ELECTRONIC DISPLAY APPARATUS AND METHOD

Field of Invention

The present invention relates to a display apparatus. More particularly, the present invention relates to an electronic display apparatus and method.

Background of the invention

Electronic paper, also referred to as electronic ink, e-ink, are display devices that mimic the appearance of ordinary ink on paper. Electronic displays reflect light like paper, thereby providing a wider viewing angle than most light-emitting displays. Application of electronic displays may be in electronic shelf labels in supermarkets, warehouse asset labels, outdoor/indoor signals, and the like.

Advantages of electronic displays is that they are able to provide ultra-lower power displays, that duly mimic the appearance of the paper, and they have a relatively thinner design as compared to most digital displays. Further, no power is required to hold an image, which makes it highly suitable for higher end applications. Also in the retail industry, electronic displays may be used replace the traditional paper price tags with a more dynamic, simple, and effective method of updating price tags as well as updating customers with latest updates regarding discounts and promotions of products

However, conventional electronic displays have certain disadvantages, due to which it is difficult to be used commercially and in a large scale. FIG. 1 illustrates a conventional electronic display (display) system 100 architecture. The conventional display system 100 architecture includes a

plurality of display units 102A-N. Each display unit of the plurality of display units 102A-N includes a microcontroller 104, an display 106, and supporting components 108. As shown in FIG. 1, each display unit 102A-N includes a separate microcontroller 104 for facilitating display changes. The use of a microcontroller 104 for each display unit 102A-N would lead to an increased manufacturing cost of the display system 100. An increased manufacturing cost may make commercialization of the display system more difficult.

Therefore, in light of the foregoing discussion, there exists a need to overcome the aforementioned drawbacks associated with the conventional display system. There is need of an display system in which multiple displays can be multiplexed to a single microcontroller.

These and other objects and advantages of the present invention will become apparent to those skilled in the art from a consideration of the following specification and claims.

Summary of the Invention

According to an aspect of the present invention, there is an electronic display (display) apparatus. The display apparatus includes an display controller and a plurality of display units communicatively coupled to the display controller. The display controller includes a microcontroller and one or more supporting components. The plurality of display units are linked together using ribbon cables. Each display unit of the plurality of display units includes an display, a flip-flop, and one or more supporting components. The display controller selects one display unit from the plurality of display units to drive by shifting data into the flip-flop of the selected display unit until the flip-flop is HIGH, and the flip-flops of the non-selected display units of the plurality of display units are LOW.

In an embodiment, the display controller communicates with the plurality of display units using a CLK (clock) communication pin, a DATA communication pin, and a CS (clock-set) communication pin.

In an embodiment, the microcontroller of the display controller shifts data into one display unit of the plurality of display units via the CLK communication path and the DATA communication path.

In an embodiment, the microcontroller of the display controller shifts data into one display unit of the plurality of display units when the CS communication pin is HIGH.

In an embodiment, the microcontroller of the display controller stops shifting data into one display unit of the plurality of display units when the CS communication pin is LOW.

In an embodiment, each flip-flop of the plurality of display units are serially connected with each other, forming a shift register.

In an embodiment, the display controller individually drives up to 255 display units.

According to an aspect of the present invention, there is a method provided for operating an electronic display (display) apparatus. The method includes establishing communication between an display controller and a plurality of display units using a CLK communication pin, a DATA communication pin, and a CS (clock-set) communication pin. The display controller includes a microcontroller

r and one or more supporting components. Each display unit of the plurality of display units includes an display, a flip-flop, and one or more supporting documents. The method further

includes selecting one display unit from the plurality of display units to drive by shifting data when the CS communication pin is HIGH. In addition, the method includes shifting data into the flip-flop of the selected display unit until the flip-flop is HIGH, and the flip-flops of the non-selected display units of the plurality of display units are LOW.

In an embodiment, the microcontroller of the display controller stops shifting data into one display unit of the plurality of display units when the CS communication pin is LOW.

In an embodiment, each flip-flop of the plurality of display units are serially connected with each other, forming a shift register.

In an embodiment, the display controller individually drives up to 255 display units.

The method and apparatus of the present invention uses a single microcontroller to drive the electronic display (display) units. Each display can be individually addressed by the microcontroller. The microcontroller is present only in the display controller and not in the display units. Use of a single microcontroller for driving the display units reduces the number of required microcontrollers when multiple displays are used. This thus leads to a reduced manufacturing cost of the claimed display apparatus. Additionally, in the method and apparatus of the present invention, a single microcontroller may individually drive up to 255 display units. This thus reduces an overall hardware cost up by approximately 30 percent. Thus, the method and apparatus of the present invention is more efficient and cost-effective when compared to conventional electronic displays.

These and other aspects of the embodiments herein will be better appreciated and understood when considered in conjunction with the following description and the accompanying drawings. It should be understood, however, that the following descriptions, while indicating preferred

embodiments and numerous specific details thereof, are given by way of illustration and not of limitation. Many changes and modifications may be made within the scope of the embodiments.

Brief Description of the Drawings

Other objects, features, and advantages of the invention will be apparent from the following description when read with reference to the accompanying drawings. In the drawings, wherein like reference numerals denote corresponding parts throughout the several views:

Figure 1 depicts a conventional electronic display (display) apparatus, in accordance with an exemplary scenario;

Figure 2 depicts an display daisy-system chain architecture, in accordance with an embodiment;

Figure 3 depicts communications and pin-outs of the display daisy-system architecture of Figure 2, in accordance with an embodiment;

Figure 4 depicts an exemplary artist impression of 11.4-inch displays linked together in a daisy-chained architecture on a shelf, in accordance with an exemplary scenario;

Figure 5 is a perspective view of an display daisy-system chain architecture including 1.54-inch displays, in accordance with an exemplary scenario; and

Figure 6 is a flow diagram depicting the steps involved in the method of operating the display apparatus of FIG. 2, in accordance with an embodiment.

Detailed Description of the Preferred Embodiments

In the following detailed description, numerous specific details are set forth in order to provide a thorough understanding of the invention. However, it will be understood by those of ordinary skill in the art that the invention may be practiced without these specific details. In other instances, well-known methods, procedures and/or components have not been described in detail so as not to obscure the invention. Reference will now be made in detail to the preferred embodiments of the present invention, examples of which are illustrated in the accompanying drawings.

Various embodiments of the present invention provide a method and an apparatus for operating an electronic display apparatus. The present invention is applicable in the retail industry. The Electronic Shelf Label (ESL) is a typical buzzword that usually comes up amongst the retail industry leaders. These ESLs can be used to replace the traditional paper price tags with a more dynamic, simple and effective method of updating price tags.

With reference to Figure 2, Figure 2 depicts an display daisy-system chain architecture, in accordance with an embodiment. Figure 3 depicts communications and pin-outs of the display daisy-system architecture of Figure 2, in accordance with an embodiment. In an embodiment, the display apparatus 200 of the present invention may be used in shelves of stores for displaying prices of items present in the shelf.

The display apparatus 200 comprises a display controller 202 and a plurality of display units 208A-N (EPD units). In an embodiment, the plurality of display units 208A-N may be communicatively coupled with the display controller 202. Each of the plurality of display unit

208A-N includes but is not limited to a liquid crystal display (LCD), organic light emitting diode (OLED), light emitting diode (LED), and the like. The display (EPD) controller 202 includes a microcontroller 204 and one or more support components 206. In an example, the microcontroller 204 may be for example, 32 bits ARM cortex micro controller. The microcontroller 204 is hidden behind or placed under the shelf in which the products are placed. In an embodiment a plurality of display units 208A-N are linked together using ribbon cables. Ribbon cables are lighter, more compact, and easier to handle and splice. Ribbon cables are best suited for future expansion since they transmit data at higher transmission rates. Ribbon cables are also very cost-effective when compared to other fiber cables. In another embodiment, a plurality of display units 208A-N are cascaded side by side and connected together to form a large display.

Further, each display unit of the plurality of display units 208A-N include an display 210, a flip-flop 212, and one or more supporting components 214. The display 210 may be a flexible electronic display or a non-flexible electronic display. The flexible electronic display may use plastic substrates for displaying the content and may be bent unlike other normal screens. The non-flexible electronic display is stiff and cannot be bent like any other normal screen. The flip-flop 212 acts as shift register to select individual ESLs to update the display and is used for storing state information. In an example, the flip-flop 212 may be a D flip-flop, a T flip-flop, or a JK flip-flop.

The display controller 202 establishes communication with the plurality of display units 208A-N using three main communication pins. The communication pins are a CLK communication pin, a DATA communication pin, and a CS (clock-set) communication pin. An display unit receives instructions from the microcontroller 204 of the display controller 202 via the CLK and DATA pins. These instructions received correspond to instructions for shifting data into one display unit

of the plurality of display units 208A-N. A display will only execute these instructions if the display is enabled via the CS pin (if the CS pin is HIGH). The data shifting will stop once the CS pin is LOW.

The display controller 202 must first select one of its connected display units 208A-N, before sending commands to that display unit. A selected display unit will have its CS pin set to HIGH. The display controller 202 sets the selected display unit's CS pin via the flip-flop 212 of the selected display unit. Each display unit's flip-flops 212 are connected to each other in serial, forming a shift-register. The display controller 202 is connected to the start of this shift-register, and is able to shift data into it. The display controller 202 selects an display unit by shifting data into this shift-register, until the selected display unit's flip-flop 212 is HIGH, and the other non-selected display unit's flip-flops 212 are LOW. For example, assuming the display daisy-chain system includes four display units. To select the third display unit, the display controller 202 would shift in the data '0010' into the shift-register. Thus, the third display unit's flip-flop has the value of 1, and the other display unit's flip-flops have the value of 0. To select the fourth display unit, the display controller 202 would shift in the data '0001' into the shift-register. The fourth display unit's flip-flop then becomes HIGH, and the other display unit's flip-flops become LOW.

The display daisy-system chain architecture of Figures 2-3 requires only a single microcontroller 204 to drive the plurality of display units 208A-N. In one embodiment, the microcontroller 204 may drive up to 255 display units. Hence, shelves in stores would require only display controller 202 to drive all the display units 208A-N. The EPS daisy-system architecture is cost-effective because it is able to reduce the overall hardware cost by 3% (For 2 display units per display controller) up to approximately 30% (For 16 display units per display controller).

For example, assuming there are 100 display units to be deployed. The conventional display apparatus of Figure 1 would require 100 display controllers that are built into the display units as a complete set. The total cost for such a setup would be 100 * USD12 = USD 1,200 (assuming that the cost of each display controller is USD12). However, using the daisy-system chain architecture of Figures 2-3 of 16 display units to 1 display controller, only 7 display controllers are required. The total cost for such setup would be (100 * USD 8) + (7 * USD 8) = USD 856. Therefore, the daisy-system chain architecture in Figures 2-3 is proven to function just as well with the conventional display apparatus of Figure 1. Furthermore, the overall hardware cost using the daisy-system chain architecture is able to reduce the overall implementation cost by up to approximately 30%.

Figure 4 depicts an exemplary artist impression of 11.4-inch displays linked together in a daisy-chained architecture on a shelf, in accordance with an exemplary scenario. The 11.4inch displays of Figure 4 may be the display units 208A-N of Figure 2. As shown in Figure 4, 15 display units are arranged in shelves of a store, where 3 display units are placed per shelf. The 15 display units are driven by a single microcontroller 204 (not shown in Figure 4). The functionality of the 15 display units driven by the microcontroller 204 is explained under the description of Figures 2-3 above.

Figure 5 depicts an exemplary daisy-chain architecture using 1.54-inch displays, in accordance with an exemplary scenario. The 1.54-inch displays of Figure 5 may be the display units 208A-N of Figure 2. As shown in Figure 5, the display units 208A-N are physically linked together using a ribbon cable 502. Ribbon cables 502 are lighter, more compact, and easier to handle and splice. Ribbon cables 502 are also very cost-effective when compared to other fiber cables.

Figure 6 is a flow diagram depicting the steps involved in the method 600 of operating the display apparatus 200, in accordance with an embodiment. In an embodiment, the display apparatus 200 of the present invention may be used in shelves of stores for displaying prices of items present in the shelf. In several exemplary scenarios the display apparatus 200 may be used to display changes in product prices, any offers/discounts/promotions available for the respective products, display name tag, medical report in a bedside card for hospital industry, and the like. The display apparatus 200 comprises an display controller 202 and a plurality of display units 208A-N. The display controller 202 includes a microcontroller 204 and one or more support components 206. In an example, the microcontroller 204 may be 16 bits, 32 bits, or 64 bits. The microcontroller 204 is hidden behind or placed under the shelf in which the products are placed. Further, each display unit of the plurality of display units 208A-N include an display 210, a flip-flop 212, and one or more supporting components 214.

At step 602, the display controller 202 establishes a communication with the plurality of display units 208A-N. The display controller 202 establishes communication with the plurality of display units 208A-N using three main communication pins. The communication pins are a CLK (clock) communication pin, a DATA communication pin, and a CS (clock-set) communication pin. An display unit receives instructions from the microcontroller 204 of the display controller 202 via the CLK and DATA pins.

At step 604, one display unit from the plurality of display units 208A-N is selected to drive by shifting data. An display unit receives instructions from the microcontroller 204 of the display controller 202 via the CLK and DATA pins. These instructions received correspond to instructions for shifting data into one display unit of the plurality of display units 208A-N. An display will only execute these instructions if the display is enabled via the CS pin (if the CS pin

is HIGH). The microcontroller 204 of the display controller 202 stops shifting data into one display unit of the plurality of display units 208A-N when the CS communication pin is LOW.

At step 606, data is shifted in to the flip-flop 212 of the selected display unit. The selected display unit will have its CS pin set to HIGH. The display controller 202 sets the selected display unit's CS pin via the flip-flop 212 of the selected display unit. Each display unit's flip-flops 212 are connected to each other in serial, forming a shift-register. The display controller 202 is connected to the start of this shift-register, and is able to shift data into it. The display controller 202 selects an display unit by shifting data into this shift-register, until the selected display unit's flip-flop 212 is HIGH, and the other non-selected display unit's flip-flops 212 are LOW. For example, assuming the display daisy-chain system includes four display units. To select the third display unit, the display controller 202 would shift in the data '0010' into the shift-register. Thus, the third display unit's flip-flop has the value of 1, and the other display unit's flip-flops have the value of 0.

The method 600 requires only a single microcontroller 204 to drive the plurality of display units 208A-N. In one embodiment, the microcontroller 204 may drive up to 255 display units. Hence, shelves in stores would require only display controller 202 to drive all the display units 208A-N. The EPS daisy-system architecture is cost-effective because it is able to reduce the overall hardware cost by approximately 30%.

As will be readily apparent to those skilled in the art, the present invention may easily be produced in other specific forms without departing from its essential characteristics. The present embodiments are, therefore, to be considered as merely illustrative and not restrictive, the scope of the invention being indicated by the claims rather than the foregoing description, and all changes which come within therefore intended to be embraced therein.

CLAIMS

1. An electronic display apparatus (200) comprising:

an display controller (202) including a microcontroller (204) and one or more supporting components (206); and

a plurality of display units (208A-N) communicatively coupled to the display controller (202), wherein the plurality of display units (208A-N) are linked together using ribbon cables, and wherein each display unit of the plurality of display units (208A-N) includes an display (210), a flip-flop (212), and one or more supporting documents (214),

wherein the display controller (202) selects one display unit from the plurality of display units (208A-N) to drive by shifting data into the flip-flop (212) of the selected display unit until the flip-flop (212) is HIGH, and the flip-flops of the non-selected display units of the plurality of display units (208A-N) are LOW.

2. The display apparatus (200) as claimed in claim 1, wherein the display controller (202) communicates with the plurality of display units (208A-N) using a CLK (clock) communication pin, a DATA communication pin, and a CS (clock-set) communication pin.

3. The display apparatus (200) as claimed in claim 2, wherein the microcontroller (204) of the display controller (202) shifts data into one display unit of the plurality of display units (208A-N) via the CLK communication path and the DATA communication path.

4. The display apparatus (200) as claimed in claim 2, wherein the microcontroller (204) of the display controller (202) shifts data into one display unit of the plurality of display units (208A-N) when the CS communication pin is HIGH.

5. The display apparatus (200) as claimed in claim 2, wherein the microcontroller (204) of the display controller (202) stops shifting data into one display unit of the plurality of display units (208A-N) when the CS communication pin is LOW.

6. The display apparatus (200) as claimed in claim 1, wherein each flip-flop (212) of the plurality of display units (208A-N) are serially connected with each other, forming a shift register.

7. The display apparatus (200) as claimed in claim 1, wherein the display controller (202) individually drives up to 255 display units.

8. A method (600) for operating an electronic display (display) apparatus (200), the method (600) comprising:

establishing (602) communication between an display controller (202) and a plurality of display units (208A-N) using a CLK (clock) communication pin, a DATA communication pin, and a CS (clock-set) communication pin, wherein the display controller (202) includes a microcontroller (204) and one or more supporting components (206), and wherein each display unit of the plurality of display units (208A-B) includes an display (210), a flip-flop (212), and one or more supporting documents (214);

selecting (604) one display unit from the plurality of display units (208A-N) to drive by shifting data when the CS communication pin is HIGH; and

shifting (606) data into the flip-flop (212) of the selected display unit until the flip-flop (212) is HIGH, and the flip-flops of the non-selected display units of the plurality of display units (208A-N) are LOW.

9. The method (600) as claimed in claim 8, wherein the microcontroller (204) of the display controller (202) stops shifting data into one display unit of the plurality of display units (208A-N) when the CS communication pin is LOW.

10. The method (600) as claimed in claim 8, wherein each flip-flop (212) of the plurality of display units (208A-N) are serially connected with each other, forming a shift register.

11. The method (600) as claimed in claim 8, wherein the display controller (202) individually drives up to 255 display units.