

tions. In some such embodiments, it may be desirable to provide a “sparse refresh” mode in which only the “delta” is transmitted from frame to frame. It may further be desirable to provide a “no updates until further notice” mode, which instructs the panel display to continue displaying the same data over and over. This is especially useful when the display panel is a flat-panel display of the type in which each pixel has its own memory cell of a type not requiring an outside data value in order to perform a refresh cycle. Details of sparse refresh can be configuration parameters.

[0052] Especially desirable in battery-powered operations is a reduced power mode in which the display panel can reduce its power consumption when the battery reaches a low charging threshold, such as a predetermined charge level. One such power reduction mode is to turn off a backlight of a reflective panel display. Another is to reduce the brightness of the display. Another is to invert the display of a black-on-white image (such as in a word processing application) to a less power consuming white-on-black image. Those techniques are known, although not as configuration parameters for a panel controller. Another, believed to be new to this disclosure, is to turn off one or more of the colors of a display, upon a low power condition. In an RGB display, most of the significant perceptual content is generally in the green image data. Upon reaching a low battery condition, a system using the teachings of this disclosure could reconfigure its panel controller to omit red and blue (perhaps together, perhaps in series) from the display. This would not only reduce the power consumed directly by the display in generating the red and blue photons, but would also reduce the power consumed by the panel controller (which could power down those respective circuits) and also the power lost driving the link to the panel.

[0053] In some applications, such as those in which the display panel pixels have a relatively long persistence, it may be suitable to, in this low power configuration, switch back and forth between subsets of the available colors. For example, only the green data might be sent and displayed for a time, then the red data and/or blue data might be sent and displayed for a time. By having each color “off” for much of the time, the overall power consumption may be reduced, while, by switching back and forth between the colors, a suitable color image may still be displayed, especially where the pixels exhibit long persistence. In some embodiments, it may be sufficient to switch between colors e.g. ten times per second.

[0054] In some display panels, there is a “charge gathering” effect, in which, over time, the display element cells could gradually accumulate charge, which can alter the actual color output versus the color data that are specified. This charge can periodically be bled off, known as “auto-zeroing” the pixel.

[0055] Table 3 illustrates one embodiment of encoding the COLOR#[2:0] signals, to accomplish this:

TABLE 13

COLOR#[2:0]	
000	draw red pixel
001	draw green pixel
010	draw blue pixel
011	reserved

TABLE 13-continued

COLOR#[2:0]	
100	auto-zero red pixel
101	auto-zero green pixel
110	auto-zero blue pixel
111	reserved

[0056] FIG. 7 illustrates one exemplary embodiment of the panel controller 68 which receives graphics input (from the graphics controller, not shown) and provides pixel data output (to the display panel, not shown). The graphics input data are processed by a pixel engine and sent through the interface logic onto the output bus. A configuration cycle machine, such as a state machine or other suitable mechanism, is coupled to the interface logic to detect and handle parameters received from the other display panel. Parameter storage, such as registers, may be used to store the received parameters. An output configurator retrieves the parameter data from the parameter storage, and uses them to configure the pixel engine. In embodiments in which the display panel provides indirect parameters (e.g. “resolution three”) rather than actual parameter values (“resolution 640×480”), the output configurator includes e.g. a lookup table (LUT) that contains the actual parameter values.

[0057] FIG. 8 illustrates a device 94 in which the graphics engine and the configurable panel controller are in one assembly 96, while the display panel is in another, separate assembly 98. In some embodiments, these assemblies may comprise separate monolithic building blocks. In others, they may comprise separate sub-assemblies each made of multiple components. For example, the graphics engine and the panel controller may be separate chips affixed to a printed circuit board, while the display panel is coupled to a separate circuit board. Or, the graphics engine and configurable panel controller may be fabricated together on a monolithic chip, and that single chip and the display panel may be affixed to the same printed circuit board. Or, the physical connection between the graphics engine and the configurable panel controller may simply be of a shorter physical length than the link between the configurable panel controller and the display panel.

[0058] The reader should appreciate that drawings showing methods, and the written descriptions thereof, should also be understood to illustrate machine-accessible media having recorded, encoded, or otherwise embodied therein instructions, functions, routines, control codes, firmware, software, or the like, which, when accessed, read, executed, loaded into, or otherwise utilized by a machine, will cause the machine to perform the illustrated methods. Such media may include, by way of illustration only and not limitation: magnetic, optical, magneto-optical, or other storage mechanisms, fixed or removable discs, drives, tapes, semiconductor memories, organic memories, CD-ROM, CD-R, CD-RW, DVD-ROM, DVD-R, DVD-RW, Zip, floppy, cassette, reel-to-reel, or the like. They may alternatively include down-the-wire, broadcast, or other delivery mechanisms such as Internet, local area network, wide area network, wireless, cellular, cable, laser, satellite, microwave, or other suitable carrier means, over which the instructions etc. may be delivered in the form of packets, serial data, parallel data, or other suitable format. The machine may include, by way of