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(54) **DISPLAY METHOD AND SYSTEM WITH
SELECT LIGHTING TO DENOTE BUTTON
ACTION**

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Related U.S. Application Data

(60) Provisional application No. 60/566,781, filed on Apr. 30, 2004.

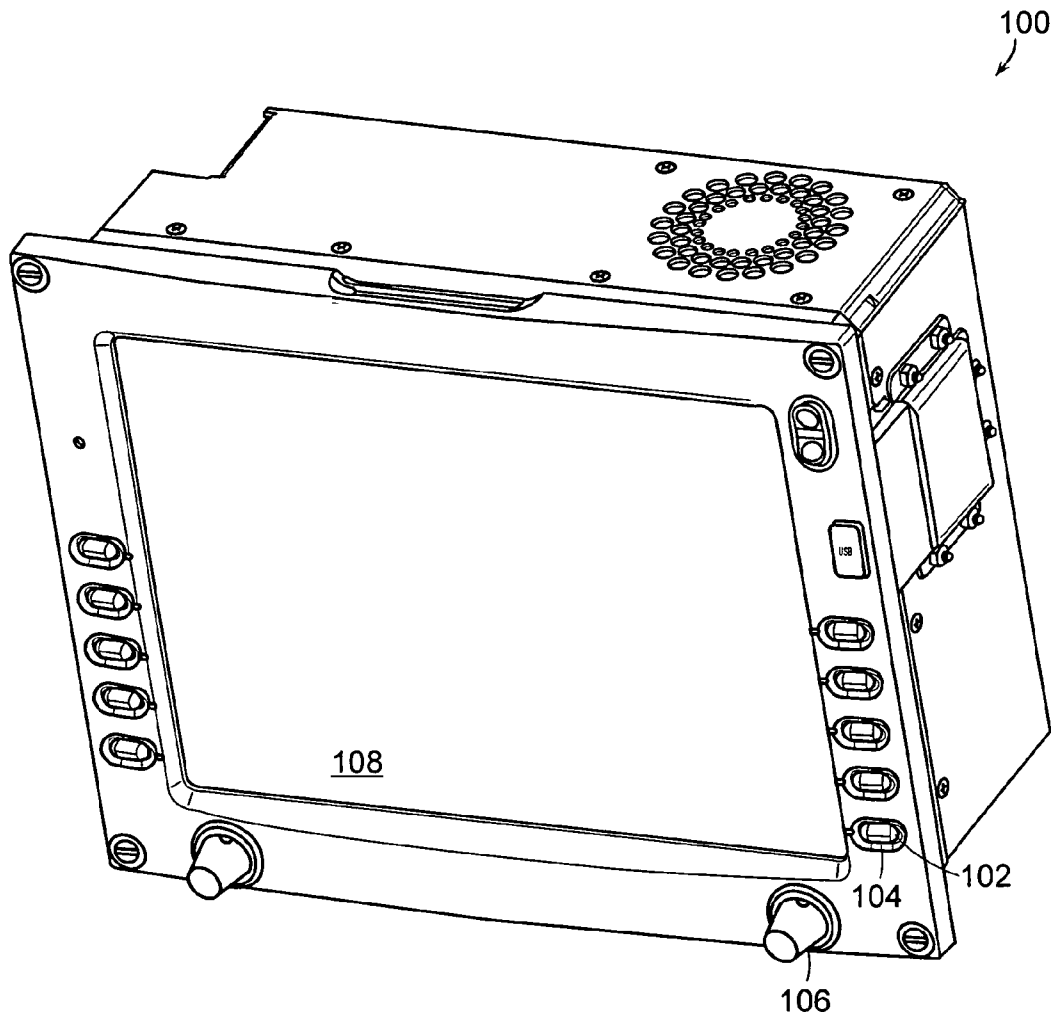
Publication Classification

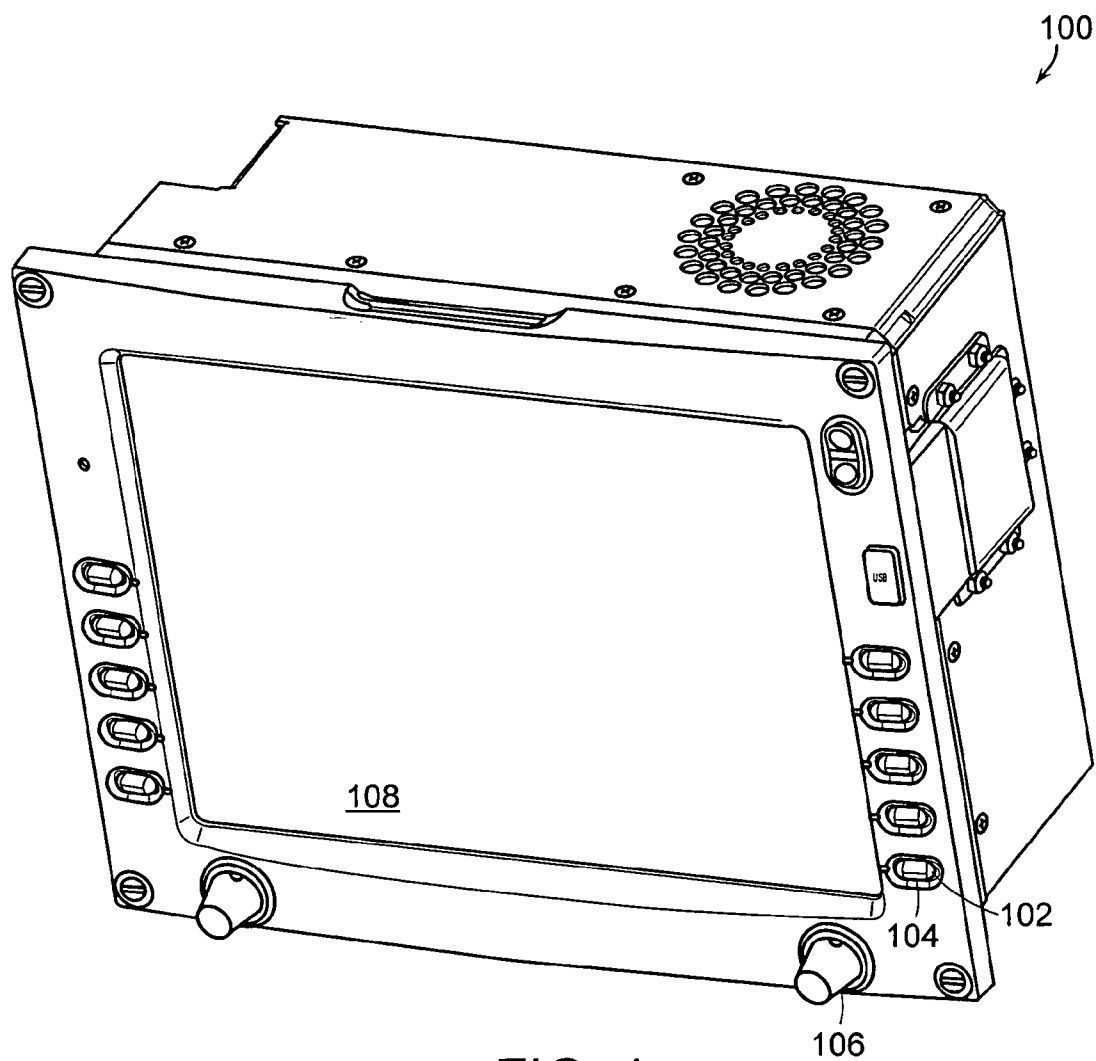
(51) **Int. Cl.⁷** **G09G 5/00**; G09G 5/08

(52) **U.S. Cl.** **345/160**; 345/172; 345/168

(57) **ABSTRACT**

Button action in a display system is dynamically denoted by either illuminating or not illuminating an illuminable element adjacent to the button to provide a lighting effect around the periphery of the button. The illumination of an illuminable element adjacent to an active button has the effect of drawing attention to an active button. Active buttons are dynamically updated based upon the state of the system and/or the particular page displayed.





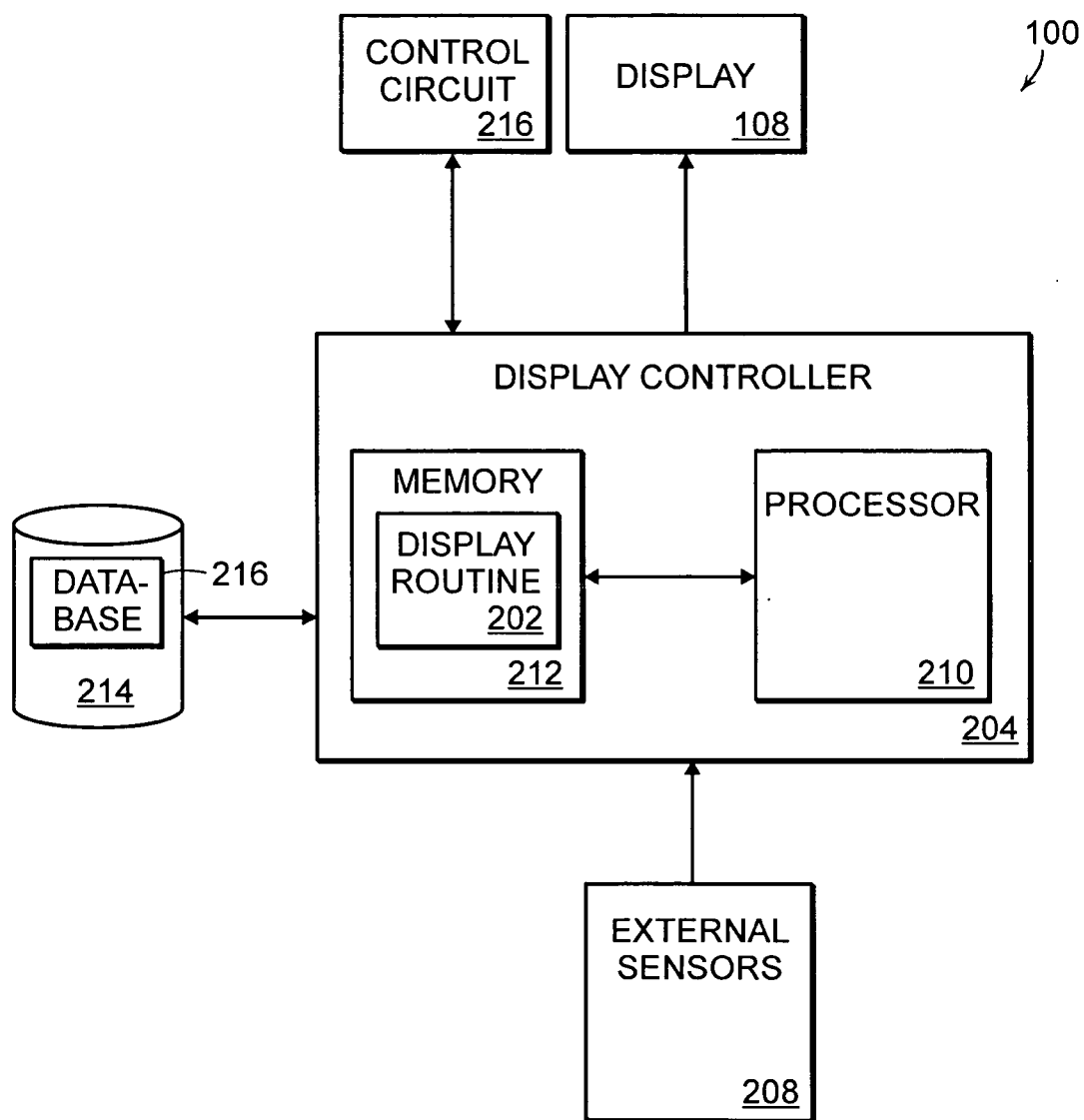


FIG. 2

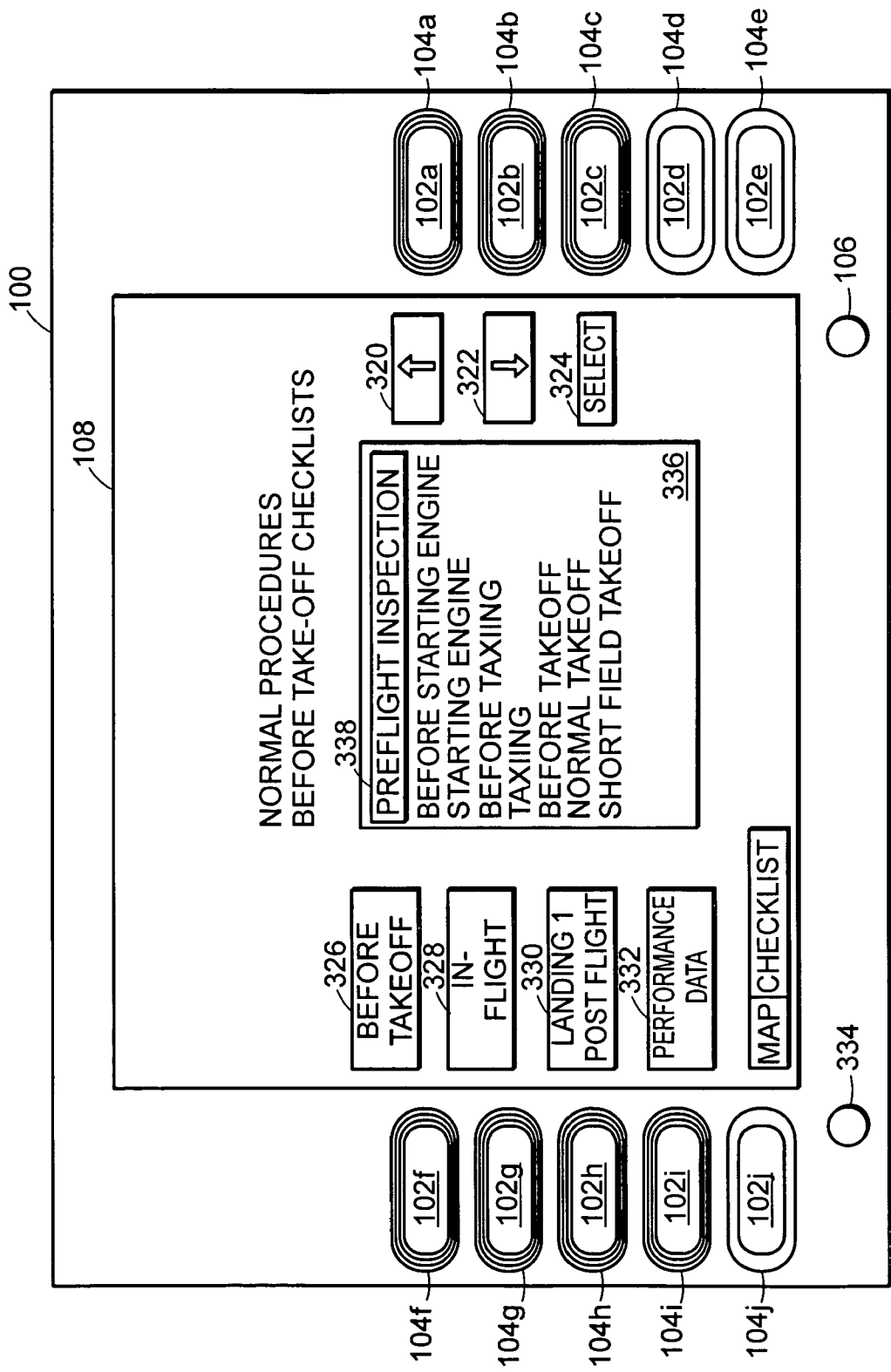


FIG. 3

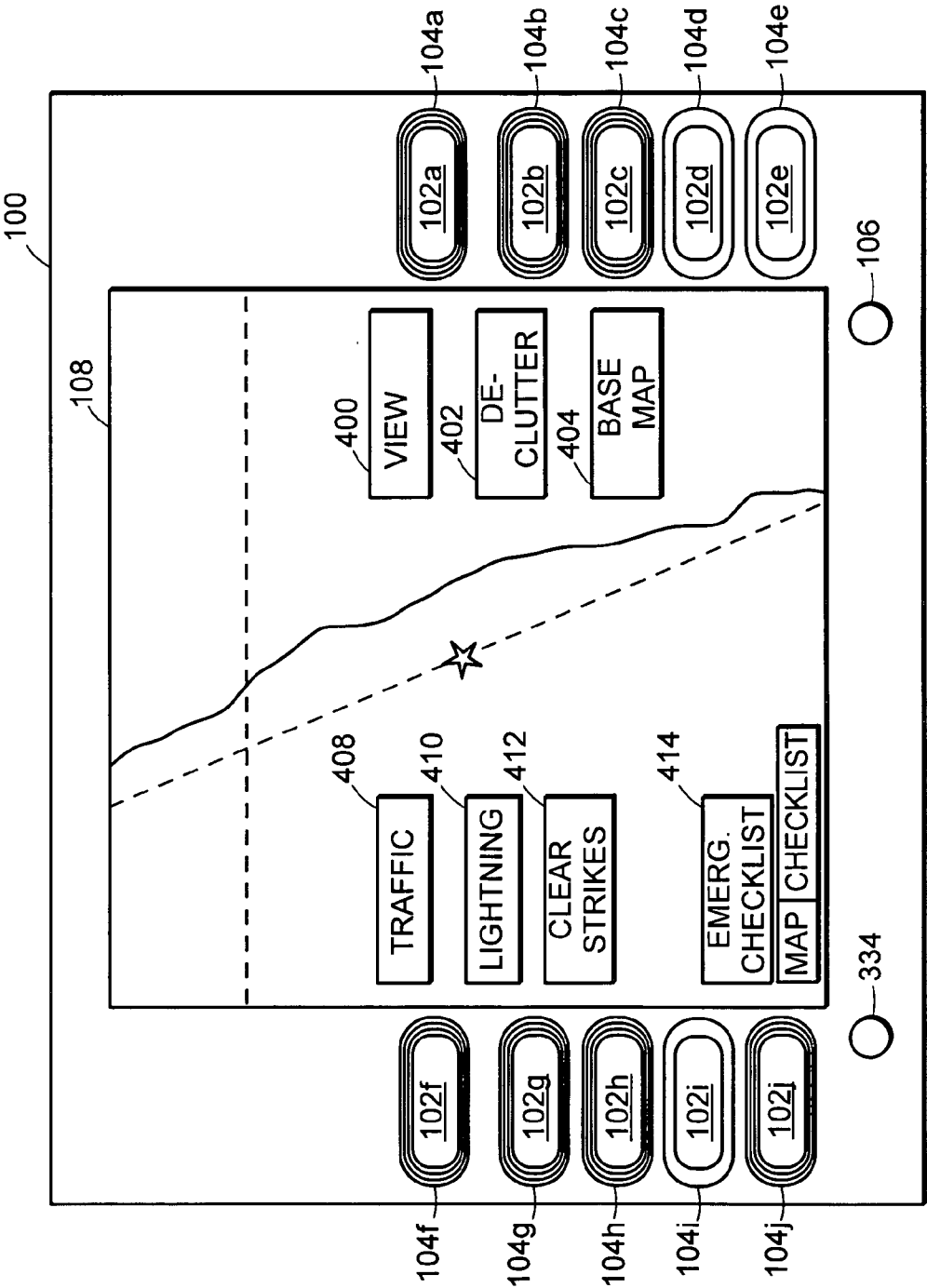


FIG. 4

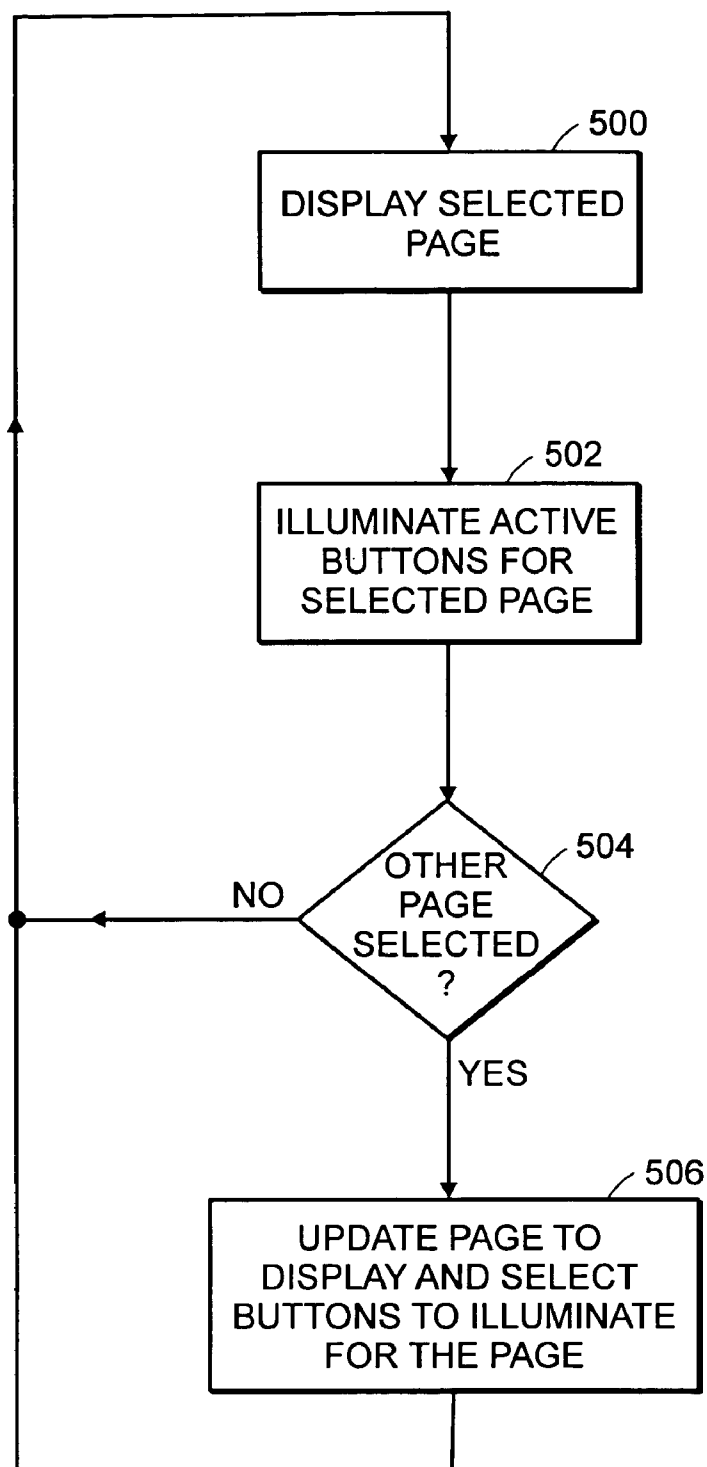


FIG. 5

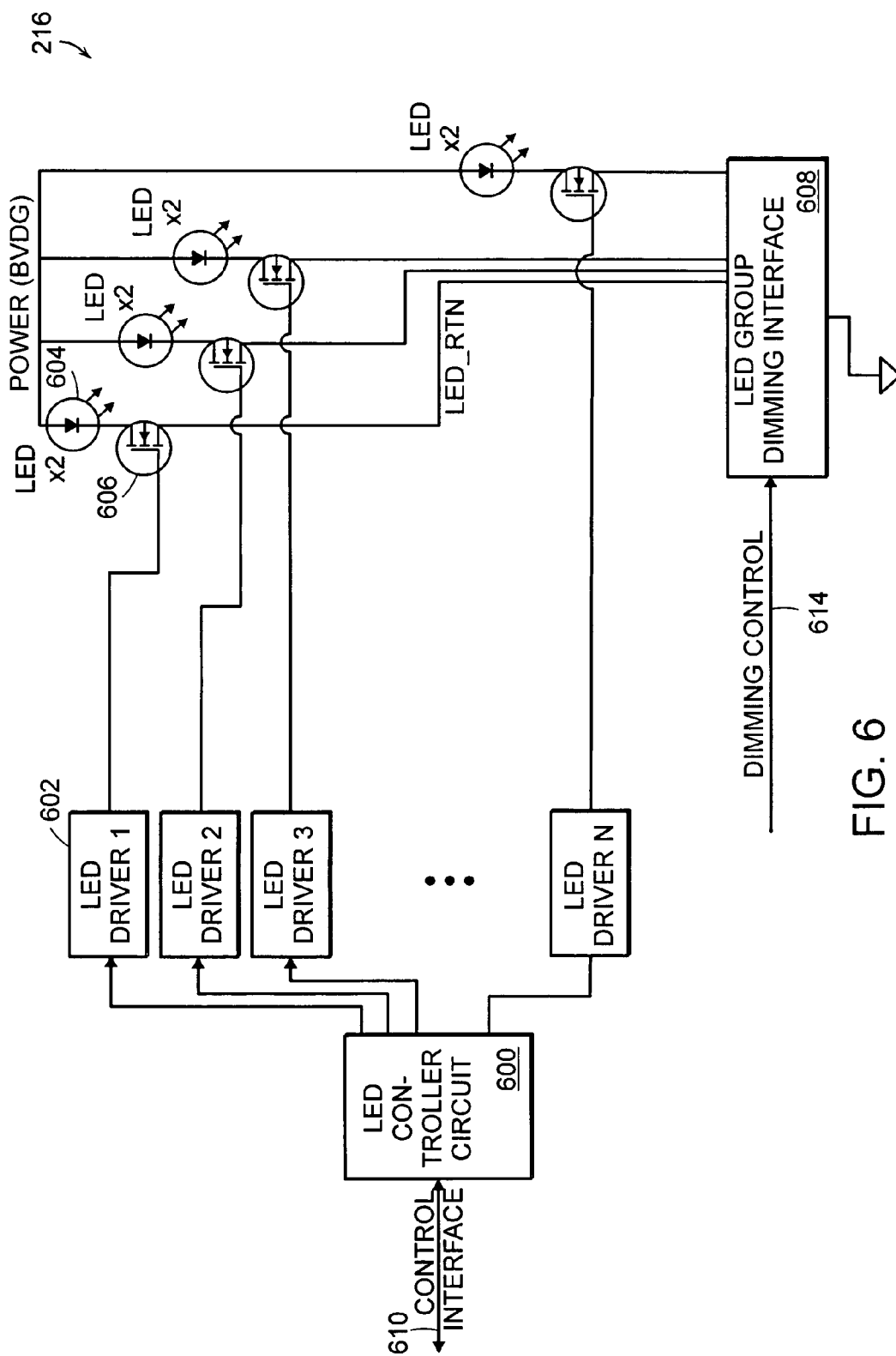


FIG. 6

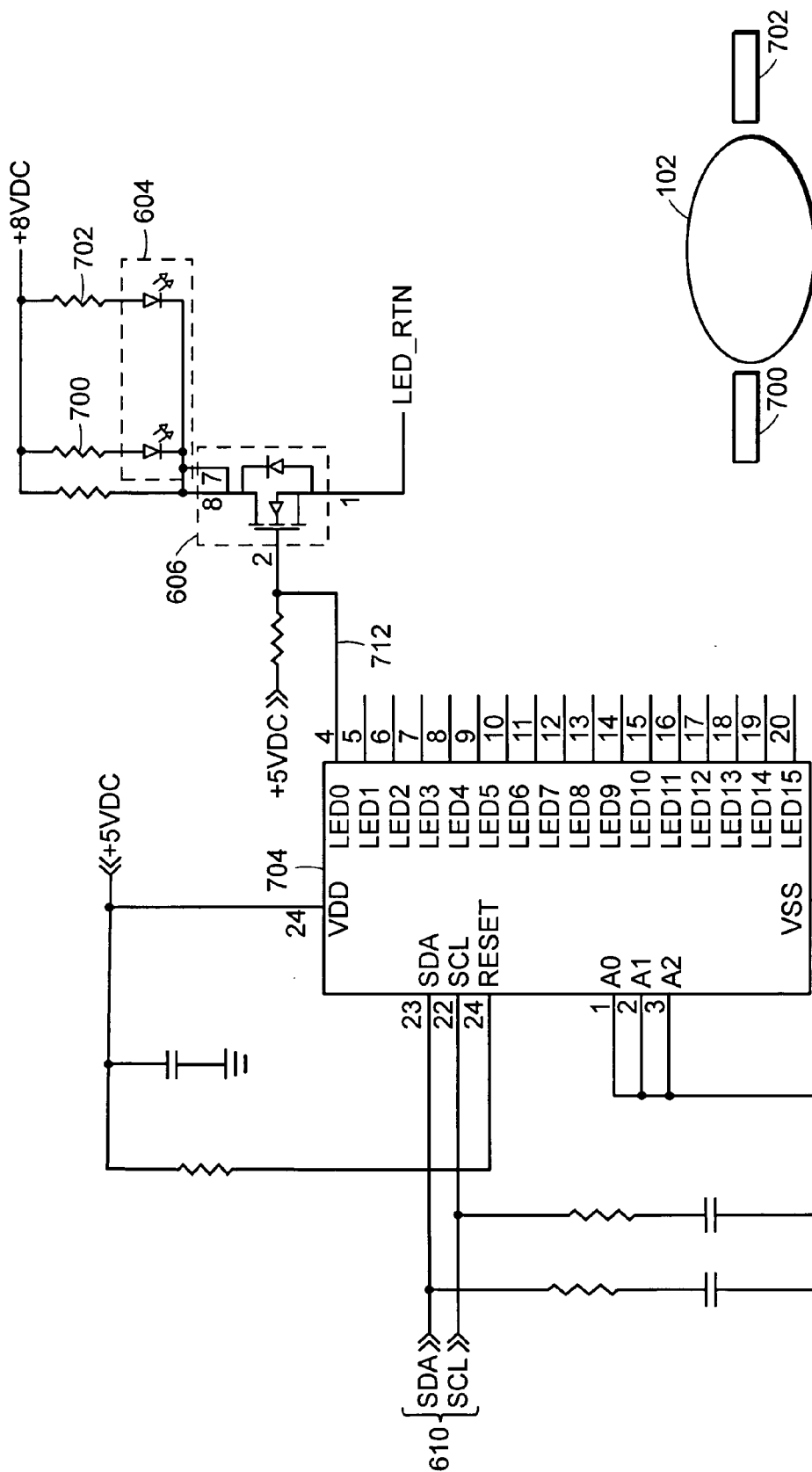


FIG. 8

FIG. 7

DISPLAY METHOD AND SYSTEM WITH SELECT LIGHTING TO DENOTE BUTTON ACTION

RELATED APPLICATION

[0001] This application claims the benefit of U.S. Provisional Application No. 60/566,781, filed on Apr. 30, 2004. The entire teachings of the above application are incorporated herein by reference.

BACKGROUND OF THE INVENTION

[0002] Flight deck systems in aircraft typically include graphical display systems that integrate numerous elements of flight critical data—including Global Positioning System (GPS) navigation information, traffic information, lightning information, and terrain. The graphical display system displays this data on a screen of a display monitor and allows the pilot to overlay important navigation data such as the active flight plan route, airways, political boundaries, obstacles and special use airspace, over a color-contoured terrain and water base map. Standard flight instrumentation including attitude, heading, airspeed, altitude and vertical speed may also be displayed on the screen.

[0003] The graphical display system includes push buttons and adjustable knobs to allow the pilot to select modes or change the data that is displayed on the screen. Different data or screen views (pages) can be selected for display on the screen. The push buttons and knobs are mapped to different functions dependent on the page being displayed.

SUMMARY OF THE INVENTION

[0004] The push buttons that are active for a particular page being displayed on the screen can be confusing to the pilot. To reduce potential confusion, each push button is seated within a recess and has an illuminable element adjacent to the push button. The illuminable element is separately controllable and is illuminated only if the push button is active for the displayed page, that is, if the push button is mapped to a selectable function for the displayed page. The illuminable element provides a lighting effect around the periphery of the button. This illumination of the active push button has the effect of drawing attention to the applicable push button and improves the ease of operation of the system.

[0005] A display system includes a screen and a plurality of push buttons, an illuminable element is adjacent to each push button to provide a lighting effect around the periphery of the button. The screen displays a page of information (screen view) that includes at least one selectable function mapped to one of the push buttons. Light is transmitted through the illuminable element adjacent to the one push button mapped to the one selectable function, to denote that the push button is active for the displayed page.

[0006] The illuminable element may be seated in a recess surrounding the push button. The push button may be in the shape of a rectangle having rounded corners. The page of information may include multiple selectable functions mapped to respective ones of the push buttons. The illuminable element of each of the respective ones of the push buttons becomes illuminated during display of the page. For different pages displayed on the display there are respective different selectable functions mapped to different ones of the

push buttons. For each different page, during display of that page the illuminable elements of the ones of the push buttons that have selectable functions mapped thereto are illuminated. The illuminable element may be a light pipe or a pair of light emitting diodes.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] The foregoing and other objects, features and advantages of the invention will be apparent from the following more particular description of preferred embodiments of the invention, as illustrated in the accompanying drawings in which like reference characters refer to the same parts throughout the different views. The drawings are not necessarily to scale, emphasis instead being placed upon illustrating the principles of the invention.

[0008] FIG. 1 is a perspective view of a display system including a plurality of push buttons;

[0009] FIG. 2 is a block diagram of the display system 100 shown in FIG. 1 including a display routine which denotes active push buttons according to the principles of the present invention;

[0010] FIG. 3 illustrates a page displayed on the display system denoting active push buttons for the displayed page according to the principles of the present invention;

[0011] FIG. 4 illustrates another page displayed on the display system denoting active push buttons for the displayed page;

[0012] FIG. 5 is a flow chart illustrating a method implemented in the display controller for controlling the illumination of active push buttons according to the principles of the present invention;

[0013] FIG. 6 is a block diagram of an embodiment of the control circuit shown in FIG. 2;

[0014] FIG. 7 is a circuit diagram for a portion of the control circuit shown in FIG. 6; and

[0015] FIG. 8 illustrates the positioning of the light emitting diodes in the circuit shown in FIG. 6 around the push button.

DETAILED DESCRIPTION OF THE INVENTION

[0016] A description of preferred embodiments of the invention follows.

[0017] FIG. 1 is a perspective view of a display system 100 including a plurality of push buttons 102. The display system 100 also includes adjustment knobs 106 and a screen 108. The display system 100 includes a display which is an electronic device such as a Cathode Ray Tube (CRT) or liquid crystal display (LCD)-based or gas plasma-based flat panel display that temporarily presents information in visual form. The information is displayed on the screen 108 of the display system 100, that is, a surface of the display system on which the information appears. In display systems, the internal representation of a screenful of information displayed on the screen is typically referred to as a page. A page is a portion of display memory that contains one complete full-screen image. The push button 102 is a small actuator that when pushed closes an electric circuit. The closing of

the electric circuit denotes selection of a function that is mapped to the push button **102**.

[0018] Each push button **102** includes a recess surrounding the actuator or controller portion of push button **102** in which an illuminable element **104** is seated. In one embodiment, the illuminable element is a light pipe that is adjacent to the push button and surrounds the push button. A light pipe is a solid transparent plastic rod for transmitting light lengthwise. The light can be provided by a Light Emitting Diode (LED). The illumination of each illuminable element **104** is separately controlled. In alternate embodiments, other lighting techniques well known to those skilled in the art can be used for the illuminable element. For example, the illuminable element can include a pair of light emitting diodes positioned adjacent to the push button such that when both diodes are lit, a lighting effect is provided around the periphery of the push button.

[0019] The light is only transmitted by the illuminable element **104**, if the push button **102** is active for the page displayed on the screen **108**, that is, if the push button **102** is mapped to a selectable function for the page displayed on the screen **108**.

[0020] In the embodiment shown, each of the push buttons **102** is in the shape of an oval or a rectangle having rounded corners. Printed circuit boards used for mounting push buttons and knobs in a display system are well known to those skilled in the art.

[0021] FIG. 2 is a block diagram of the display system **100** shown in FIG. 1 including a display routine **202** which denotes active push buttons according to the principles of the present invention. The display system **100** includes a display controller **204**, screen **108** and external sensors **208**. The display controller **204** includes a processor **210** and memory **212** for processing parameters received by the external sensors **208**. The display controller **204** may also include a storage device **214** such as a disk or CD-ROM for storing a data base which stores parameters displayed on the screen **108**.

[0022] The display routine **202** controls the information displayed (displayed pages/screen view) on the screen **108** and the illumination of the illuminable elements **104** adjacent to push buttons **102** to denote active push buttons for the displayed page. The illumination of the illuminable element **104** adjacent to each push button **102** is controlled by the control circuit **216** for the active push buttons **102**. An embodiment of the control circuit **216** will be described later in conjunction with FIGS. 6 and 7. The display routine **202** may also be stored in the storage device **214**.

[0023] FIG. 3 illustrates a page displayed on the display system **100** denoting active push buttons for the displayed page according to the principles of the present invention. The display system includes ten push buttons **102a-j**, five located on each side of the screen **108**. Four push buttons **102f-i** located at the left of the screen **108** are active as indicated by the illumination of the illuminable element **104f-i** to provide a lighting effect around the periphery of each push button. Three push buttons **102a-c** located at the right of the display are illustrated as active.

[0024] The checklist page is displayed on the screen **108**. The checklist page includes a checklist menu **336**. A menu is a list of options from which the user can make a selection

in order to perform a desired action. The checklist menu **336** is a list of all the normal procedures checklists for each phase of flight. The first item in the checklist menu **336** is highlighted by a rectangular box **338**. The checklist page also includes a label (description of the function) indicating the function that is mapped to each active push button **102a-c** and **102f-i**. The label is displayed at a position on the display screen that is adjacent to the respective push button **102**. For example, push buttons **102a** and **102b** are mapped to functions that move the outlined box **338** up and down over the items in the menu **336**.

[0025] Label **320** adjacent to push button **102a** is an up arrow symbol that indicates that push button **102a** is mapped to the function which moves the outlined box **338** to the item directly above the currently selected item in the list/menu **336**. Label **322** adjacent to push button **102b** is a down arrow symbol that indicates that push button **102b** is mapped to the function which moves the outlined box **338** to the item in the menu **336** directly below the currently highlighted item in the menu **336**. Label **324** adjacent to push button **102c** includes the text "select" that indicates that push button **102c** is mapped to the function that selects the currently highlighted item in the menu **336**. Respective illuminable elements **104d**, **104e** adjacent to push buttons **102d**, **102e** are not illuminated indicating that the push buttons are not active for the current page (screen view) displayed on the screen **108**. Also, there is no label displayed at positions on the screen **108** adjacent to non-active push buttons **102d**, **102e**.

[0026] The active push buttons **102f-102i** on the left side of the screen **108** allow the pilot to select other checklists to be displayed on the screen **108**. A label **326**, **328**, **330**, **332** indicating the respective checklist that is mapped to each push button **102f-102i** is displayed at a screen position adjacent to each push button **102**. In the embodiment shown, all of the active push buttons remain active with the respective illuminable element **104** adjacent to each active push button to provide a lighting effect around the periphery of the push button while the checklist page is displayed on the screen **108**.

[0027] Thus, push button action can be dynamically denoted by whether the illuminable element **104** adjacent to the push button **102** is illuminated. This draws attention to the push buttons that are active dependent on the state of the system and/or the page displayed on the screen **108** and thus improves the ease of operation of the system **100**. Additional benefit is obtained by reducing clutter and overall ambient brightness in the cockpit of the aircraft by not illuminating the illuminable element adjacent to non-active push buttons **102**.

[0028] The left knob **334** below the screen **108** controls the page that is displayed on the display screen. The left knob **334** provides access to the map page. In the embodiment shown, only two pages are available, the checklist page and the map page. However, in other embodiments, there may be more than two selectable pages.

[0029] FIG. 4 illustrates another page (map page) displayed on the screen **108** of system **100** with only active push buttons **102a-c**, **102f-102h** and **102j** illuminated by respective illuminable elements **104a-104c**, **104f-104h** and **104j**. The map page provides a view of the flight situation based on input from external sensors **208** (FIG. 2) such as

a global positioning system (GPS). The display controller **204** (**FIG. 2**) also uses information stored in the database **216** (**FIG. 2**) for mapping off-route navigational data such as nearby airports, special use and restricted airspace and terrain water and obstacles. The map page can display different levels of detail including contoured terrain, water features and political boundaries. The number of levels displayed is user selectable.

[0030] As shown, each active push button **102a-102c**, **102f-102h** and **102j** has an associated label **400**, **402**, **404**, **408**, **410**, **412** and **414** describing the function that is mapped to the push button (actuator). The labels displayed on the screen **108** and the active push buttons are different for each page displayed. As described in conjunction with the checklist page shown in **FIG. 3**, a label is only displayed on the screen **108** for an active push button and the illuminable element adjacent to a push button is only illuminated if the push button is active for the displayed page.

[0031] Referring to the map page shown in **FIG. 4**, push buttons **102a-c** control the basic look of the map in terms of orientation, number of elements, and base map. The view line select button **102a** associated with currently displayed label “view”**400** when selected orients the map for either forward view or center view in north-up, track-up or heading up orientation. The declutter line select button **102b** associated with displayed label “de-clutter”**402** when selected allows the pilot to quickly choose from multiple levels of database navigation map detail.

[0032] Likewise, the base map function key (push button) **102c** corresponds to the “base map” label **404** displayed in the current screen view **108**. The base map function key (push button) **102c** selects from multiple levels of map detail, starting with contoured terrain and water base map and political boundaries. Pressing (pushing) the button **102c** removes contoured terrain, while leaving water and political boundary references. Pressing (pushing) the button **102c** again views the flight plan.

[0033] Push buttons **102f-102h** control overlay and modes of available sensors. The traffic button **102f** associated with the displayed label “traffic”**408** cycles through traffic sensor modes displaying intruders. The lightning button **102g** associated with label “lightning”**410** cycles through lighting sensor modes. The clear strikes button **102h** associated with label “clear strikes”**412** removes lightning symbols to allow for the refresh of lightning data. Push button **102j** associated with the label “emergency checklist”**414** allows the emergency checklist to be displayed with one-button access from the map page.

[0034] **FIG. 5** is a flow chart illustrating a method implemented in the display controller **204** for controlling the illumination of push buttons **102** according to the present invention.

[0035] At step **500**, the page selected by the left knob **334** (**FIGS. 3 and 4**) is displayed on the screen **108** (**FIGS. 3 and 4**). Labels indicating functions mapped to active push buttons are displayed in the areas of the screen view **108** close to the push buttons **102**.

[0036] At step **502**, the illuminable element **104** adjacent to each active push button **102** associated with the function labels displayed on the screen **108** is illuminated by the illumination control circuit to provide a lighting effect

around the periphery of the push button, indicating that the push button **102** is active for the displayed page.

[0037] At step **504**, the display routine **202** (**FIG. 2**) checks the state of the left knob **334** (**FIGS. 3 and 4**) to determine if the user has selected another page to be displayed. If so, processing continues with step **506** to display the new page and select the corresponding push buttons **102** to be illuminated. If not, processing continues with step **500** to continue to display the current page and illuminate the illuminable elements **104** adjacent to the active push buttons **102** for the current page.

[0038] At step **506**, the display routine **202** updates the page to be displayed by retrieving information from the database **216** and updating the data to be displayed on the screen **108**. The display routine **202** also selects the push buttons **102** to be illuminated based on the active push buttons for the newly selected page. Processing continues with step **500** to display the newly selected page.

[0039] **FIG. 6** is a block diagram of an embodiment of the control circuit **216** shown in **FIG. 2**. The control circuit **216** includes a Light Emitting Diode (LED) controller circuit **600** for controlling a plurality of LED drivers **602**, each LED driver **602** controls a pair of LED diodes **604** through a Field Effect Transistor **606** coupled between the LED driver **602** and the pair of LEDs **604**. The pair of LEDs correspond to the illuminable element **104** shown in **FIG. 1**.

[0040] The LED controller circuit **600** receives commands from the processor **210** (**FIG. 2**) over a control interface **610**. The LED controller **600** has a respective output control signal for each LED driver **602**. One of the output signals from the LED driver is coupled to the gate of a Field Effect Transistor (FET) **606** to turn the FET ON when the output signal from the LED controller circuit to the LED driver **602** based on the command received from the processor indicates that the illuminable element **104** is to be illuminated. While the FET **606** is ON, the pair of LEDs are also ON and the illuminable element **104** is illuminated. Both LEDs **604** are lit to provide a uniform lighting effect around the periphery of the button **102**. (**FIG. 1**) Each FET **606** is also coupled through a respective signal labeled LED_RTN to a LED group dimming interface **608**. The LED group dimming interface **608** combines all of the LED_RTN signals to form an overall dimming signal that results in dimming all LEDs at the same time.

[0041] The LED group dimming interface **608** allows use of a secondary Pulse Width modulated signal to enhance the resolution of night time dimming. This allows sub one nit luminosity levels. The secondary pulse width modulated signal labeled “dimming control”**614** provides a greater resolution of the dimming range than that provided by the LED controller circuit **600** and LED driver **602**. In the LED group dimming circuit, the secondary Pulse Width Modulated signal is applied to a MOSFET gate, whose drain and source are in series with the combined LED_RTN signal allowing software control of the dimming through the processor **210**.

[0042] **FIG. 7** is a circuit diagram of an embodiment of a portion of the control circuit **216** shown in **FIG. 6**. The control circuit **216** includes a pair of light emitting diodes (LEDs) **700**, **702** corresponding to the pair of diodes **604** shown in **FIG. 6**. For simplicity, only one of the pairs of LEDs **604** is shown in **FIG. 7**.

[0043] The LED drivers **602** and LED controller circuit **600** shown in **FIG. 6** are included in a single LED controller device (PCA9532PW) **704** manufactured by Philips Semiconductors. The device **704** is coupled through a control interface **610** to the processor **210**. In the embodiment shown, the control interface is the I²C serial bus from Philips Semiconductor. The control interface includes a clock signal (SCL) and a data signal (SDA).

[0044] The output signal **712** from the LED controller device **704** is coupled to the gate of FET **606** to control whether LEDs **700, 702** are lit dependent on control signals received on the control interface **610** from the processor **210** over. While the FET **606** is ON, the pair of LEDs **700, 702** are lit and the illuminable element **104** is illuminated.

[0045] In one embodiment, the LEDs **700, 702** are manufactured by Toyoda Gosei, for example, part number E1S03-AC1A7-02 RANK P. However, any LED with an approximate 20 mA cathode current draw can be used.

[0046] **FIG. 8** illustrates the positioning of the light emitting diodes in the circuit shown in **FIG. 7** around the push button in the display system **100** shown in **FIG. 1** on a printed circuit board. The pair of light emitting diodes **700, 702** shown in the circuit diagram in **FIG. 6** are positioned at opposite ends of the button **102** on the printed circuit board and are both lit in order to provide a uniform lighting effect around the periphery of the button **102**.

[0047] The illumination of an illuminable element **104** to provide a lighting effect around the periphery of the push button **102** can also be used to indicate the position of a focus point (cursor) on the display for use in display systems for helicopters. An illuminable element is illuminated dependent on the proximity of the cursor on the display to the illuminable element.

[0048] An embodiment of the invention has been described for a display system for use in the cockpit of an aircraft. However, the invention is not limited to aircraft display systems. The invention can be used in any display system having selectable functions mapped to push buttons.

What is claimed is:

1. A display system comprising:
 - a plurality of push buttons, an illuminable element adjacent to each push button to provide a lighting effect around the periphery of the button; and
 - a screen that displays a page of information including at least one selectable function mapped to one of the push buttons, light being transmitted through the illuminable element adjacent to the one push button mapped to the one selectable function to denote that the push button is active for the displayed page.
2. The display system of claim 1, wherein the illuminable element is seated in a recess surrounding the push button.
3. The display system of claim 1, wherein the one selectable push button is in the shape of a rectangle having rounded corners.
4. The display system of claim 1, wherein the page of information includes multiple selectable functions mapped to respective ones of the push buttons

the illuminable element of each of the respective ones of the active push buttons becomes illuminated during display of the page.

5. The display system of claim 1, wherein for different pages displayed on the display there are respective different selectable functions mapped to different ones of the push buttons.

6. The display system of claim 5, wherein for each different page, during display of that page the illuminable elements of the ones of the push buttons having a selectable functions mapped thereto, being illuminated.

7. The display system of claim 1, wherein the illuminable element is a light pipe.

8. The display system of claim 1, wherein the illuminable element is a pair of light emitting diodes.

9. A computer implemented method for denoting button action in a display system comprising the steps of:

displaying a page of information on a screen of the display system, the page including at least one selectable function mapped to one of a plurality of push buttons; and

transmitting light through an illuminable element adjacent to each push button to provide a lighting effect around the periphery of the one push button mapped to the one selectable function to denote that the push button is active for the displayed page.

10. The method of claim 9 wherein the illuminable element is seated in a recess surrounding the push button.

11. The method of claim 9 wherein the one selectable push button is in the shape of a rectangle having rounded corners.

12. The method of claim 9 wherein the page of information includes multiple selectable functions mapped to respective ones of the push buttons,

the illuminable element of each of the respective ones of the active push buttons becomes illuminated during display of the page.

13. The method of claim 9 wherein for different pages displayed on the display there are respective different selectable functions mapped to different ones of the push buttons.

14. The method of claim 13 wherein for each different page, during display of that page the illuminable elements of the ones of the push buttons having a selectable functions mapped thereto, being illuminated.

15. The method of claim 9, wherein the illuminable element is a light pipe.

16. The method of claim 9, wherein the illuminable element is a pair of light emitting diodes.

17. A display system comprising:

means for displaying a page of information on a screen of the display system, the page including at least one selectable function mapped to one of a plurality of push buttons; and

means for transmitting light through an illuminable element adjacent to each push button to provide a lighting effect around the periphery of the one push button mapped to the one selectable function to denote that the push button is active for the displayed page.

* * * * *