General Explanation
of Special Issue

NEC Group's Activities on Video Display Technologies

A consequence of the evolution of information technology is the diversified forms that information assumes. In this context, video display devices play the role of output equipment in a wide range of applications. The NEC Group is developing several types of video display devices for different application scenarios, ranging from portable, compact sizes to large-size applications such as movie theater screens. In this special issue, in addition to the most important product technology trends, we will introduce the latest trends on device technologies such as LCD and backlight.

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1 Development Trends on Video Display Technologies

Keeping pace with the evolution of information technology, the growing speed of communication infrastructures and the progress of digital image technologies, video display equipment have gained importance as the core of human-machine interfaces. Display devices for video display equipment are transitioning from the CRT (Cathode Ray Tube) to flat-panel displays such as LCD (Liquid Crystal Display) and PDP (Plasma Display Panel), and at the same time the progress achieved on display devices and image processing technologies facilitates the use of higher resolution and larger screens. In general, direct sight displays are the most commonly used video display devices for screen sizes up to 60 inches, and projection-type projectors are used for larger screen sizes. We will introduce the latest development trends in each of these fields.

Main display devices for direct-view displays include PDP, LCD, LED (Light-Emitting Diode), OLED (Organic Light-Emitting Diode, or Organic EL), electronic paper and others, and their applications are expanding into several display equipment, where the advantages of their specific characteristics are used. The field of display equipment employing LCD is the one experiencing the most impressive growth in the market, with a wide range of applications from small to large screen sizes. Regarding the trend towards larger screen sizes, models exceeding 100 inches have been put into practical operation, keeping pace with the larger resolutions currently available such as the “full-HD”. In terms of core technologies, it is needless to mention the importance of achieving low power consumption. Aside that, other activities include achieving higher levels of quality for moving pictures using 120Hz-drive or sequential (intermittent) backlight illumination, and also enhancing the color reproduction bandwidth by using color spaces that exceed 100% NTSC.

In the field of monitors for personal computers, recent trends indicate an accelerated transition to the wide format (aspect ratio 16:10), in addition to resolution enhancements. The widespread use of LCD is also reaching the field of industrial appliances. In the medical field, high-resolution and high-performance black & white and color LCD’s are finding applications in video display devices for MRI and CT, and also as a substitute for films in X-ray images. In this area, images are used in medical diagnosis, requiring higher levels of fineness and resolution compared to conventional personal computer monitors. Moreover, high-performance, color LCD’s are finding new uses in other applications such as electronic medical charts and PACS (Picture Archiving and Communication System). In the field of mobile terminals for business use, technology requirements are

for low power consumption, slimness, improved outdoor connectivity, and enhanced capability for moving picture reproduction. In addition, special requirements such as enhanced operation temperature ranges and longer life cycles exist.

Major display devices for use in projectors are the DMD* (Digital Micromirror Device) and the HTPS (High Temperature Poly-Silicon) LCD, among others, and both are known as microdisplay devices because they form minute picture elements on panels less than 1-inch wide, determining the resolution. The DMD is a device that produces images with light reflected from microscopic mirrors placed on silicon, which are deflected on a pixel-by-pixel basis. The reflection-based system makes it possible to achieve high performance in terms of contrast. Moreover, the fast response of the microscopic mirrors enables separate control of RGB on a single chip, facilitating miniaturization. An optical engine is under development targeted on mobile phone applications. The HTPS LCD, on the other hand, is based on active matrix driving, and produces images through light transmission. Among the most recent advances is downsizing to less than 0.5 inches and better aperture ratios, in addition to the development of devices with better cost-performance ratios due to the longer durability enabled by the use of inorganic materials in oriented films. Projector products usually try to make the best use of the specific device employed. In any case, however, performance is dictated by the output efficiency of the light emitted by the high-pressure mercury lamp (in terms of power consumption of the equipment, as well as the life time, size, weight, and noise characteristics of the cooling system, crystal and deflecting plate). For that reason, efforts are being spent on improving the light utilization efficiency of the optical engine. In addition, technology is advancing in the field of image processing for reducing the contrast loss caused by external light in products that are based on screen projection. Other technologies worth mentioning targeted on improving installation convenience are auto-focus, automatic trapezoidal compensation, and the ability to perform automatic adjustment of color and brightness uniformity across neighboring equipment through network connection (see **Fig**.).

2 Development Trends and Products in NEC Group

In the field of display panels, we are developing and manufacturing LCD products for industrial equipment based on the SFT (Super Fine TFT) technology, which achieves a broad visual field and high-quality images. The SFT technology makes it possible to minimize color and brightness fluctuation errors in intermediate gradations, resulting in color or monochrome LCD products with high resolution and high contrast, suitable for medical applications. In the area of professional mobile terminals, we have achieved low power consumption and high outdoors connectivity performance with the NLT (Natural Light TFT) technology. Other technologies under development are the SR-NLT that combines the features of the "transmissive"

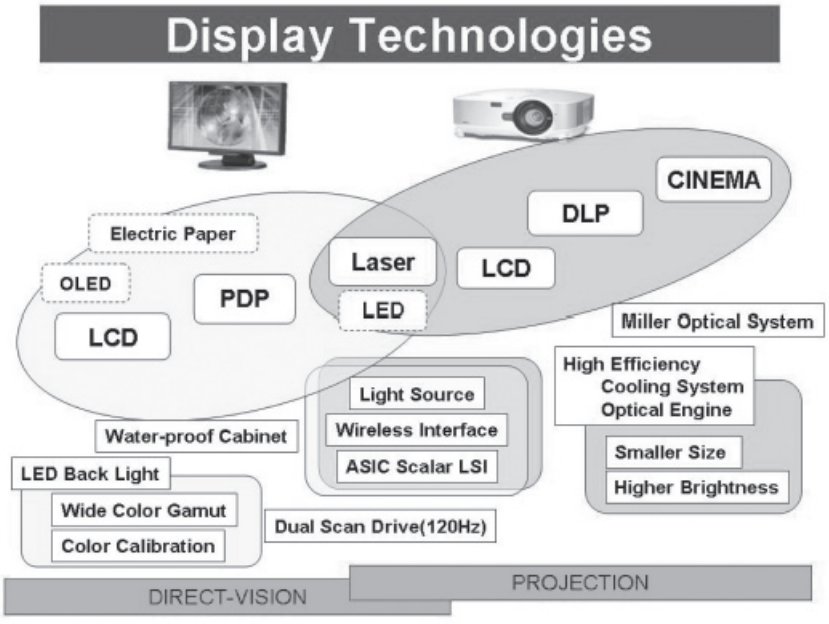

Fig. Development trends of video display technologies.

and "reflective" modes, which respectively use backlight or environment light as the light source, and also the semi-transmissive SFT, whose characteristics during the "transmissive mode" are comparable to those of SFT panels in terms of broadness of viewing angle range and image quality. On the other hand, the development of LED back light technology results in enhanced operation temperature range of the LCD, longer life times, lower power consumption, and the development of environment-friendly mercury-free LCD's.

In terms of products, LCD monitors range from 15 to 57 inches and are broadly classified into general-purpose IT monitors, professional monitors, and large-size monitors for digital signage.

The advent of Windows Vista is fostering the transition to the wide format in general-purpose IT monitors, and we strengthened development activities on that front. We now have a full line-up of wide formats from 15 to 24 inches to meet all kinds of needs. In the area of monitors for professional use, SFT and other technologies to obtain the maximum performance and quality from the LCD are being developed such as uniformity, gamma, and color correction, with applications in medicine and high-end graphics (**Photo 1**). Moreover, we became worldwide pioneers in building professional high color range monitors suitable for photograph and printing correction by the combination of high-quality LED backlight LCD and SFT, as well as ultra-precise calibration technologies. For now on, it is our target to continue developing true professional monitors with a full line-up from 19 to 30-inch wide formats, creating high performance, high resolution and large-size monitors employing LED backlight technology. For digital signage, the most important sizes are currently 32, 40, 46, and 57 inches. However, it is our plan to include the size of 65 inches and keep pace with the trend towards larger screen sizes. In terms of performance, our priorities are to ensure visibility in bright environments and also high quality and long-term reliability for airport applications and others. In addition, we became worldwide pioneers in commercializing an LCD with the slimmest bezel width of its class, or 15.5mm (slim bezel), achieving considerable visibility improvement in situations where multiple units are displayed at the same time.

For the projector market, we develop products to meet diverse needs ranging from small, pocket-size projectors up to extremely large products such as digital cinema equipment and the like. Both LCD and DMD are used in our line-up as display devices, taking the most advantage of either one. One of our unique products is an ultra-short focal point projector (**Photo 2**) where we replaced all reflective lenses by spherical mirrors, capable of projecting images on up to 100-inch large-size screens with a short projection path of just 65cm. Another example is a digital cinema projector that can project images on large-size screens up to 25-m wide.

In this special issue, we show new cooling systems that make it possible to build more compact projectors, and image processing technologies that improve the apparent contrast of images. As mentioned before, technological advances in the area of projectors aim basically at achieving high levels of brightness and lower levels of noise with smaller sizes. For that purpose, NEC has developed a cooling system that uses a compact air pump. The most important cooling points of a projector are lamps and display devices. Our system provides efficient cooling of such points, enabling us to achieve 3000lm with just 1.6-kg weight and a noise level of 30dB. And in addition to basic functions, we also develop products that provide convenient functionalities such as supporting the network projector function of Windows Vista.

Photo 1 Monitors for medical use.

Photo 2 Short focal point mirror projector.

3 Future Video Display Technologies

It is expected that video display technologies will broaden the existing array of component technologies and advance towards two different fronts. On one hand is the spread of image display devices, and on the other is the spread of their applications and the development of optimal application technologies.

As for display devices, it is expected that devices such as organic EL will gain momentum in the compact display arena, while laser light sources will find widespread use for very large or large-size screens. These new devices will enable further advances in terms of slimness, compactness, and color reproduction capacity by image equipment, contributing for the creation of new market opportunities in several fields. In other words, we expect that as a consequence of the ubiquitous presence of display devices, and the different applications in such areas as public displays, monitoring, control, general-purpose halls and the like, it will become necessary to provide devices optimized for each situation.

With the expanding applications of image equipment, we will see the technologies for processing and using image data such as production, edition, processing, transmission and security gain increasing importance.

For now on, we at NEC Group will continue developing technologies comprising the processing and utilization of images, considering them as part of the broader realm of digital image communications.

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*Windows Vista is either a registered trademark or trademark of Microsoft Corporation in the United States and/or other countries.

*DMD is a trademark of Texas Instruments, Inc.