality: http://www.ia.hiof.no/~michaell/home/vr/vrhiof98/index.html
http://www.ia.hiof.no/~michaell/home/vr/vrhiof98/whatisvr/What1.html

A computer system used to create an artificial world in which the user has the impression of being in that world and with the ability to navigate through the world and manipulate objects in the world."

- C. Manetta and R. Blade in "Glossary of Virtual Reality Terminology" in the International Journal of Virtual Reality, Vol.1 Nr.2 1995.

Types of VR

Adventure games, MUD/MOO

Textually described virtual worlds where the user perceives the virtual environment through mental images based on the words read (like reading a novel).

Desktop

3D virtual environment graphically displayed on a desktop computer monitor.

Projected

3D environment projected onto a screen. Enables a single

Technology requirements

Hardware capable of rendering real-time 3D graphics and high-quality stereo sound.

Input devices to sense user interaction and motion.

Output devices to replace user's sensory input from the physical world with computer-generated input.

Software that handles real-time input/output processing, rendering, simulation, and access to the world database in which the environment is defined.
user to demonstrate concepts to a group of people. A CAVE(tm), where several sreens are used to surround the user with images, is the most advanced form of projected VR in use today.

Semi-immersive

Most advanced flight, ship and vehicle simulators are semi-immersive. The cockpit, bridge, or driving seat is a physical model, whereas the view of the world outside is computer-generated (typically projected).

Immersive

3D environment seen through a head-mounted display (HMD). In a completely immersive system the user feels part of the environment (experiences a feeling of 'presence'). The user has no visual contact with the physical world.

VR is a powerful user interface technology

Information is important, as is choosing the best way to visualise it

VR enables the user to interact directly with information

VR can enable the user to see/experience things in new ways

Full 'presence' is not provided by current technology, instead telepresence is provided through several devices.

A number of potentially serious physiological problems remain unsolved

VR does not have to be immersive to be useful

Haptics
http://haptic.mech.nwu.edu/links

Haptics is the science of applying tactile sensation to human interaction with computers. A haptic device is one that involves physical contact between the computer and the user, usually through an input/output device, such as a joystick or data gloves, that senses the body's movements. By using haptic devices, the user can not only feed information to the computer but can receive information from the computer in the form of a felt sensation on some part of the body. This is referred to as a haptic interface. For example, in a virtual reality environment, a user can pick up a virtual tennis ball using a data glove. The computer senses the movement and moves the virtual ball on the display. However, because of the nature of a haptic interface, the user will feel the tennis ball in his hand through tactile sensations that the computer sends through the data glove, mimicking the feel of the tennis ball in the user's hand.

http://www.ia.hiof.no/~michaell/home/vr/vrhiof98/whatisvr/What14.html
Dactile feedback provides a sense of touch through, typically, vibrating nodules or expanding air bubbles inside a glove or suit

Force feedback provides physical constraints :
- Motion platforms
- Exoskeletons
- Joysticks
- Hand controllers

Guantes (Controllers)
A glove equipped with sensors that sense the movements of the hand and interfaces those movements with a computer. Data gloves are commonly used in virtual reality environments where the user sees an image of the data glove and can manipulate the movements of the virtual environment using the glove. (http://www.pcwebopedia.com/TERM/d/data_glove.html)

5DT Data Glove 16 / 5DT Data Glove 16-W
http://www.genreality.com/p_glove16.html
Description

The 5DT Data Glove 16 is (currently) a 14-sensor data glove that measures finger flexure (2 sensors per finger) as well as the abduction between fingers. It is the higher-end version of the 5DT Data Glove 5.

Features

- Affordable quality
- Extreme comfort
- One size fits many
- Automatic calibration - minimum 8-bit flexure resolution
- Platform independent - serial port interface (RS 232)
- Cross-platform drivers
- Bundled software
- High update rate
- On-board processor
- Low crosstalk between fingers
- Wireless version available (5DT Data Glove 16-W)
- Quick "hot release" connection

Trackers
Motion tracking

Main types

Mechanical
Usually a mechanical arm attached to the tracked object
Very accurate, short lag, but restict movement

Electromagnetic [Image]
Measures strength of magentic fields in coils attached to objects
Fast, short lag, but often prone to interference
Limited range

Optical
Typically, pulsating LEDs monitored by a camera at a fixed position
Fast, reasonably short lag, but often prone to interference caused by ambient lighting conditions
Line of sight problems

Acoustic
Use ultrasound waves to measure position and orientation
Slow and often imprecise

Head-Mounted Displays (HDM)

Can display either stereo or mono images depending on type Stereo images (binocular disparity), Same image twice (binocular concordance); Single image (uniocular); May be totally immersive or see-through; may include a built-in head-tracker; may have built-in stereo headphones

How to select the right HMD

(by Arthur Zwern, General Reality Company, Published in Meckler's VR World, March/April 1995)
So, you decide to purchase a new head-mounted display (HMD) for your office's immersive videoconferencing system.

You go down to Circuit City, and there in the VR Department is a bewildering array of HMD selections. You try one on."Too heavy", you say. You try another. "Not enough resolution". And another. "The colors don't look right". Finally, youfind the perfect HMD, which another customer has just rejected as "not rugged enough". She buys the heavy one tothrow in the back of her pick-up truck for emergency response visualization in the Rocky Mountains, while you go for lighter weight and maximum visual performance.

Sound familiar? It should, because variety, application specificity, feature/benefit trade-offs, hands-on demonstration, andretail distribution are key aspects to most mass-market electronics purchasing decisions. But for HMDs, this is a storyfrom early in the next century.

Today, HMD selection is much more challenging for a number of reasons. First, the only opportunities to "wear and compare" HMDs occur at tradeshows, where you might wait in line an hour for each HMD, and where each will display different imagery generated by a different graphics engine. Some of these HMDs might be field-proven production products, while others have been "shipping soon" for many months. And every supplier shouts "ours is best" in a market where the pros and cons of each model for your particular application are not yet clear. In the face of so much hype, what can you do to be a smart HMD buyer?

The answer is to go beyond the "field-of-view, pixel count, and price" questions, and instead use an analytical approach, in which you understand the trade-offs involved in HMD design, and base your analysis on the specific application(s) for which the HMD will be used. By starting with analysis, you can narrow your options down to two or three alternative models. At that point, there is no alternative but negotiating with potential suppliers to ensure that you try before you buy.

To support your analysis, General Reality Company has developed a chart called the "Wear and Compare HMD Selection Tool". This tool is organized into five sections designed to ensure that your shopping trip into Cyberspace is as organized and productive as possible. For each decision or selection criterion, the first blank column allows you to flag your most important needs, while the other three columns let you rank or rate 3 HMDs using any scale you prefer.

Selecting The Right Category of HMD For Your Application

The first step in the analysis is to decide what kind of HMD you need. This is analogous to deciding between a pick-up truck and a sports car before visiting auto row. Here are the key trade-offs:

1) Extended Wear vs. Many Users:The first decision to make is whether your application demands an HMD to be used for long periods of time by a small number of users, or for short periods of time by many users. The extreme examples would be a doctor’s personal display for endoscopic surgery control compared to an arcade game.

If extended wear is anticipated, minimizing eye-strain and maximizing comfort are critical, which would suggest an HMD designed to maximize visual quality and minimize weight. According to the latest HMD safety research, a complete set of adjustments is also required, including focus and interpupillary distance (which aligns the HMD optics to the different distances between people’s eyes). An example is General Reality’s original CyberEye(tm) Model CE-100M, designed specifically for extended wear applications.

In contrast, no amount of bulletproofing is ever enough for an arcade, while every moment spent adjusting an HMD is dead time for the arcade’s cash flow. But, since time of use will be short, much higher levels of eye strain, discomfort, and weight can be tolerated. Liquid Image (Winnipeg, Canada) has built a solid business by offering arcade operators the MRG-2, which is itself solid enough to stand on.

2) Stereoscopic vs. Monoscopic:The human brain perceives depth using a number of subconscious rules such as "known items are certain sizes at certain distances", or "close objects block views of more distant objects". Many of these cues can be provided in software, without a stereoscopic HMD. But, if your application needs every 3D cue possible, then a stereoscopic system should be used. In such a system, your two eyes are presented with slightly different images, which drives your eyes to "converge", in which they roll further towards each other as objects get closer. While stereoscopy adds a powerful depth cue, it will typically entail greater software complexity, two image rendering boards instead of one, and a slower graphics frame rate.

3) Field-Of-View vs. Optical Performance:In applications where maximum immersion is desired, wide fields-of-view can be used to increase the user's sense of "being there". For example, in games, objects can approach from your peripheral vision, causing you to turn your head to shoot them. Alternative ways to achieve greater immersion include using 3D audio to attract attention, and minimizing tracking lag to improve the user's ability to "look around" in an intuitive way. One penalty for maximizing immersion through a wider field-of-view (FOV) is larger, heavier optics, since the lens closest to your eye must have a diameter at least as wide as the FOV angle seen from your eye. As FOV grows, it also becomes more and more difficult to maintain sharp, undistorted images across the entire display, and aligning the display to your eyes generally becomes more difficult.

4) Acuity vs. Field-Of-View:Acuity refers to how well the HMD displays fine detail in images. In the absence of degradation caused by loosely toleranced lens systems, acuity is set by the number of picture elements (pixels) available in the display, and by the HMD's FOV.

With a limited number of display pixels available in today's displays, you as the application developer or user have a critical trade-off to assess. You can use an HMD that spreads the available number of pixels over a wide FOV and thus lose fine detail in the image, or you can maintain image detail but give up wide FOV. For shoot-em-up games, wide FOV is usually more important than image detail, while for industrial applications detail is typically more important.

A useful way to quantify this trade-off is to express an HMD's visual acuity in the same manner used by standard eye charts. In this system, a subject's vision is deemed 20/D, where D is an "effective distance" at which a perfect eye can see objects that the subject barely resolves at 20 feet. For example, the limit for legal blindness is 20/200, which means that a perfect eye can see an object at 200 feet that the subject can only see at 20 feet.

To calculate visual acuity for an HMD, find the number of pixels spread across the display in one dimension (ie; 640 for a 640x480 display). Using the angular FOV in that same direction, solve the equation:

$$D = \frac{FOV * 1200}{\#ofPixels}$$

To illustrate, take a typical low-cost game HMD with a 70ohorizontal FOV and 420 pixels in the horizontal direction. This HMD's effective distance D is 70*1200/420 = 200, which results in visual acuity of 20/200, right at the legal limit of blindness. Clearly, this HMD would not be useful in a driver training simulator.

As a general rule, high-priced HMDs at $5,000 to $150,000 currently use cathode ray tube display sources capable of 640x480 to 1280x1024 resolutions, while lower-priced HMDs at $499 to $5,000 use active matrix liquid crystal displays (AMLCDs) ranging from 320x200 to 640x480. Over the next few years, the pixel count for commercial AMLCDs can be expected to double every two years, which should result in significant ongoing HMD price/performance advances.

At present, there are two methods commercially available for expanding the performance envelope created by the acuity vs FOV trade-off. The more common method works only for stereoscopic systems, and reduces overlap between the images presented to each eye. For example, an HMD specified at 70% overlap means that the outer 30% of each eye's FOV is not projected to the other eye. You can demonstrate this effect to yourself by closing one eye and then the other while looking straight ahead. Unfortunately, your optical cortex has had years of experience at ignoring the overlap effects caused by your nose, while the unfamiliar optical geometry presented by an HMD's partial overlap can cause disturbing visual artifacts.

A second method for attacking the performance envelope has been pioneered by Kaiser Electro-Optics, and is commercially available in its VIM-1000. This technique uses multiple AMLCDs and lenses for each eye, and is known as tiling. While the potential performance improvement is significant, visual artifacts between the tiles are an issue. In addition, the bulk of an HMD's cost-of-goods is currently driven by the AMLCD, which makes tiling a relatively expensive approach.

5) External Light Block vs. Safety Risks:Today's HMDs display video to only a portion of the user's FOV, so you need to decide what to display to the rest. To maximize suspension of disbelief, you may want immersive eyecups, which block all outside light and force you to see only the HMD's display. However, many HMD designers are now moving away from fully-immersive designs for two reasons. First, if the user is allowed to move about, the risk of falling rises astronomically when you can't see your feet. More curiously, all VR systems suffer from a time lag between turning your head and seeing updated graphics for the new line-of-sight in the HMD. The resulting mismatch between the user's visual perception and sense of physical motion can cause simulator sickness symptoms such as nausea, disorientation, and fatigue.

6) Heads-Up Viewing vs. Field-Of-View:In many HMD applications, suspension of disbelief is not important, but simultaneous visual access to the real world and the HMD display is important. For example, several companies are now introducing wearable computers, which display maintenance instructions from a belt-mounted hard-drive. In these cases a monochromatic, single-eye display might be adequate, while in medical imaging uses, full-color stereoscopic imagery might be called for. Either way, your eyes only have so much FOV to go around, so if you use most of it to view the real world, the FOV of the HMD will be limited.

7) See-Through Display vs. Light Loss:One technology area with great promise is augmented reality, in which computer graphics are visually-overlaid on a direct view of the physical world. Applications range from real-time maintenance instructions to the surgical equivalent of "paint by numbers". Achieving augmented reality requires a see-through HMD, such as the "i-glasses" from Virtual I/O (Seattle, WA). Because see-through HMDs use beamsplitters to combine the virtual and real views, half of the total light is thrown away. Since today's display sources are brightness-limited, the image will appear dimmer to the extent the discarded light is from the virtual image.

Optical Requirements

Hoy en día se venden dispositivos que permiten tener una pantalla muy cerca del ojo, (una para cadaojo, o para un solo ojo) de 800x600.

Eye Relief:Eye relief is the distance from your eye to the first lens your eye sees. Eye relief of at least 25mm is required to allow users to wear prescription glasses, which is a critical requirement in public attractions and for many individual users. Even in cases where eyeglass compatibility can be given up, short eye relief distances can cause severe discomfort, and even eye injury if contact occurs between the lens and eye. For a given FOV, the larger the eye relief, the larger (and heavier) the lens needs to be. Thus eye relief often limits FOV. To test eye relief, just wear the thickest glasses you can find.

Exit Pupil Diameter:An HMD's exit pupils can be thought of as portholes through which you view the scene in the HMD. Like portholes, if you move too far to one side, you lose sight of the center of the scene. With small exit pupils, the left and right optical systems must be aligned very precisely to the wearer's eyes at all times, both vertically and by adjusting for the interpupillary distance between the user's eyes. Any adjustment inaccuracy or shifting during active movement will cut off the edges of the images or cause them to blur severely. To minimize this, the optics can be designed with wide exit pupils, which in extreme cases like General Reality's "public"

HMDs, can even eliminate the need for any interpupillary adjustments. However, wide exit pupils tend to conflict with wide FOV, so you have another trade-off to assess. To evaluate exit pupils, swing your head around a few times and see if the images still look centered.

Visual Comfort:The most perfect optical design in the world will look terrible if accurate optomechanical alignment
tolerances are not maintained during assembly. In particular, accurate alignment between the left and right optical systems
is crucial if eyestrain is to be avoided. For example, if the difference in vertical alignment, rotation, or magnification
between the left and right images is only fractions of a percentage point, you will have difficulty fusing the left and right
eye images into a single image, and you will likely feel uncomfortable after even brief use. To assess this most critical of
HMD parameters, wear any HMD you are considering for 15 minutes, then describe how you feel in detail.

Brightness:An HMD's apparent brightness is a complex function of the display source's brightness, the HMD's FOV, and
numerous individual factors such as how many lenses are used, the quality of the anti-reflection coating on each lens, and
losses from beam-splitters for see-through capability. To see whether brightness is adequate, wear the HMD in bright light
in its most non-immersive mode, and decide subjectively.

Contrast:The difference in brightness between the darkest and brightest pixels can be expressed as a ratio, with 100:1 a
good minimum to require. Any less, and the display will appear to be "washed out"

Color:Are colors saturated or subdued? Assuming you are connected to an image generator that outputs a large color
palette, you should also check to ensure that an HMD's colors are correct. Does skin look like skin and sky like sky?

Distortion:One key imperfection in every optical system is distortion, in which portions of the image are shifted with
respect to their ideal positions as a function of distance from the image center. In general, larger fields of view and
lower-cost optical systems result in greater distortion, with a fish-eye lens representing the extreme example. In
low-performance HMDs, distortion makes a rectangular image boundary resemble the profile of a barrel or a pincushion.
To evaluate distortion, view large straight lines near the edges of the visual field.

Aberrations:Every optical system generates aberrations, which are a series of unavoidable image imperfections created
when light propagates through a series of air/glass interfaces. Severe aberrations can result in problems such as inability to
achieve crisp focus, difficulty in focusing the image center and edges simultaneously, colored shadows at object edges,
and points being imaged as comet shapes. In general, higher-priced HMDs successfully attack these problems by
incorporating extra lens surfaces to correct the more severe aberrations. To evaluate aberrations, look for the problems
just described.

Defective Pixels:Most AMLCDs include one or more defective pixels, which either remain stuck on, stuck off, randomly fluctuating, or tied to a neighboring pixel. Specifying "zero defective pixels" eliminates the resulting artifacts, at a correspondingly higher cost. To evaluate this issue, look for errors in "all white", "all black", and small checkerboard scenes.

Pixelization:Most HMDs under $5,000 use AMLCDs as display sources for light weight and low cost. Unfortunately, a significant percentage of any LCD panel is comprised of black spaces between the individual pixels. Especially at larger FOVs, this makes the HMD image appear as if you were looking through a screen door. Some HMD manufacturers leave this pixelation effect alone, while others blur the entire image to eliminate it, with severe and obvious impacts on visual quality. Some of the more advanced HMDs now use holographic filtering techniques to depixelize HMD images without introducing visual degradation, which can have a major positive impact on perceived image acuity.

<u>Mechanical Requirements</u>

Weight:Beyond visual comfort, a wide variety of issues affect physical comfort. One is weight, which is easily measurable and thus often used as a proxy for comfort by unsophisticated HMD shoppers. Commercial HMDs range in weight from 8 ounces to 80 ounces, with comfort and muscle fatigue determining the acceptable limit. For safety reasons, HMDs used on young children should be as light as possible.

Nose Weight:You'll get a sinus headache much faster from a one-pound pair of eyeglasses than from a three pound hat. So, until three-ounce VR glasses really exist, it might be best to avoid any nasal contact whatsoever.

Balance:Ideally, an HMD's center of gravity should be the same as your head's, ie; somewhere around the middle of your brain. Unfortunately, most of the HMD's functionality is usually in front of your eyes. Some designs attack this problem with a counterweight at the back of your head, which raises total weight and increases inertial resistance to turning your head. Other designs attack the problem using lighter weight optical components, such as injection molded plastic lenses.

Fit:Early HMDs fit so poorly that users typically held the HMD in place with one hand throughout VR experiences, thus giving rise to the legendary dance "VR Grasp". Today a wide range of fit-enhancing solutions are available, ranging from ratchet knobs to air bladders. To test, adjust HMD and start jumping around. Does the HMD stay on and do the images stay clear?

Air Flow: Many still call head-mounted displays "helmets" because early designs were exactly that. Now that HMDs are not just for soldiers anymore, most users prefer an open-frame design with minimum head contact, an open top, and no nose immersion. These features maximize hygiene and minimize sweating or lens fogging.

Ruggedness: Even if not for arcade use, your new HMD should be rugged enough to withstand a few bumps and bruises. Look out for small parts, weak hinges, protruding screws, or wires without strain relief. Are the lenses protected by a window from dust and fingerprints? Also, if the HMD needs to travel, can you get a case?

Adjustments: Are brightness/contrast or audio volume adjustable? Does the unit have the focus and interpupillary adjustments if you need them? Are they easy to adjust properly? Do they stay adjusted?

Support Electronics Size/Weight: Many early HMDs required an electronics support cabinet the size of a shoe box, making portable use impossible. Newer designs have compressed this to the size of a pack of cigarettes, or mounted all electronics on the HMD. If it matters, ask.

Maintenance & Storage: Can the HMD be swabbed with alcohol to clean it and kill germs? Are wear items like headbands easily replaceable? Can you hang the HMD on a hook for storage or does it need a shelf?

<u>Electronic Requirements</u>

Audio: If your application calls for audio, make sure volume is adequate but not deafening, and listen for solid bass response. Is the HMD compatible with 3D spatial audio generators? If you do not need audio, consider an HMD that lets you remove the audio speakers to reduce weight.

Standards Compatibility: Connecting an HMD can be easy or nightmarish depending upon its signal interface. The most common and easiest interfaces (in the US) are NTSC (the HMD plugs in like a TV to a VCR), and VGA (it plugs into a computer VGA port). VGA can be converted to NTSC easily at low cost, so for most VR platforms, either will do. For extreme-performance systems running on high-end workstations, separate RGB connections are more common, but using such an HMD on non-RGB systems can be problematic.

Power Consumption: If you need to run off a battery pack or computer bus, select an HMD using less than a watt or two. Otherwise, ignore the issue.

Connectors: For most applications, RCA jacks are acceptable and quite common. For higher-performance applications, a BNC video connector is more desirable.

Approvals: Is the HMD approved by Underwriters Laboratories or the FCC if needed?

Stereo Displays
LCD shutter glasses

[Image]

Display shows left and right images alternately, switching at high speed between images

Stereoscopic image is seen when the display is viewed with special glasses

Typical 'Fishtank VR'

Particularly good for large audiences in a theatre

BOOM - Binocular Omni-Orientation Monitor

Uses a CRT to provide high-resolution display

It is comfortable to use, since it does not have to be worn

Has fast, accurate, built-in tracking

Virtual Retinal Display

Image is projected directly onto the retina

Otros sensores

Interaction devices

3D Mice [Image]

Spaceballs [Image]

Eye tracking

Video camera and shadows (eg. Krueger's Critter and Videoplace)

Voice recognition

Biological sensors

Gloves [Image]
- Hand and gesture tracking
- Enables natural interaction with objects
- Can use hand-signs to execute actions

Full body suits

Sound

Important to create a sense of atmosphere

Can greatly enhance feeling of presence

Can be used to provide valuable depth cues, aiding navigation

Enables the user to pervieve events that occur outside the immediate field of view

Audio feedback (can be useful as a substitute for haptic feedback)

Voice input/output

Software

http://www.ia.hiof.no/~michaell/home/vr/vrhiof98/whatisvr/What16.html
Need modelling tools to create objects

AutoCAD, 3D Studio Max, MultiGen II, etc.
Designing objects is time-consuming
Objects often need to be optimised for VR use
In some cases (eg scientific visualisation) the objects might be generated by software -- need to provide equations and data to define objects

To define an interactive virtual environment:
Import objects (models)
Define behaviour of objects
Define motion and interaction model

Typical Run-time Components
Real-time visual/audio rendering engine
Input/Output handling process
Simulation process
World database (objects and scripts that define virtual environment)

Applications

Medical

Surgery

Practice performing surgery

Perform surgery on a remote patient

Rehabilitation

Phobia therapy

Use VR input devices and telepresence to enable handicapped people to do things that would otherwise be impossible for them to do

Enable handicapped people to visit/see places that they would be otherwise unable to experience

Use VR to teach new skills in a safe, controlled, environment

FUTURO