DISCLOSURE OF INVENTION

[0030] According to one aspect of the present invention there is provided

[0031] a method of displaying an image of variable perceived depth using a display including:

[0032] one or more at least partially transparent, substantially parallel imaging screens located in front of, and overlapping with, a rear imaging screen,

[0033] characterised in that a physical image is formed on two or more imaging screens, each image being of substantially identical configuration and being sized and aligned such that like portions of each image are coterminous to a viewer observing the display,

[0034] wherein at least two of said coterminous images are displayed with different luminance.

[0035] According to a further aspect of the present invention, there is provided a display capable of operating in accordance with the above-described method.

[0036] As used herein, an image includes any definable portion of the screen ranging in size from the smallest discrete addressable element (e.g. a pixel) to an image substantially filling the imaging screen area.

[0037] Varying the luminance of the displayed images according to the present invention enables images to be displayed which are perceived by the viewer as being located at some point intermediate, or in front or behind the imaging screens.

[0038] As the imaging planes of the screens may be formed in relatively close proximity to each other, a far more compact display may be produced than is possible with conventional twin displays combined with a half-silvered mirror. This is primarily due to utilisation a common optical axis for a viewer observing all the image planes in contrast to distinct optical paths taken by light incident on the half-silvered mirror from each display in combination displays.

[0039] Preferably, the alignment and magnification of the two-layer image are perceived as coterminous when viewed along an observer's fixation axis, i.e., a line from the viewed image extending equidistantly to the fovea of each retina to the mid-point between the viewer's eyes.

[0040] Preferably the relative luminance of the imaging screen area adjacent the said images between at least two separate image planes may be varied.

[0041] Preferably, the imaging screen areas adjacent the said images on at least two separate image planes are displayed with different luminance.

[0042] Preferably, the image and imaging screen area adjacent the said image are displayed with different luminance.

[0043] It has been found that varying the luminance of an image displayed on both image planes of a dual-layer display (for example) in the above described manner will enable an observer to perceive an apparent image located between the two display screens.

[0044] It has been further realised that the perceived image generated may be caused to protrude outside the front or rear of the display. This is achieved when the two images are displayed with opposite signs of luminance difference between the image and its surroundings.

[0045] There are four possible combinations and permutations of luminance variation between an image and the adjacent area of the imaging screen on two separate screens of a multi-layer display.

[0046] Nevertheless, each variation has the common property that the front and rear displays have opposite signs of luminance between the image and its surroundings:—a front image luminance brighter than its surroundings would have a rear image with a darker luminance to the surrounding area of the rear screen and vice-versa.

[0047] Preferably, the said images appear coterminous to an observer viewing along a along a sight-line extending from a mid point between the observers eyes to the images.

[0048] A potential disadvantage of displays comprised of mechanically stacked image planes as described above is that a proportion of the illuminating light, whether emitted from the rear screen or incident light reflected one or more of the display screens, is absorbed during successive transmissions through the transparent screen layers. As the display layers located in front of the emissive or reflective rear screen are transparent with passive display images or elements (i.e. non-light generating), it is not possible to obtain a brighter image, or image surroundings on a front screen than on a rear screen without the introduction of some form of additional illumination between screen layers.

[0049] Combined displays using a half-silvered mirror configuration as previously described circumvent this difficulty as neither display is transparent in itself and may therefore be formed with an emissive backlight source whose luminance may be individually varied as required.

[0050] However, this disadvantage may be overcome according to a further aspect of the present invention by the inclusion of an at least partially transparent emissive layer between said image planes. In one embodiment, said emissive layer is a light guide.

[0051] According to one aspect of the present invention, said emissive layer is a sheet with substantially planar opposed upper and a lower surfaces and a peripheral boundary of a prescribed thickness, said sheet formed from a material such that light rays incident from said peripheral boundary are retained between the said planar surface through total internal refraction at angles less than a critical angle.

[0052] Preferably, at least one said sheet planar surface has a plurality of defined features located thereupon capable of refracting a said retained light ray incident on a said feature through an angle greater than the said critical angle of total internal reflection sufficient to exit said sheet via one of said planar surfaces.

[0053] In order to be capable of displaying the four permutations of luminance variation possible between an image and its adjacent screen area displayed on two overlapping screens, it follows that the front-most screen must be capable of independently displaying images with greater luminance than the rearward screen.

[0054] Thus, for embodiments utilizing a light guide as the emissive layer, the said features are only applied to the surface facing the front screen.