MULTILAYER VIDEO SCREEN

TECHNICAL FIELD

[0001] This invention relates to methods of providing improved quality video display system.

BACKGROUND ART

[0002] A method of creating the appearance of depth in video displays is to use a multilayer display system typically comprising at least two parallel coaxial video screens separated by between 10 and 100 millimetres in depth. The rear screen can be larger than the front screen and the screens are preferably separated by a slab of clear material of refractive index substantially greater than 1 which both supports the two screens and helps avoid the effect of looking through a window in that the edges of the view between the screens are made to largely disappear. The front screen is transparent except where its pixels are activated to create a display so that it is possible to see behind much of the front screen to the background shown on the rear screen. Backlighting for the front screen is provided by illumination from the rear screen or more commonly a common backlight is used for both screens, being placed behind the rear screen which for this case is also transparent except where pixels are activated. The front screen can also be formed from transparent electro-luminescent technology where pixels and sub-pixels produce their own light. With the backlit system it is found that there is sufficient diffusion of light from the back screen even when activated to allow normal colour vision on the front screen as well.

[0003] Multi-layered display (MLD) units provide a significant improvement over existing single layer display (SLD) units or displays. MLD units may be used to nest display content over spacially displaced or stacked layers to provide an enhanced mechanism for information absorption and analysis by users. An example of an existing multi-layer display is discussed for example in WO9942889 A.

[0004] Reference throughout this specification will also be made to the present invention being used in conjunction with multi-layer displays of the type disclosed in WO9942889A. However, those skilled in the art should appreciate that the present invention may also be adapted for use with other types of MLD units and reference to the above only throughout this specification should in no way be seen as limiting.

[0005] It is known from studies of human vision that the human eye is more sensitive to intensity than colour in interpreting detail in images. Furthermore, of the primary colours red green and blue, the eye is least sensitive to blue. The relative sensitivity of the eye to red is 0.51 compared to green and to blue is 0.19. Accordingly a video image in which the blue sub-pixels are up to 5 times the area of the green sub-pixels shows no obvious visual loss of resolution compared to an image in which the blue sub-pixels are the same size as the green sub-pixels. Therefore it is possible to reduce the cost of a video pixel system by using a smaller number of larger blue sub-pixels without losing resolution.

[0006] A pixel is defined as the smallest resolvable area of an image on a display device. Each pixel in a monochrome image has its own brightness, from 0 for black to the maximum value (e.g. 255 for an eight-bit pixel) for white. In a colour image, each pixel has its own brightness and colour, usually represented as a triple of red, green and blue intensities. To turn on a pixel, the integrated circuit sends a charge down the correct column of one substrate and a ground activated on the correct row of the other. The row and column intersect at the designated pixel and that delivers the voltage to untwist the liquid crystals at that pixel. A sub-pixel is the colour filter and its components.

[0007] Liquid Crystal Displays depend on thin film transistors (TFT). Thin film transistors are tiny switching transistors and capacitors. They are arranged in a matrix on a glass substrate and often referred to as the black matrix. To address a particular pixel, the proper row is switched on, and then a charge is sent down the correct column. Since all of the other rows that the column intersects are turned off, only the capacitor at the designated pixel receives a charge. The capacitor is able to hold the charge until the next refresh cycle. And if the amount of voltage supplied to the crystal is carefully controlled, it can be made to untwist only enough to allow some light through. By doing this in very exact, very small increments, Liquid Crystal Displays can create a grey scale. Most displays today offer 256 levels of brightness per pixel.

[0008] The basic form of the multilayer display as described above suffers from certain problems. When similar liquid crystal display screens are used for both the front and rear screens the display suffers from a Moiré fringe pattern which makes it unusable. Moiré interference is usually described as "an independent usually shimmering pattern seen when two geometrically regular patterns (such as two sets of parallel lines or two liquid crystal display screens) are superimposed especially at an acute angle". The independent pattern seen is the result of the interference between the two or more regular patterns. This can be circumvented as disclosed in patent WO9942889A such as by placing at least one light diffusing layer immediately in between display layers. However one effect of the diffusion screen is to reduce the sharpness of the rear screen to viewers. Another undesirable effect is to reduce the contrast of the rear screen to viewers.

[0009] A further problem with the system is that it is difficult to get sufficient brightness from the backlighting for the display. By improving the transparency of one or more of the pixel patterns the brightness of the image seen in the display can be improved.

[0010] The contrast sensitivity of the human visual system is the capability of the latter to detect the difference in brightness between neighboring regions in a scene. A high sensitivity means the ability to distinguish small differences in brightness. Human visual contrast sensitivity is largely dependent upon the sizes of the neighboring regions in question. That is, the sensitivity is a function of spatial frequency. Many psychophysical experiments have been conducted to determine how the human visual contrast sensitivity varies with spatial frequency. Most often used as test scenes are bar patterns or gratings with different spatial frequencies and contrast. For each frequency, gratings of different contrast are shown to human subjects to determine the lowest contrast discernible. It turns out that the human visual contrast sensitivity also varies with the orientation of the grating; it achieves the highest value when a grating is horizontally or vertically oriented and achieves the lowest value when a grating is oriented at 45 degrees from hori-