PHYSICS TERM PAPER

EVALUATION REPORT

TOPIC:-- LCD (LIQUID CRYSTAL DISPLAY)

TITLE:-- FEATURES OF LCD & CHALLENGING TECHNOLOGIES FOR LCD IN TODAY'S TIME

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EVALUATION REPORT

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2) WORKING OF LCD MONITOR AND TELEVISION
3) CLASSIFICATIONS OF LCD
4) USES OF LCD
5) AN EXPERIMENT FOR LCD TECHNOLOGY FEATURING DIFFERENCE BETWEEN LCD & DLP

WHAT I AM DOING:-
1) DIFFERENCE BETWEEN PLASMA AND LCD
2) HIGH PERFORMANCE LCD BLACKLIGHTING USING HIGH INTENSITY RED, GREEN & BLUE LED
3) APPLICATIONS OF LCD TECHNOLOGY

WHAT I WILL BE DOING:-
1) ADVANTAGES AND DISADVANTAGES OF LCD
2) CHALLENGING TECHNOLOGIES FOR LCD IN TODAY'S TIME (CRT & DLP)
3) HIGH TRANSMISSIVE ADVANCES TFT LCD TECHNOLOGY
4) CONCLUSION
LIQUID CRYSTAL DISPLAY

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SECTION-
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FIGURES
ABSTRACT

A liquid crystal display (LCD) is an electrooptical amplitude modulator realized as a thin, flat display device made up of any number of color or monochrome pixels arrayed in front of a light source or reflector.
There are 2 types of LCD that is PASSIVE MATRIX and ACTIVE MATRIX LCD. LC’s can be aligned by electric and magnetic fields. One electro optical affects with LCs requires a current through the LCs cell; all other practiced electro optical affects only require an electric field (without current) for the alignment of LC.

LCD television now uses liquid crystals captivated between two polarized glass sheets and a matrix of TFT (thin film transistor) transistors that control the electric flow through the crystals. The glass sheet contains thousands of tiny cells or pixels and each one is colored with green, blue, or red. The performance of LCD can be improved what is LCD(RGB) light emitting diodes instead of cold cathode fluorescent lamps in edge lit LCD backlights brightness and color performance (gamut) of LCD displays.

In present daily life some other technologies have entered this feild which have better features than LCD technology like DLP (Digital liquid processing) and CRT (cathode ray tube). Presently it is being challenged by PLASMA television. The main difference between LCD and DLP is being presented in the project. Texas Instruments experiment clearly describes the difference between LCD and DLP technology.

What is LCD........??????

A liquid crystal display (LCD) is an electro optical amplitude modulator realized as a thin, flat display device made up of any number of color or monochrome pixels arrayed in front of a light source or reflector.

It is often utilized in battery-powered electronic devices because it uses very small amounts of electric power.
Above picture represents us Reflective Twisted Nematic liquid crystal display.

The main features of this particular liquid crystal display are as follows:-

Glass substrate with ITO electrodes. The shapes of these electrodes will determine the shapes that will appear when the LCD is turned ON. Vertical ridges etched on the surface are smooth.

1. Twisted nematic liquid crystal.
2. Glass substrate with common electrode film (ITO) with horizontal ridges to line up with the horizontal filter.
3. Polarizing filter film with a horizontal axis to block/pass light.
4. Reflective surface to send light back to viewer.

An example of LCD:-

LCD monitor

Liquid Crystal display or LCD monitor is a thin and flat device for display. It is made by large number of color or monochromatic pixels which are arrayed in way of a light source or a reflector. It uses very small amount of electric power and hence is used often in battery powered electronic devices. The technology used is very much dissimilar to CRT technology which is used by many desktop monitors. It was used only on notebook computers for a very long time. Only recently they have been offered as an alternative to CRT monitors. They take up very less desk space and are much lighter than the CRT monitors. But they are also quite expensive.

Each pixel of LCD monitor display has a layer of aligned molecules between two electrodes which are transparent and two polarizing filters. Because there is no liquid crystal between the aligned polarizing filters, light which has passed through the first filter will be blocked by the second polarizer. The surface which is in contact with the crystal is treated to align it in particular direction. The direction of alignment is defined by direction of rubbing.

Resolution, in terms of horizontal and vertical size expressed in pixels, is native supported for the best display effects. This is
one of the things that sets LCD monitor apart. Dot Pitch is defined as the distance between two adjacent pixels. It is the minimum for sharper image. Each pixel is divided into three cells, or sub pixels. These are colored red, green and blue. Each sub pixel can be controlled independently for millions of combinations and hence colors. Older CRT monitors use phosphors for sub pixel structure. The analog electron beam though does not hit the exact sub pixel.

Color components can be arrayed in various geometries, depending on how the monitor is to be used. If the software being used knows the geometry, it can be used to increase the apparent number of pixels using sub pixel rendering. This kind of technique is often used in text anti-aliasing. LCDs which are used in digital watches and calculators have separate contact for each segment. Thus an external dedicated circuit charges each segment individually. This is not possible if the number of elements increases.

Small monochrome displays like the ones used in Personal Organizers or in older laptops have passive matrix like structure and employ super twisted nematic or double layer STN technology. Here, each row or each column has a single electrical circuit and the pixels are hence addressed according to rows and columns. But as the number of pixels increases, the response time decreases and the technique no longer remains feasible.

Color displays used in modern LCD monitors and televisions use active matrix structure. An array of thin film transistors (TFT) is added. Each pixel has a dedicated transistor. Active Matrix display looks brighter and sharper than passive matrix display of similar size and has better response time.

LCD technology has some critical drawbacks too. Resolution of a CRT monitor can be changed without introduction of any new artifact. But LCDs can produce only their native resolution and non native resolutions are achieved by scaling. The blacks of LCDs are actually grey because of presence of a light source. This results in lower contrast ratio when compared to CRTs. LCDs with cheaper parts cannot display as many colors plasma or CRT counterparts.

Also, LCD display has longer response time when compared to Plasma or CRT counterparts. Input lag is also present and the viewing angle is limited. In spite of these drawbacks, LCD display is quickly gaining prominence.

WORKING OF A LCD TELEVISION
HOW DOES A LCD TELEVISION WORK??

LCD television uses liquid crystals captivated between two polarized, glass sheets and a matrix of TFT (thin-film transistor) transistors that control the electric flow through the crystals. The glass sheet contains thousands of tiny cells or pixels and each one is coloured with green or blue or red.

There is a florescent bulb which sits right behind the glass pixels and illuminates these cells. Each pixel has a TFT transistor next to it that determines how much it should be electrically charged. Less the pixel is electrically charged, more light beams it allows and greater the intensity of respective colour on the LCD screen. Thus, the light beams are either blocked off or shown in different amounts so the combination of all pixels produce the image on the screen.

FEATURES OF LCD TELEVISION:-

Screen resolution

The native or screen resolution determines how much sharp the picture will look on the screen. CRT type TVs work well with standard definition and can show pictures of 330 lines resolution.

FIGURE 4 represents the LCD resolution

LCD TV is a bit thinner (less than 3" thickness) and also weighs much lesser than plasma TV so it can be hung on the wall.

Wide Aspect Ratio
LCD TV looks typically rectangular as its screen supports 16:9 aspect ratio, which is the standard screen format of high definition videos. However, home videos and standard TV broadcast still use 4:3 aspect ratio so all LCD TVs are designed to automatically fit 4:3 aspect ratio images to its screen so you see the picture filling the entire screen.

FIGURE 5 represents us a CRT Television with 4:3 Aspect Ratio on the other hand FIGURE 6 represents us a LCD Television with 16:9 Aspect ratio….

FIGURE 5 (A SUBPIXEL OF COLOUR LCD)

In color LCDs each individual pixel is divided into three cells, or sub pixels which are colored red, green, and blue, respectively, by additional filters (pigment filters, dye filters and metal oxide filters). Each sub pixel can be controlled independently to yield thousands or millions of possible colors for each pixel. CRT monitors employ a similar 'sub pixel' structures via phosphors, although the electron beam employed in CRTs do not hit exact 'sub pixels'.

Color components may be arrayed in various pixel geometries, depending on the monitor's usage. If the software knows which type of geometry is being used in a given LCD, this can be used to increase the apparent resolution of the monitor through sub pixel rendering. This technique is especially useful for text anti-aliasing.

To reduce smudging in a moving picture when pixels do not respond quickly enough to color changes, so-called pixel overdrive may be used.

DIFFERENCE BETWEEN PLASMA AND LCD TECHNOLOGY
Plasma and LCD panels may look similar, but the flat screen and thin profile is where the similarities end. Plasma screens, uses a matrix of tiny gas plasma cells charged by precise electrical voltages to create a picture. LCD screens (liquid crystal display) are in layman's terms sandwiches made up of liquid crystal pushed in the space between two glass plates. Images are created by varying the amount electrical charge applied to the crystals.

Both plasma and LCD sets produce excellent pictures, although many home entertainment specialists and gamers still say CRTs produce the best overall images.

The biggest advantage plasmas have had over their LC cousins is price. In the past 12 months, things have changed, with LCDs matching or even beating plasmas in both resolution and price. Plasmas being sold in Australia generally run between 42-inches and 63-inches wide, with the cheapest standard definition 42-inch selling for approximately AU$2,300 (although you can expect to find sets cheaper than AU$2,000 in real world prices). 60-inch and above plasmas can go for as much as $25,000.

LCDs, on the other hand, generally top out around the 52-inch mark -- though there is now a ludicrously expensive 70-inch sony available -- but are incredibly competitive with similar-sized plasmas.

ADVANTAGES OF LCD OVER PLASMA
Apart from being price competitive, LCD has the edge over plasma in several other key areas. LCDs tend to have higher native resolution than plasmas of similar size, which means more pixels on a screen.

There are no sources in the current document. LCDs also tend to consume less power than plasma screens, with some estimates ranging that power saving at up to 30 per cent less than plasma. LCDs are also generally lighter than similar sized plasmas, making it easier to move around or wall mount.

LCD pundits also point to the fact that LCDs have a longer lifespan than plasma screens. This was true of earlier plasma models, which would lose half of their brightness after more than 20,000 hours of viewing. Later plasma generations have bumped that up to anything between 30,000 and 60,000 hours. LCDs, on the other hand, are guaranteed for 60,000 hours.

You might have also heard that plasmas suffer from screen burn in, an affliction not as commonly associated with LCDs. Screen burn in occurs when an image is left too long on a screen, resulting in a ghost of that image burned in permanently. Newer plasmas are less susceptible to this thanks to improved technology and features such as screen savers, but burn-in is still a problem.

DO PLASMA HAS A GREATER MARKET VALUE OR LCD
Plasmas give you more bang for your buck at the big end of town, and while LCDs can give you better resolution, plasma still has the edge in terms of picture quality. One other thing to look for, whether you opt for
Texas Instruments' Test : DLP vs. LCD
Evan Powell, July 2, 2003

THIS EXPERIMENT GIVES US THE MAIN DIFFERENCE BETWEEN DLP AND LCD TECHNOLOGY

Texas Instruments had examined the reliability of the DLP and LCD technologies. The test results seemed to indicate that DLP-based projectors deliver stable picture quality over their expected usable life, whereas LCD projectors may be expected to degrade over time.

MAINFRAME OF THE EXPERIMENT

Texas Instruments commissioned a lab test to compare the relative stability and longevity of the DLP and LCD technologies. The test commenced in May, 2002. Two DLP projectors and five LCD projectors were run 24 hours a day, 7 days a week for five months, with breaks only to change lamps as needed. During this time each projector was periodically measured for lumen output, contrast, uniformity, and color chromaticity for white, red, green, and blue.

The test was sponsored by TI and the test itself was conducted at the Munsell color science Laboratory (MCSL)

Description of the Lab Test

The test was conducted at the facilities of the Munsell Color Science Laboratory in Rochester, NY. It was carried out in a dedicated 10 x 18 foot room. Eight projectors were operated essentially 24 hours per day, 7 days per week. These included the two DLP projectors and five LCD projectors already noted, plus an LCOS-based projector. The technical performance data pertaining to the LCOS machine was not included in the final report issued by TI since a sample of one is not sufficient to support any conclusions about the technology.

The two DLP and five LCD machines were portable-class machines. Six of the seven units (both DLPs and all but one of the LCDs) were XGA resolution. The fifth LCD unit was 16:9 format of unspecified resolution. The five LCD projectors consisted of three with 0.9" panels and two with 0.7" panels. The DLP units represented one each of 0.9" and 0.7" chips. Both DLP projectors were rated at 2000 ANSI lumens. The five LCDs had brightness ratings of 800, 1000, 1100, 2000, and 2000 ANSI lumens.

The eight units in the test were placed in fairly close proximity, from a minimum of 4 to 5 inches, to as much as a foot or more apart. They were placed on three shelves one above another, with several units on each shelf. They were arranged in a manner to prevent the hot exhaust of one unit feeding the intake vent of another. At the end of each...
shelf a fan was installed to blow air across all units on that shelf. The objective of these fans was to distribute cool air from the air conditioning vents as evenly as possible over all units.

The room was cooled by a central air conditioning unit operated by a wall-mounted thermostat located about 10 to 12 feet from the projectors. Average ambient temperature in the room during the test was 25 degrees C, or 77 degrees F. The actual temperature variance range around the average any given point in time was about ten degrees F, from just under 75 degrees to the mid-80's.

Temperatures rose and fell in this range with the cycling of the air conditioning system.

The projectors were run round the clock seven days a week, with downtime for the changing of lamps and filter cleaning/replacement as necessary. They were all fed the same computer data signal with rotating graphic images to prevent burn-in. Technical performance measurements were taken at days 0, 1, 2, and 4; weeks 1, 2, and 4; and months 2, 3, 4, and 5.

Results of the Texa’s Instrument test

At the end of about 4700 hours of operation, TI summarized the results as follows:

1. Full On/Off, and ANSI contrast degraded over time on all five LCD units, but remained relatively constant on the two DLPs.

2. The optical degradation seen in the LCDs washed the picture out and raised the dark levels.

3. Color chromaticity remained stable on the DLPs, but significant changes were seen in the LCDs. There was a visible yellowing of the image on all the units, and some later developed a "blue blemish" as well.

4. The pattern of degradation was the same on all five LCD products tested. The degradation occurred first in the blue channel. TI's theory is that the organic compounds in the polarizer and LCD panel were breaking down under exposure to high frequency blue and UV light. Eventually there are signs of breakdown in the red and green channels as well.

5. The first of the LCD projectors to fail was judged by TI personnel to have reached an unacceptable condition in 1368 hours of operation. Subsequent failure of the other four units occurred at 2160, 2352, 3456, and 3456 hours.

Based on these test results, TI suggests that a fundamental flaw exists in LCD technology that causes the picture quality it delivers to deteriorate well before the end of life of the projector itself might be expected. Because DLP technology is allegedly immune to degradation, it is purported to offer a lower cost-of-ownership since DLP projectors do not need to be replaced as often as LCD-based products.

Conclusion

Manufacturers recognize that the organic compounds in LCD panels and polarizers are susceptible to high heat and light energy stress, and will eventually break down if
deployed in high stress environments—in particular 24x7 operation with higher than normal ambient temperatures. Compact portable LCD projectors are in general not recommended for 24x7 duty cycles because of this.

On the other hand, DLP technology does not use organic compounds. Thus the elements which can be expected to degrade over time under high stress in an LCD projector do not exist in a DLP projector. Therefore when these two technologies are placed side-by-side in an unusually high stress environment as they were in this test, the DLP-based products should be more resistant to image shift over time. TI's test demonstrated this in no uncertain terms.

We agree with TI's assessment that high intensity blue and UV light in the blue channel contributes to accelerated breakdown of the organic compounds in that channel. However degradation due to high intensity light is not normally expected to occur at the rates documented in the test unless the components are subjected simultaneously to abnormally high heat stress. Therefore we suspect that 24x7 operation, higher than normal ambient temperatures, and the close proximity of the test units to one another may have combined to create abnormal conditions that led to a more rapid and severe degradation of the components than users would typically experience.

Thus the generalized inference that many observers have drawn from the test data, which is that LCD technology itself may be expected to routinely break down under normal usage before the expected lifespan of the projector, is difficult to sustain based upon the limited sample size and the abnormal conditions we believe may have existed in the lab.

The test at Munsell Color Science Lab clearly draws attention to the fact that LCD technology has a failure mode that does not exist with DLP, and that failure mode becomes readily apparent in an unusually high stress environment. What the test does not tell us is how much of a problem this really is in real life.

**HIGH TRANSMISSIVE ADVANCED TFT LCD TECHNOLOGY**

**Introduction**

Today transmissive TFT LCDs have been mainly used for digital camera and digital video camera displays. However, transmissive TFT LCDs need to secure at least 350 cd/m2 or greater screen brightness to achieve good visibility under bright sunlight. It leads to the increase of power consumption. On the other hand, transflective TFT LCDs are mainly used for cellular phones. In a transflective LCD, a part of the transmissive area is used as a reflective area, thus the transmissive area decreases. Consequently, the color filter that is 1.5 to 2 times as bright as those of transmissive LCDs have been adopted for achieving high brightness. Thus the color reproduction area that can be displayed is narrowed by transmittance of CFs increases. This is because that higher priority has been given to power consumption than display quality for cell phones.
Advanced TFT
Pixel Structure and Its Features

The division ratio of the transmissive area and the reflective area can be optionally set, and if the transmissive area is set bigger than the reflective area, display characteristics with priority given to transmissive mode are obtained, and if the reflective area is set greater than the transmissive area, display characteristics with priority given to reflective mode are obtained. This division ratio should be determined in accord with the products to which the display is mounted. For example, for clamshell-type cellular phones the priority is given to display quality rather than power consumption, and the latter can be applied to straight-type cellular phones to which priority is given to low power consumption. The transmissive area and the reflective area can be set by forming the transmissive electrode and the reflective electrode inside the pixel electrode on the TFT substrate. In the transmissive area, a transparent ITO electrode that allows light from the backlight to transmit is formed, while in the reflective area, a high-reflectivity aluminum electrode that reflects the ambient light entering from the observer side is formed. In addition, MRS (micro reflective structure) is adopted on the aluminum electrode surface. Therefore, it is possible to design the light so that it scatters within a range of specified angles, and high reflectance can be obtained by efficiently utilizing the ambient light.

On the other hand, the distance of the light that passes the liquid crystal layer of the reflective area and transmissive area can be made equal by making the liquid crystal of the transmissive area about two times thicker than the liquid crystal of the reflective area. When the liquid crystal thickness of the transmissive area is set equal to that of the reflective area and the reflectance is set to the maximum as, the transmittance is about 50% of the theoretical value. On the other hand, by making the path of the light that passes the liquid crystal layers of the reflective area and the transmissive area equal, the transmittance and reflectance can be achieved the maximum value respectively. In order to form different thickness of liquid crystal between the reflective area and the transmissive area, it makes a bump formed by arranging an insulation layer in only the reflective area on TFT substrate (multi-gap structure on TFT substrate). However, with this structure, the edge of the insulation layer that corresponds to the boundary section between the transmissive area and the reflective area does not contribute to either transmittance or reflectance.

Figure 7 and Figure 8

(Display image of High-Transmissive Advanced TFT LCD Technology)
Cathode ray tube (CRT) display and liquid crystal display (LCD) were compared for their suitability in visual tasks. For this purpose visual performance was assessed by means of a search task carried out using both displays with different levels of ambient light. In addition, suitability was rated subjectively by users of visual display units (VDUs). Error frequency for search tasks carried out using LCD were significantly smaller when compared to error frequency for tasks at CRT. LCD gave rise to 34% less errors than did CRT. Reaction time in search task was found to be significantly shorter using LCD when tasks were carried out in darkness. Subjective rated suitability of LCD was scored twice as high as suitability of CRT. Results indicate that LCD used in this experiment may give better viewing conditions in comparison to CRT display.

DLP VS LCD TECHNOLOGY

The Technical Differences between LCD and DLP

LCD (liquid crystal display) projectors usually contain three separate LCD glass panels, one each for red, green, and blue components of the image signal being fed into the projector. As light passes through the LCD panels, individual pixels ("picture elements") can be opened to allow light to pass or closed to block the light, as if each little pixel were fitted with a Venetian blind. This activity modulates the light and produces the image that is projected onto the screen.

DLP ("Digital Light Processing") is a proprietary technology developed by Texas Instruments. It works quite differently than LCD. Instead of having glass panels through which light is passed, the DLP chip is a reflective surface made up of thousands of tiny mirrors. Each mirror represents a single pixel.
In a DLP projector, light from the projector's lamp is directed onto the surface of the DLP chip. The mirrors wobble back and forth, directing light either into the lens path to turn the pixel on, or away from the lens path to turn it off.

In very expensive DLP projectors, there are three separate DLP chips, one each for the red, green, and blue channels. However, in DLP projectors under $20,000, there is only one chip. In order to define color, there is a color wheel that consists of red, green, blue, and sometimes white (clear) filters. This wheel spins between the lamp and the DLP chip and alternates the color of the light hitting the chip from red to green to blue. The mirrors tilt away from or into the lens path based upon how much of each color is required for each pixel at any given moment in time. This activity modulates the light and produces the image that is projected onto the screen.

The Advantages of LCD Technology

One benefit of LCD is that it has historically delivered better color saturation than you get from a DLP projector. That's primarily because in most single-chip DLP projectors, a clear (white) panel is included in the color wheel along with red, green, and blue in order to boost brightest, or total lumen output. Though the image is brighter than it would otherwise be, this tends to reduce color saturation, making the DLP picture appear not quite as rich and vibrant. However, some of the DLP-based home theater products now have six-segment color wheels that eliminate the white component. This contributes to a richer display of color. And even some of the newer high contrast DLP units that have a white segment in the wheel are producing better color saturation than they used to. Overall however, the best LCD projectors still have a noteworthy performance advantage in this area.

LCD also delivers a somewhat sharper image than DLP at any given resolution. The difference here is more relevant for detailed financial spreadsheet presentations than it is for video. This is not to say that DLP is fuzzy--it isn't. When you look at a spreadsheet projected by a DLP projector it looks clear enough. It's just that when a DLP unit is placed side-by-side with an LCD of the same resolution, the LCD typically looks sharper in comparison.

A third benefit of LCD is that it is more light-efficient. LCD projectors usually produce significantly higher ANSI lumen outputs than do DLPs with the same wattage lamp. In the past year, DLP machines have gotten brighter and smaller--and there are now DLP projectors rated at 2500 ANSI lumens, which is a comparatively recent development. Still, LCD competes extremely well when high light output is required. All of the portable light cannons under 20 lbs putting out 3500 to 5000 ANSI lumens are LCD projectors.

The Disadvantages of LCD Technology

LCD projectors have historically had two weaknesses, both of which are more relevant to video than they are to data applications. The first is visible pixelation, or what is commonly referred to as the "screendoor effect" because it looks like you are viewing the image through a screendoor. The second weakness is not-so-impressive black levels and contrast, which are vitally important elements in a good video image. LCD technology has traditionally had a hard time being taken seriously among some home theater enthusiasts (understandably) because of these flaws in the image.
While an XGA projector uses about 589,000 pixels to create a 16:9 image, a WXGA projector uses over one million. At this pixel density, the sreenoord effect is eliminated at normal viewing distances.

Second, the inter-pixel gaps on all LCD machines, no matter what resolution, are reduced compared to what they used to be. So even today's inexpensive SVGA-resolution LCD projectors have less sreenoord effect than older models did. The third development in LCDs was the use of Micro-Lens Array (MLA) to boost the efficiency of light transmission through XGA-resolution LCD panels. Some XGA-class LCD projectors have this feature, but most do not. For those that do, MLA has the happy side effect of reducing pixel visibility a little bit as compared to an XGA LCD projector without MLA. On some projectors with this feature, the pixel grid can also be softened by placing the focus just a slight hair off perfect, a practice recommended for the display of quality video. This makes the pixels slightly indistinct without any noticeable compromise in video image sharpness.

Now when it comes to contrast, LCD still lags behind DLP by a considerable margin. But recent major improvements in LCD's ability to render higher contrast has kept LCD machines in the running among home theater enthusiasts. All of the LCD projectors just mentioned have contrast ratios of at least 800:1. They produce much more snap, better black levels, and better shadow detail than the LCD projectors of years past were able to deliver.

The Advantages of DLP Technology

There are several unique benefits that are derived from DLP technology. One of the most obvious is small package size, a feature most relevant in the mobile presentation market. Since the DLP light engine consists of a single chip rather than three LCD panels, DLP projectors tend to be more compact. All of the current 3-pound miniprojectors on the market are DLPs. Most LCD projectors are five pounds and up.

Another DLP advantage is that it can produce higher contrast video with deeper black levels than you normally get on an LCD projector. DLP has ardent followers in the home theater world primarily due to this key advantage.

While both technologies have seen improvements in contrast in the past two years, DLP projectors still have a commanding lead over LCDs in this regard. Leading-edge LCD projectors like the Sony VPL-VW12HT is rated at 1000:1 contrast, and Sanyo's PLV-70 is rated at 900:1. Meanwhile, the latest DLP products geared toward home theater are rated as high as 3000:1. Less than two years ago the highest contrast ratings we had from DLP were in the range of 1200:1.

This boost in contrast is derived from Texas Instrument's newer DLP chip designs, which increase the tilt of the mirrors from 10 degrees to 12 degrees, and features a black substrate under the mirrors. These changes produced a significant advance in contrast performance that simply did not exist before.

A third competitive advantage of DLP over LCD is reduced pixelation. These days it is most relevant in the low priced, low resolution SVGA class of products. In SVGA resolution, DLP projectors have a muted pixel structure when viewed from a typical viewing distance. Conversely, most SVGA-resolution LCD projectors tend to
have a more visible pixel grid. This is entirely irrelevant if you are using the projector for PowerPoint slide presentations. However, it is more problematic for a smooth video presentation. For this reason, we don't normally recommend SVGA-resolution LCD projectors for home theater. Conversely, the revolutionary is a DLP-based SVGA resolution projector. It is selling now for under $1,000 and is an incredible deal for the home theater enthusiast on a limited budget.

In XGA and higher resolution, DLP technology pretty much eliminates pixel visibility from a normal viewing distance. However, the latest WXGA resolution LCDs do so as well. So with higher resolutions, differences in pixelation are not the big competitive battleground they used to be. DLP continues to hold a small competitive edge, but the dramatic advantage of DLP over LCD no longer exists. The screendoor effect is receding into history as a problem of days gone by.

A Potential Problem with DLP: The Rainbow Effect

If there is one single issue that people point to as a weakness in DLP, it is that the use of a spinning color wheel to modulate the image has the potential to produce a unique visible artifact on the screen that folks refer to as the "rainbow effect," which is simply colors separating out in distinct red, green, and blue. Basically, at any given instant in time, the image on the screen is either red, or green, or blue, and the technology relies upon your eyes not being able to detect the rapid changes from one to the other. Unfortunately some people can. Not only can some folks see the colors break out, but the rapid sequencing of color is thought to be the culprit in reported cases of eye strain and headaches. Since LCD projectors always deliver a constant red, green, and blue image simultaneously, viewers of LCD projectors do not report these problems.

How big of a deal is this? Well, it is different for different people. For some who can see the rainbow effect, it is so distracting that it renders the picture literally unwatchable. Others report being able to see the rainbow artifacts on occasion, but find that they are not particularly annoying and do not inhibit the enjoyment of the viewing experience. Fortunately, the majority of the population either cannot detect the rainbow artifacts, or if they can they are not overly bothered by them. The fact is if everyone could see rainbows on DLP projectors the technology never would have survived to begin with, much less been embraced by so many as a great technology for home theater video systems. Nevertheless, it can be a serious problem for some viewers.

Texas Instruments and the vendors who build projectors using DLP technology have made strides in addressing this problem. The first generation DLP projectors incorporated a color wheel that rotated sixty times per second, which can be designated as 60Hz, or 3600 RPM. So with one red, green, and blue panel in the wheel, updates on each color happened 60 times per second. This baseline 60Hz rotation speed in the first generation products is also known as a "1x" rotation speed.

Upon release of the first generation machines, it became apparent that quite a few people were seeing rainbow artifacts. So in the second generation DLP products the color wheel rotation speed was doubled to 2x, or 120Hz, or 7200 RPM. The doubling of the refresh rate reduced the margin of error, and so reduced or eliminated the visibility of rainbows for many people.
Today, many DLP projectors being built for the home theater market incorporate a six-segment color wheel which has two sequences of red, green, and blue. This wheel still spins at 120Hz or 7200 RPM, but because the red, green, and blue is refreshed twice in every rotation rather than once, the industry refers to this as a 4x rotation speed. This further doubling of the refresh rate has again reduced the number of people who can detect them. Nevertheless it remains a problem for a number of viewers even today.

CONCLUSION

From the above detailed explanation about LCD technology I have concluded that LCD is a growing technology. LCD technology will be used in many fields like High Performance LCD Blacklighting using high intensity Red, Green and Blue light emitting Diodes.

In future LCD technology will be overcomed by latest DLP technology which is invented by TEXAS INSTRUMENT. As DLP have small package size. DLP consists of one single chip than 3 in LCD Panels. DLP panels are more compact than LCD.

DLP can produce higher contrast video with deeper blacklevels than we get in LCD projectors.

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