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Kwong et al.

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(54) **DISPLAY FOR ELECTRONIC DEVICE**

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(73) Assignee: **Intel Corporation**, Santa Clara, CA (US)

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G09G 3/36	(2006.01)
G02F 1/1333	(2006.01)

(52) **U.S. Cl.**

CPC ***G02F 1/1336*** (2013.01); ***G09G 3/36*** (2013.01); *G02F 1/13338* (2013.01); *G02F 2001/133342* (2013.01); *G09G 2300/023* (2013.01); *G09G 2360/04* (2013.01)

(58) **Field of Classification Search**

CPC G02F 1/13; G02F 1/13338
USPC 345/1.1, 102, 173
See application file for complete search history.

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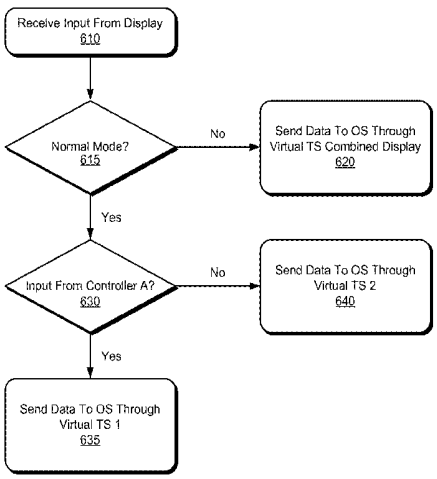
(74) *Attorney, Agent, or Firm* — Alpine Technology Law Group LLC

(57) **ABSTRACT**

In one embodiment a display assembly comprises a backlight assembly, a first display panel proximate a first side of the backlight assembly, wherein the first liquid crystal panel is to be communicatively coupled to a controller, and a second display panel proximate a second side of the backlight assembly, opposite the first side, wherein the second display panel is to be communicatively coupled to the controller. Other embodiments may be described.

20 Claims, 7 Drawing Sheets



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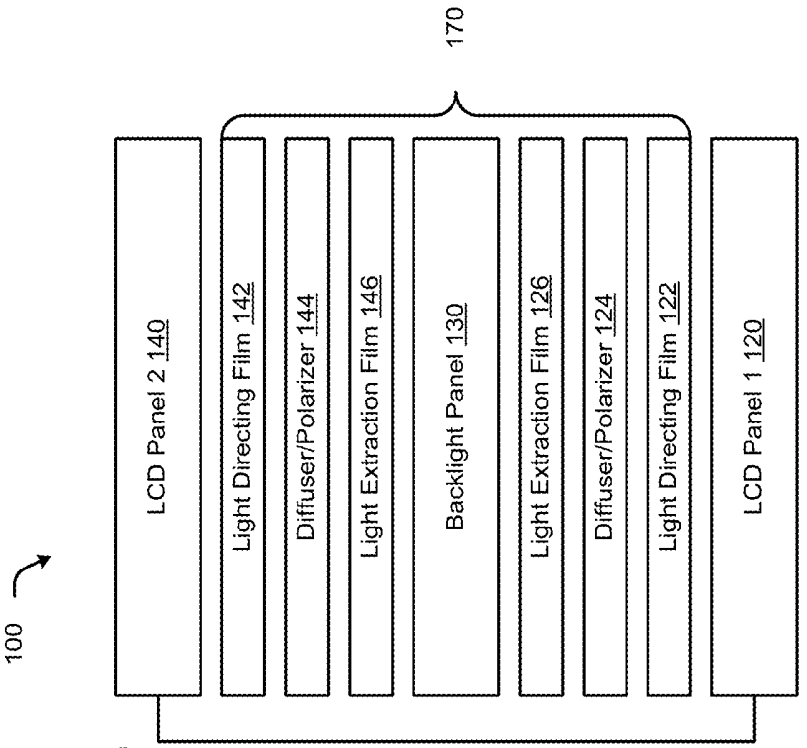

FIG. 1C

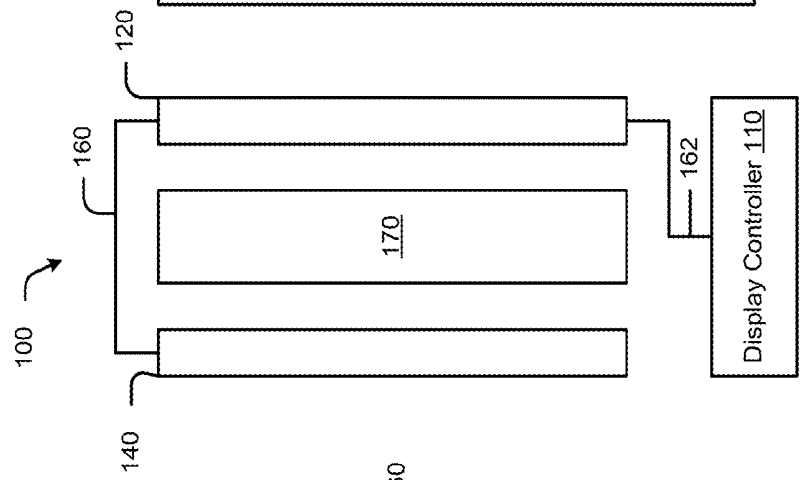

FIG. 1B

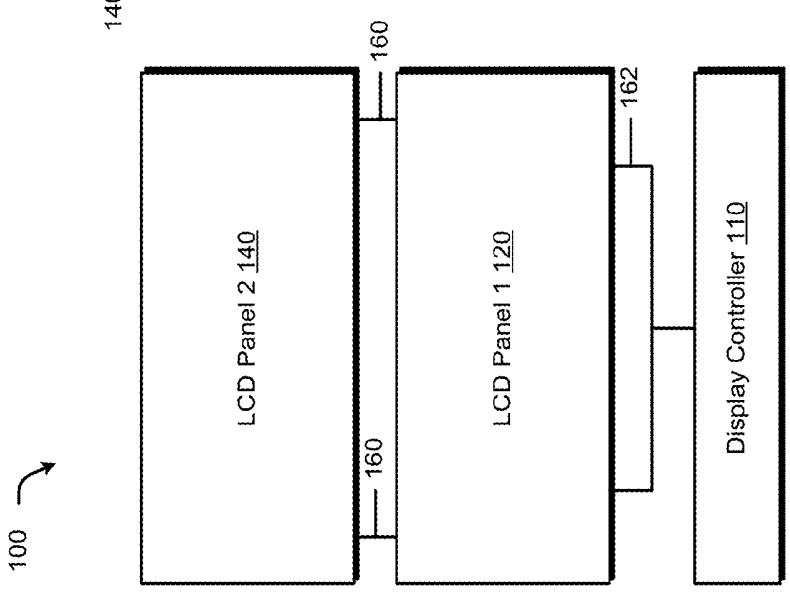

FIG. 1A

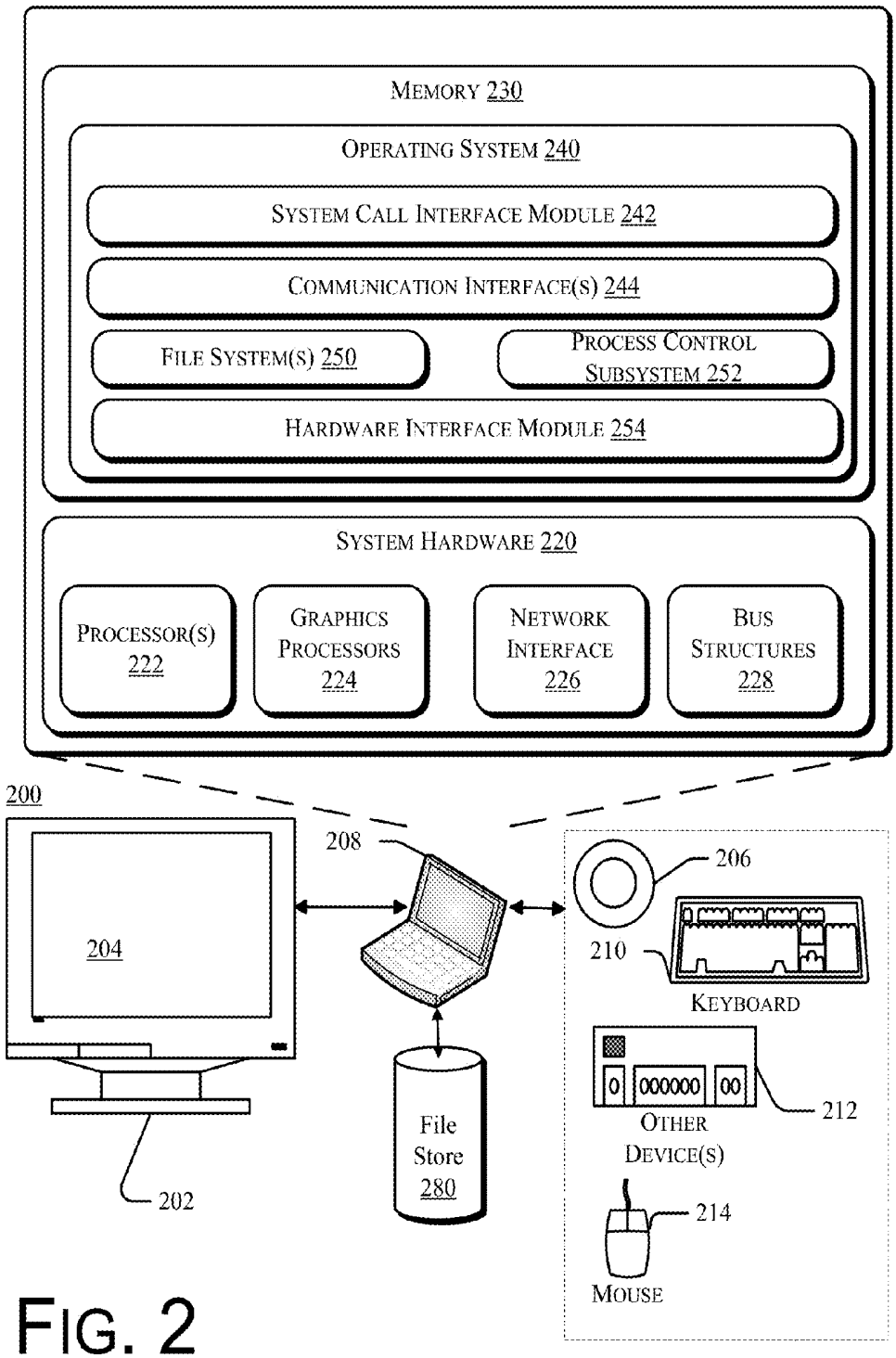
MEMORY 230
OPERATING SYSTEM 240
SYSTEM CALL INTERFACE MODULE 242
COMMUNICATION INTERFACE(S) 244
FILE SYSTEM(S) 250
PROCESS CONTROL SUBSYSTEM 252
HARDWARE INTERFACE MODULE 254
SYSTEM HARDWARE 220
PROCESSOR(S) 222
GRAPHICS PROCESSORS 224
NETWORK INTERFACE 226
BUS STRUCTURES 228
200
208
206
210
KEYBOARD
204
212
OTHER DEVICE(S)
214
MOUSE
File Store 280
202

FIG. 2

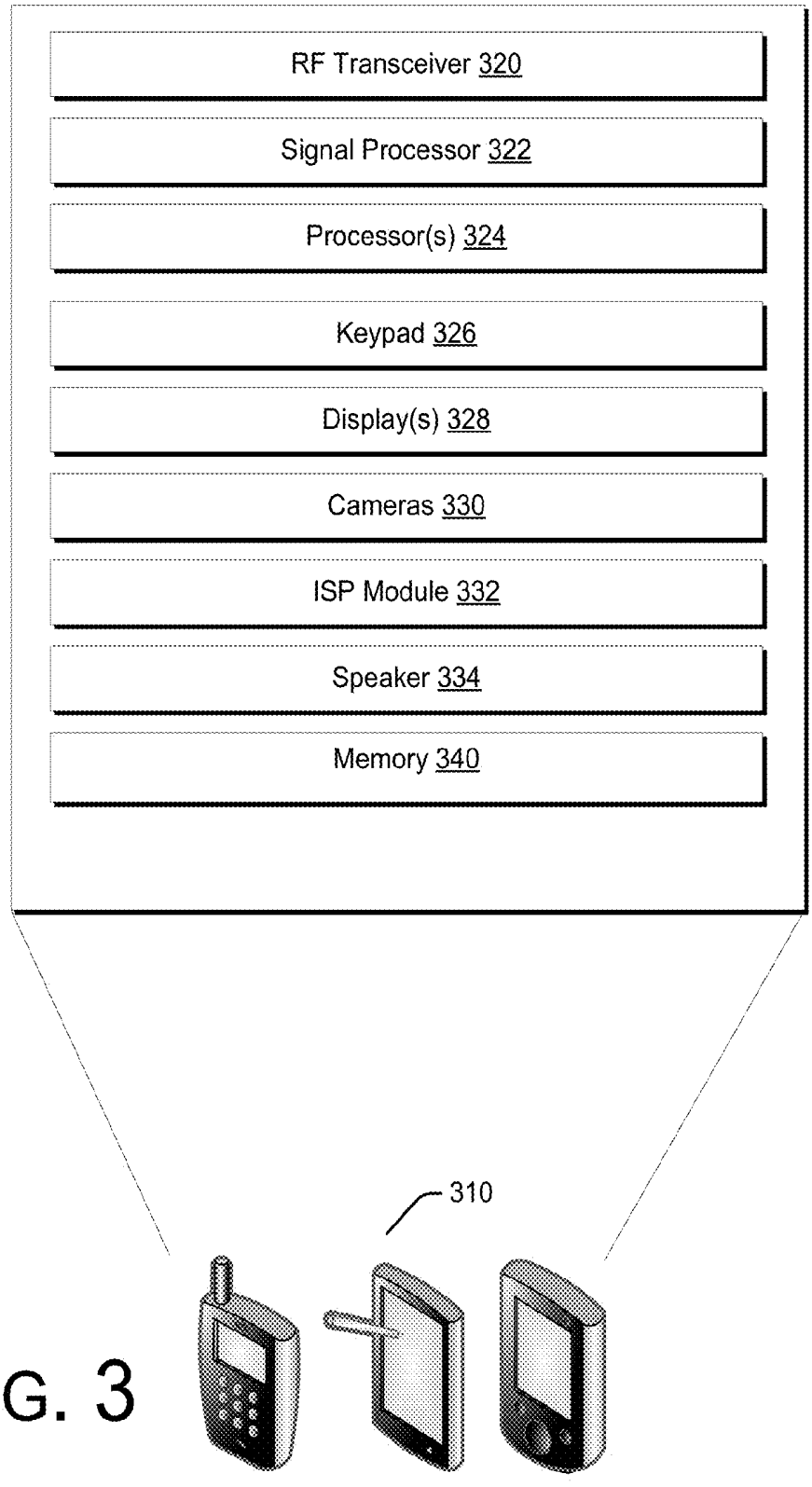
RF Transceiver 320
Signal Processor 322
Processor(s) 324
Keypad 326
Display(s) 328
Cameras 330
ISP Module 332
Speaker 334
Memory 340
310

FIG. 3

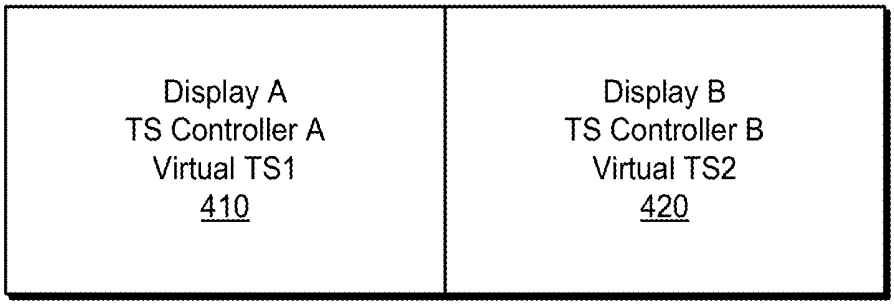
Display A
TS Controller A
Virtual TS1
410
Display B
TS Controller B
Virtual TS2
420

FIG. 4A

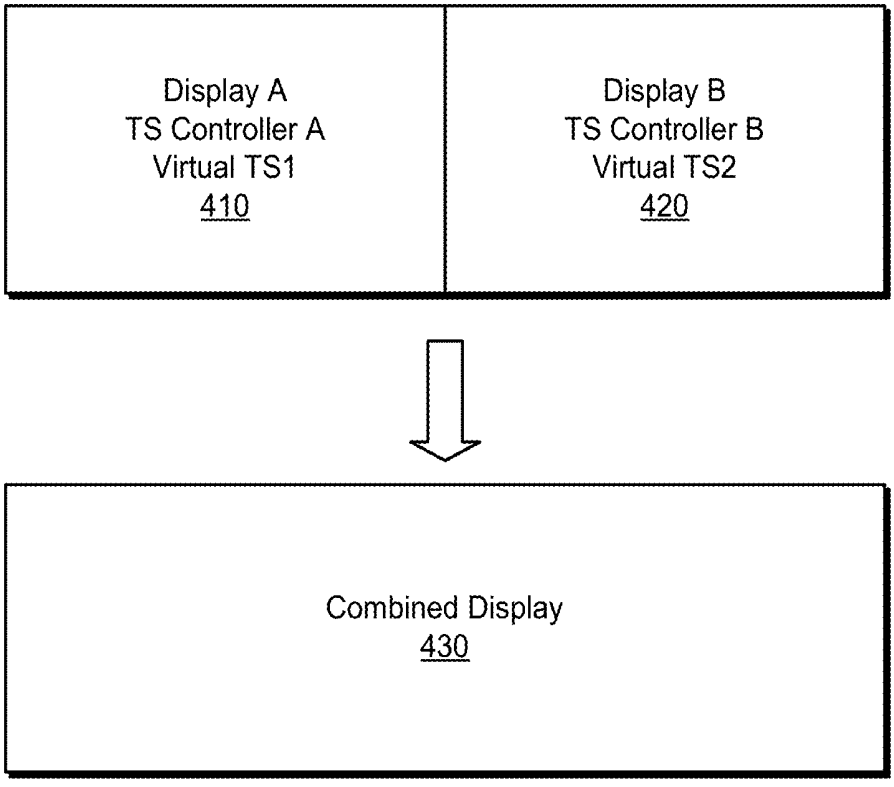
Display A
TS Controller A
Virtual TS1
410
Display B
TS Controller B
Virtual TS2
420
Combined Display
430

FIG. 4B

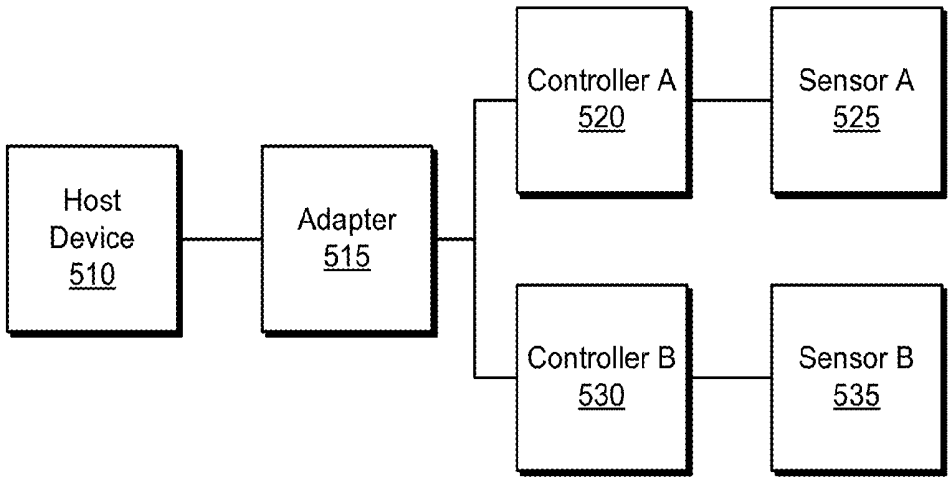
Host Device 510
Adapter 515
Controller A 520
Sensor A 525
Controller B 530
Sensor B 535

FIG. 5

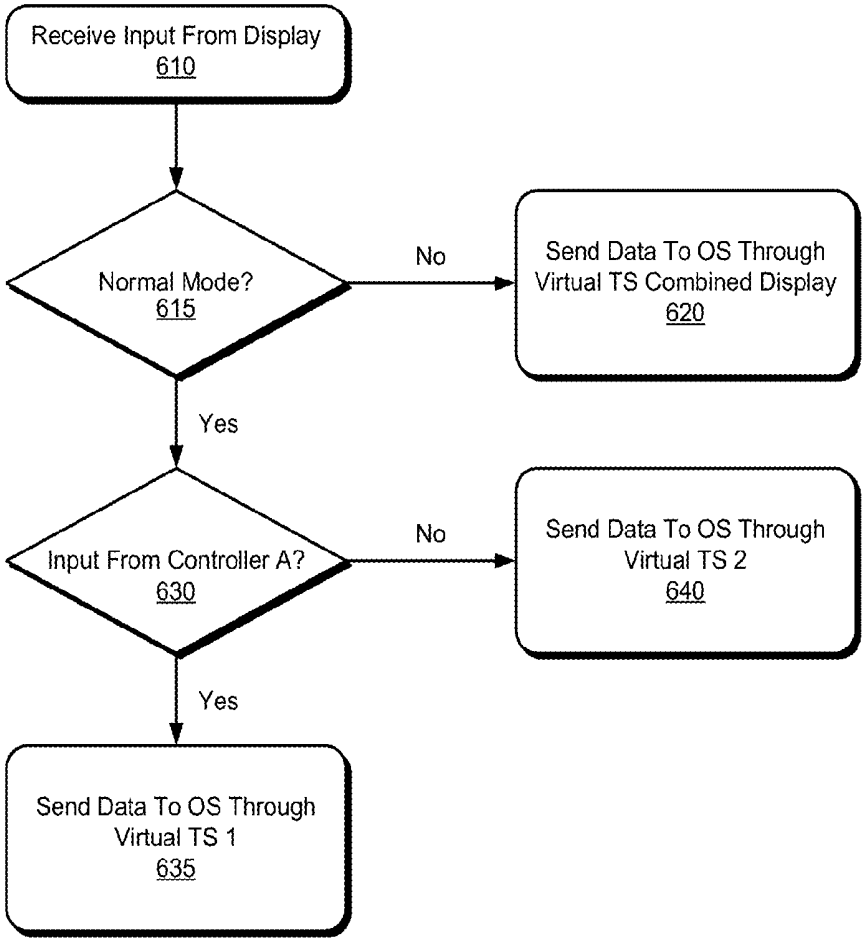
Receive Input From Display 610
Normal Mode? 615
No
Send Data To OS Through Virtual TS Combined Display 620
Yes
Input From Controller A? 630
No
Send Data To OS Through Virtual TS 2 640
Yes
Send Data To OS Through Virtual TS 1 635

FIG. 6

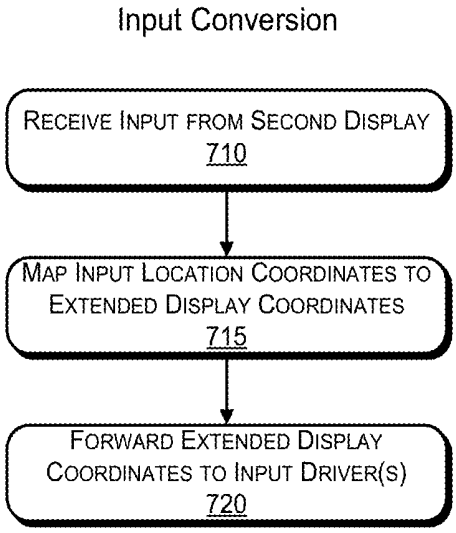
Input Conversion
RECEIVE INPUT FROM SECOND DISPLAY
710
MAP INPUT LOCATION COORDINATES TO EXTENDED DISPLAY COORDINATES
715
FORWARD EXTENDED DISPLAY COORDINATES TO INPUT DRIVER(S)
720

FIG. 7A

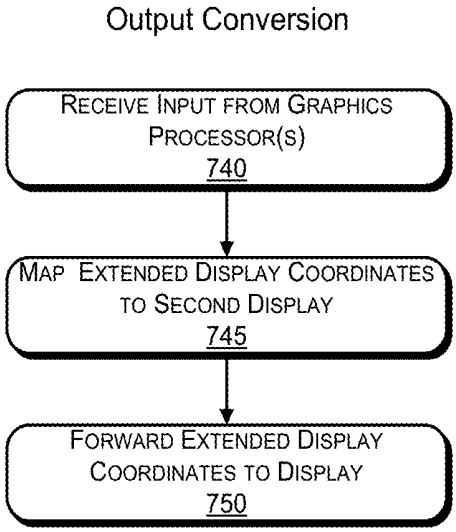
Output Conversion
RECEIVE INPUT FROM GRAPHICS PROCESSOR(S)
740
MAP EXTENDED DISPLAY COORDINATES TO SECOND DISPLAY
745
FORWARD EXTENDED DISPLAY COORDINATES TO DISPLAY
750

FIG. 7B

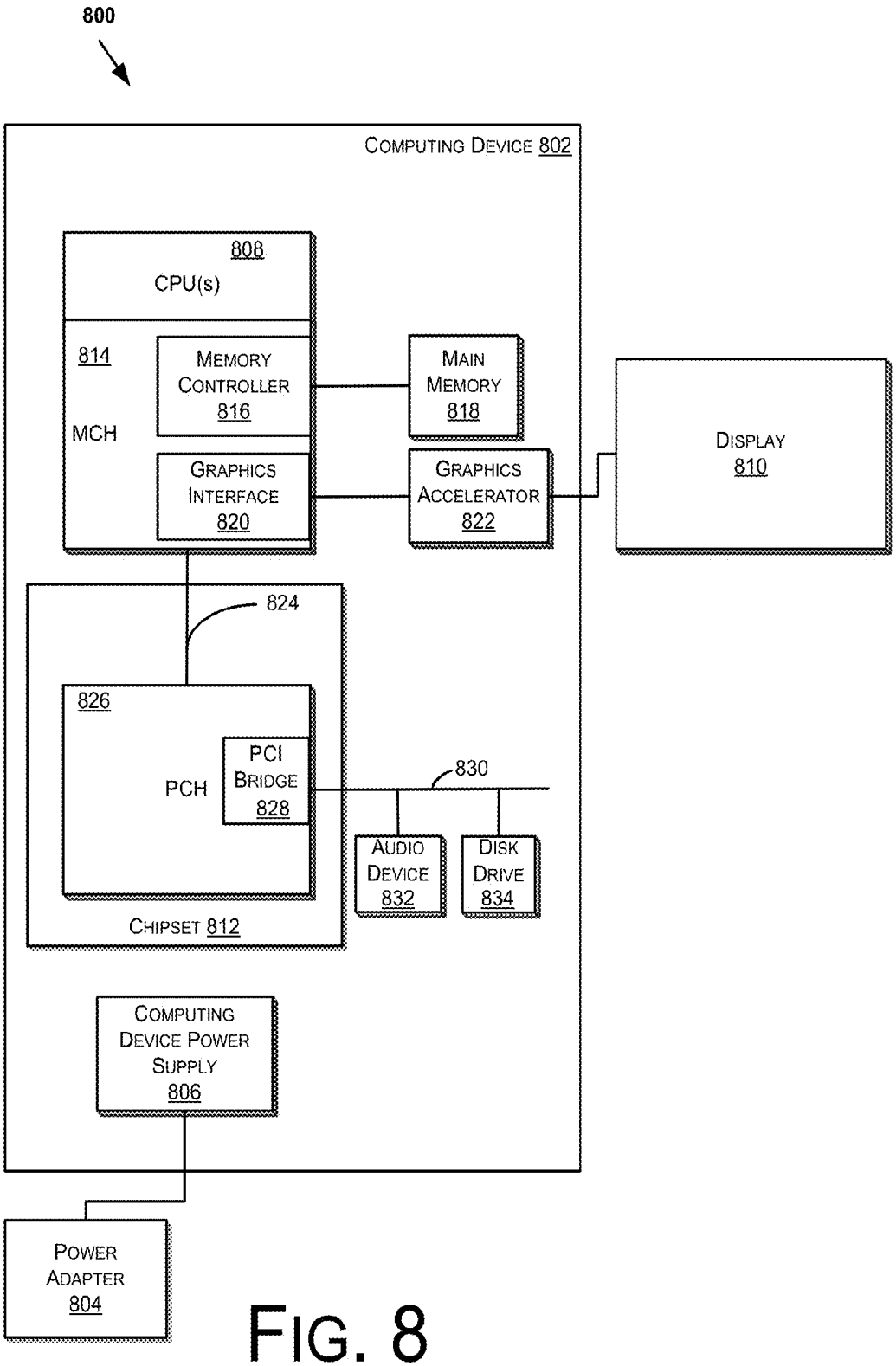
800
COMPUTING DEVICE 802
808
CPU(s)
814
MCH
MEMORY CONTROLLER 816
GRAPHICS INTERFACE 820
MAIN MEMORY 818
GRAPHICS ACCELERATOR 822
DISPLAY 810
824
826
PCH
PCI BRIDGE 828
830
AUDIO DEVICE 832
DISK DRIVE 834
CHIPSET 812
COMPUTING DEVICE POWER SUPPLY 806
POWER ADAPTER 804

FIG. 8

DISPLAY FOR ELECTRONIC DEVICE

RELATED APPLICATIONS

None.

BACKGROUND

The subject matter described herein relates generally to the field of electronic devices and more particularly to a display assembly for electronic devices.

Electronic devices such as, e.g., laptop computers, notebook computers, tablet computers, and the like have traditionally had a single display. In some situations it may be useful for an electronic device to include two displays accordingly display assemblies for electronic commerce may find utility.

BRIEF DESCRIPTION OF THE DRAWINGS

The detailed description is described with reference to the accompanying figures.

FIGS. **1**A-**1**C are schematic illustrations of an exemplary backlight assembly for electronic devices in accordance with some embodiments.

FIGS. **2** and **3** are high-level schematic illustrations of electronic device which may be adapted to include displays in accordance with some embodiments.

FIGS. **4**A-**4**B and **5** are schematic illustrations of architectures for displays in accordance with some embodiments.

FIG. **6** is a flowchart illustrating operations in a method to manage displays for electronic devices in accordance with some embodiments.

FIGS. **7**A-**7**B are flowcharts illustrating operations in a method to convert location coordinates for a display in accordance with some embodiments.

FIG. **8** is a schematic illustration of an electronic device which may be including displays in accordance with some embodiments.

DETAILED DESCRIPTION

Described herein are exemplary systems and methods to implement displays in electronic devices. In some embodiments described herein first and second liquid crystal display (LCD) panels are configured to share a common backlight assembly and a single display controller. The display controller maps inputs from and outputs to the second LCD panel onto a virtual extended LCD panel, such that the second LCD panel is presented as an extension of the first LCD panel to other components of the electronic device. This enables a low-cost dual display assembly to be integrated into electronic devices without modifications to other components of the electronic devices.

In the following description, numerous specific details are set forth to provide a thorough understanding of various embodiments. However, it will be understood by those skilled in the art that the various embodiments may be practiced without the specific details. In other instances, well-known methods, procedures, components, and circuits have not been illustrated or described in detail so as not to obscure the particular embodiments.

FIGS. **1**A-**1**C are schematic illustrations of an exemplary backlight assembly for electronic devices in accordance with some embodiments. Referring to FIGS. **1**A-**1**C, in some embodiments a display assembly **100** comprises a display controller **110**, a first LCD panel **120** and a second LCD panel **140**. The first LCD panel **120** is communicatively coupled to the display controller **110** via a suitable communication bus **162**.

The second LCD panel **140** is also coupled to the display controller **110**. In some embodiments the second LCD panel **140** may be coupled to the display controller **110** via a communication connection with the first LCD panel **120**. By way of example, in some embodiments the second LCD panel may be connected to the first LCD panel by one or more flexible ribbon cables **160**.

As illustrated in FIG. **1**B, in some embodiments the first LCD panel **120** and the second LCD panel **140** may be positioned proximate a first side of a backlight assembly **170** and the second LCD panel **140** may be positioned proximate a second side of the backlight assembly **170**, such that the first LCD panel **120** and the second LCD panel **140** share the backlight assembly **170**. In the embodiment depicted in FIG. **1**B the second LCD panel **140** is communicatively connected to the display controller **140** via the first LCD panel **120** provided by ribbon cable(s) **160**. In alternate embodiments the second LCD panel **140** may have a direct communication connection to display controller **110** via a suitable communication bus.

FIG. **1**C is a schematic view of backlight assembly **170**, according to some embodiments. Referring to FIG. **1**C, backlight assembly may comprise a backlight panel **130**. A light extraction layer **126**, a diffuser **124** and a light directing layer **122** is disposed proximate a first side of the backlight panel **130**. Similarly, a light extraction layer **146**, a diffuser **144** and a light directing layer **142** is disposed proximate a second side of the backlight panel **130**. In some embodiments, diffuser **144** may also act as a polarizer to polarize light emitted by light-emitting diodes (LEDs) in the backlight assembly.

A first LCD panel **120** is positioned adjacent light directing layer **122** and a second LCD panel **140** is positioned adjacent light directing layer **142**. In some embodiments, LCD panel may be a twisted nematic LCD, an in-plane switching LCD, or a vertical alignment (VA) LCD and may comprise other components for the display image formation such as TFT backplane, polarizer, analyzer, color filter array, etc. In alternate embodiments the display may comprise an OLED display, which does not require a backlight.

FIG. **2** is a schematic illustration of an exemplary system which may be adapted to include a backlight assembly as described herein, in accordance with some embodiments. In one embodiment, system **200** includes an electronic device **208** and one or more accompanying input/output devices including a display **202** having a screen **204**, one or more speakers **206**, a keyboard **210**, one or more other I/O device(s) **212**, and a mouse **214**. The other I/O device(s) **212** may include a touch screen, a voice-activated input device, a track ball, and any other device that allows the system **200** to receive input from a user.

In various embodiments, the electronic device **208** may be embodied as a personal computer, a laptop computer, a personal digital assistant, a mobile telephone, an entertainment device, or another computing device. In one embodiment, the computing device further comprises a housing having a lid **207**.

The electronic device **208** includes system hardware **220** and memory **230**, which may be implemented as random access memory and/or read-only memory. A file store **280** may be communicatively coupled to computing device **208**. File store **280** may be internal to electronic device **208** such as, e.g., one or more hard drives, CD-ROM drives, DVD-ROM drives, or other types of storage devices. File store **280**

may also be external to electronic device **208** such as, e.g., one or more external hard drives, network attached storage, or a separate storage network.

System hardware **220** may include one or more processors **222**, at least two graphics processors **224**, network interfaces **226**, and bus structures **228**. In one embodiment, processor **222** may be embodied as an Intel® Core2 Duo® processor available from Intel Corporation, Santa Clara, Calif., USA. As used herein, the term "processor" means any type of computational element, such as but not limited to, a microprocessor, a microcontroller, a complex instruction set computing (CISC) microprocessor, a reduced instruction set (RISC) microprocessor, a very long instruction word (VLIW) microprocessor, or any other type of processor or processing circuit.

In some embodiments one of the processors **222** in system hardware **220** may comprise a low-power embedded processor, referred to herein as a manageability engine (ME). The manageability engine **222** may be implemented as an independent integrated circuit or may be a dedicated portion of a larger processor **222**.

Graphics processor(s) **224** may function as adjunct processor that manages graphics and/or video operations. Graphics processor(s) **224** may be integrated onto the motherboard of electronic device **208** or may be coupled via an expansion slot on the motherboard.

In one embodiment, network interface **226** could be a wired interface such as an Ethernet interface (see, e.g., Institute of Electrical and Electronics Engineers/IEEE 802.3-2002) or a wireless interface such as an IEEE 802.11a, b or g-compliant interface (see, e.g., IEEE Standard for IT-Telecommunications and information exchange between systems LAN/MAN—Part II: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications Amendment 4: Further Higher Data Rate Extension in the 2.4 GHz Band, 802.11 G-2003). Another example of a wireless interface would be a general packet radio service (GPRS) interface (see, e.g., Guidelines on GPRS Handset Requirements, Global System for Mobile Communications/GSM Association, Ver. 3.0.1, December 2002).

Bus structures **228** connect various components of system hardware **228**. In one embodiment, bus structures **228** may be one or more of several types of bus structure(s) including a memory bus, a peripheral bus or external bus, and/or a local bus using any variety of available bus architectures including, but not limited to, 11-bit bus, Industrial Standard Architecture (ISA), Micro-Channel Architecture (MSA), Extended ISA (EISA), Intelligent Drive Electronics (IDE), VESA Local Bus (VLB), Peripheral Component Interconnect (PCI), Universal Serial Bus (USB), Advanced Graphics Port (AGP), Personal Computer Memory Card International Association bus (PCMCIA), and Small Computer Systems Interface (SCSI).

Memory **230** may include an operating system **240** for managing operations of electronic device **208**. In one embodiment, operating system **240** includes a hardware interface module **254** that provides an interface to system hardware **220**. In addition, operating system **240** may include a file system **250** that manages files used in the operation of computing device **208** and a process control subsystem **252** that manages processes executing on electronic device **208**.

Operating system **240** may include (or manage) one or more communication interfaces that may operate in conjunction with system hardware **220** to transceive data packets and/or data streams from a remote source. Operating system **240** may further include a system call interface module **242** that provides an interface between the operating system **240** and one or more application modules resident in memory **230**. Operating system **240** may be embodied as a UNIX operating system or any derivative thereof (e.g., Linux, Solaris, etc.) or as a Windows® brand operating system, or other operating systems.

FIG. **3** is a schematic illustration of another embodiment of an electronic device **310** which may be adapted to include a backlight assembly as described herein, according to embodiments. In some embodiments electronic device **310** may be embodied as a mobile telephone, a personal digital assistant (PDA), a laptop computer, or the like. Electronic device **310** may include an RF transceiver **320** to transceive RF signals and a signal processing module **322** to process signals received by RF transceiver **320**.

RF transceiver **320** may implement a local wireless connection via a protocol such as, e.g., Bluetooth or 802.11x. IEEE 802.11a, b or g-compliant interface (see, e.g., IEEE Standard for IT-Telecommunications and information exchange between systems LAN/MAN—Part II: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications Amendment 4: Further Higher Data Rate Extension in the 2.4 GHz Band, 802.11 G-2003). Another example of a wireless interface would be a general packet radio service (GPRS) interface (see, e.g., Guidelines on GPRS Handset Requirements, Global System for Mobile Communications/GSM Association, Ver. 3.0.1, December 2002).

Electronic device **310** may further include one or more processors **324** and a memory module **340**. As used herein, the term "processor" means any type of computational element, such as but not limited to, a microprocessor, a microcontroller, a complex instruction set computing (CISC) microprocessor, a reduced instruction set (RISC) microprocessor, a very long instruction word (VLIW) microprocessor, or any other type of processor or processing circuit. In some embodiments, processor **324** may be one or more processors in the family of Intel® PXA27x processors available from Intel® Corporation of Santa Clara, Calif. Alternatively, other CPUs may be used, such as Intel's Itanium®, XEON™, ATOM™, and Celeron® processors. Also, one or more processors from other manufactures may be utilized. Moreover, the processors may have a single or multi core design.

In some embodiments, memory module **340** includes random access memory (RAM); however, memory module **340** may be implemented using other memory types such as dynamic RAM (DRAM), synchronous DRAM (SDRAM), and the like. Memory **340** may comprise one or more applications which execute on the processor(s) **322**.

Electronic device **310** may further include one or more input/output interfaces such as, e.g., a keypad **326** and one or more displays **328**. In some embodiments electronic device **310** comprises one or more camera modules **330** and an image signal processor **332**, and speakers **334**.

In some embodiments two displays may be presented to the host device as two separate displays. By way of example, referring to FIG. **4**A, in some embodiments the two displays may be embodied as touch screens. A first display **410** may comprise a touch screen controller and a second display **420** may comprise a second touch screen controller. In one mode of operation, referred to herein as a normal mode, the first display **410** and the second display **420** may be exposed to the host device's operating system as separate displays.

In some embodiments electronic devices allow only a single touch screen to be active. In order to implement a display with two touch screens the two screens are presented to the host device as a single display by combining the frame buffers. By way of example, referring to FIG. **4**B, in some

embodiments the first display **410** and the second display **420** are exposed to the host device's operating system as a single, combined display **430**.

FIG. **5** is a schematic illustration of an architecture to implement a dual touch device. Referring to FIG. **5**, a host device **515** is coupled to a touch adapter **515** by a suitable connection, e.g., a universal serial bus (USB) link. A first touch controller **520** is coupled to a first sensor **525**, which may be embodied as a touch screen sensor. Similarly, a second controller **530** is coupled to a second sensor **535**.

FIG. **6** is a flowchart illustrating operations in a method to manage displays for electronic devices in accordance with some embodiments. Referring to FIG. **6**, at operation **610** a touch screen driver receives input from a touch screen. If, at operation **615** the display is not operating in normal mode (i.e., if the display is operating in a combined mode) then control passes to operation **620** and the touch screen input data is sent to the operating system through the virtual touch screen combined display.

By contrast, if at operation **615** the display is operating in normal mode, then control passes to operation **630**. If, at operation **630** the touch screen input is from controller A **520**, then the touch screen data is sent to the operating system through virtual touch screen 1 (operation **635**). By contrast, if at operation **630** the input did not come from controller A **520**, then the touch screen data is sent to the operating system through virtual touch screen 2 (operation **640**).

As described above, in some embodiments the display controller **110** is configured to present the second LCD panel **140** as an extension of the first LED panel **120**. By way of example, if the first and second LCD panels have a resolution of 1920×1080 pixels, the display controller **110** is configured to present the LCD panels **120**, **140** as an extended LCD panel having a resolution of 1920×2160, or 3940×1080 pixels. In such embodiments the display controller **110** implements a method to convert location coordinates associated with inputs to and outputs from the second LCD panel **140** from the actual coordinates on the second LCD panel to coordinates on the extended LCD panel. One skilled in the art will recognize that the LCD panels could have different resolutions, e.g., 2560×1400, or 3200×1600.

FIGS. **7**A and **7**B are flowcharts illustrating operations in a method to convert location coordinates for a display in accordance with some embodiments. In the embodiments depicted the operations depicted in the flowchart of FIGS. **7**A-**7**B may be implemented by the display controller **110**.

FIG. **7**A is a flowchart illustrating operations in an exemplary input location conversion method. Referring first to FIG. **7**A, at operation **710** the display controller **110** receives an input from the second LCD panel **140**. By way of example, the input may originate from an input device such as a mouse, a keyboard, or the like, or from a touch on a touch screen. At operation **715** the display controller maps the input location coordinates from the second LCD panel **140** to coordinates on an extended panel. By way of illustration, in an embodiment in which two 1920×1080 displays are presented as a single extended display with a resolution of 1920×2160, the display controller may add **1080** to the row location coordinate on the second display to obtain the row location in the extended display. Because the displays are combined in a vertical fashion the column location coordinate remains the same. One skilled in the art will recognize that similar mapping conversions may be performed for LCD panels of different resolutions. At operation **720** the display controller forwards the converted location coordinates to one or more input drivers on the electronic device.

FIG. **7**B is a flowchart illustrating operations in an exemplary output location coordinate conversion method. Referring to FIG. **7**B, at operation **740** the display controller **110** receives an input from a graphics processor such as the graphics processor **224** depicted in FIG. **2**. As described above, the display controller **110** presents the LCD panels **120**, **140** as a single, extended display. Thus, the input from the graphics controller is mapped to the extended display. At operation **745** the display controller maps the location coordinates received from the graphics controller **224** to the second display. By way of illustration, in an embodiment in which two 1920×1080 displays are presented as a single extended display with a resolution of 1920×2160, the display controller may subtract 1080 from the row location coordinate on the extended display to obtain the row location in the second display. Again, because the displays are combined in a vertical fashion the column location coordinate remains the same. One skilled in the art will recognize that similar mapping conversions may be performed for LCD panels of different resolutions. At operation **750** the display controller forwards the converted location coordinates to the display.

As described above, in some embodiments the electronic device may be embodied as a computer system. FIG. **8** is a schematic illustration of a computer system **800** in accordance with some embodiments. The computer system **800** includes a computing device **802** and a power adapter **804** (e.g., to supply electrical power to the computing device **802**). The computing device **802** may be any suitable computing device such as a laptop (or notebook) computer, a personal digital assistant, a desktop computing device (e.g., a workstation or a desktop computer), a rack-mounted computing device, and the like.

Electrical power may be provided to various components of the computing device **802** (e.g., through a computing device power supply **806**) from one or more of the following sources: one or more battery packs, an alternating current (AC) outlet (e.g., through a transformer and/or adaptor such as a power adapter **804**), automotive power supplies, airplane power supplies, and the like. In some embodiments, the power adapter **804** may transform the power supply source output (e.g., the AC outlet voltage of about 110 VAC to 240 VAC) to a direct current (DC) voltage ranging between about 7 VDC to 12.6 VDC. Accordingly, the power adapter **804** may be an AC/DC adapter.

The computing device **802** may also include one or more central processing unit(s) (CPUs) **808**. In some embodiments, the CPU **808** may be one or more processors in the Pentium® family of processors including the Pentium® II processor family, Pentium® III processors, Pentium® IV, CORE2 Duo processors, or Atom processors available from Intel® Corporation of Santa Clara, Calif. Alternatively, other CPUs may be used, such as Intel's Itanium®, XEON™, and Celeron® processors. Also, one or more processors from other manufactures may be utilized. Moreover, the processors may have a single or multi core design.

A chipset **812** may be coupled to, or integrated with, CPU **808**. The chipset **812** may include a memory control hub (MCH) **814**. The MCH **814** may include a memory controller **816** that is coupled to a main system memory **818**. The main system memory **818** stores data and sequences of instructions that are executed by the CPU **808**, or any other device included in the system **800**. In some embodiments, the main system memory **818** includes random access memory (RAM); however, the main system memory **818** may be implemented using other memory types such as dynamic RAM (DRAM), synchronous DRAM (SDRAM), and the

like. Additional devices may also be coupled to the bus **810**, such as multiple CPUs and/or multiple system memories.

The MCH **814** may also include a graphics interface **820** coupled to a graphics accelerator **822**. In some embodiments, the graphics interface **820** is coupled to the graphics accelerator **822** via an accelerated graphics port (AGP). In some embodiments, a display (such as a flat panel display) **840** may be coupled to the graphics interface **820** through, for example, a signal converter that translates a digital representation of an image stored in a storage device such as video memory or system memory into display signals that are interpreted and displayed by the display. The display **840** signals produced by the display device may pass through various control devices before being interpreted by and subsequently displayed on the display.

A hub interface **824** couples the MCH **814** to an platform control hub (PCH) **826**. The PCH **826** provides an interface to input/output (I/O) devices coupled to the computer system **800**. The PCH **826** may be coupled to a peripheral component interconnect (PCI) bus. Hence, the PCH **826** includes a PCI bridge **828** that provides an interface to a PCI bus **830**. The PCI bridge **828** provides a data path between the CPU **808** and peripheral devices. Additionally, other types of I/O interconnect topologies may be utilized such as the PCI Express™ architecture, available through Intel® Corporation of Santa Clara, Calif.

The PCI bus **830** may be coupled to an audio device **832** and one or more disk drive(s) **834**. Other devices may be coupled to the PCI bus **830**. In addition, the CPU **808** and the MCH **814** may be combined to form a single chip. Furthermore, the graphics accelerator **822** may be included within the MCH **814** in other embodiments.

Additionally, other peripherals coupled to the PCH **826** may include, in various embodiments, integrated drive electronics (IDE) or small computer system interface (SCSI) hard drive(s), universal serial bus (USB) port(s), a keyboard, a mouse, parallel port(s), serial port(s), floppy disk drive(s), digital output support (e.g., digital video interface (DVI)), and the like. Hence, the computing device **802** may include volatile and/or nonvolatile memory.

The terms "logic instructions" as referred to herein relates to expressions which may be understood by one or more machines for performing one or more logical operations. For example, logic instructions may comprise instructions which are interpretable by a processor compiler for executing one or more operations on one or more data objects. However, this is merely an example of machine-readable instructions and embodiments are not limited in this respect.

The terms "computer readable medium" as referred to herein relates to media capable of maintaining expressions which are perceivable by one or more machines. For example, a computer readable medium may comprise one or more storage devices for storing computer readable instructions or data. Such storage devices may comprise storage media such as, for example, optical, magnetic or semiconductor storage media. However, this is merely an example of a computer readable medium and embodiments are not limited in this respect.

The term "logic" as referred to herein relates to structure for performing one or more logical operations. For example, logic may comprise circuitry which provides one or more output signals based upon one or more input signals. Such circuitry may comprise a finite state machine which receives a digital input and provides a digital output, or circuitry which provides one or more analog output signals in response to one or more analog input signals. Such circuitry may be provided in an application specific integrated circuit (ASIC) or field programmable gate array (FPGA). Also, logic may comprise machine-readable instructions stored in a memory in combination with processing circuitry to execute such machine-readable instructions. However, these are merely examples of structures which may provide logic and embodiments are not limited in this respect.

Some of the methods described herein may be embodied as logic instructions on a computer-readable medium. When executed on a processor, the logic instructions cause a processor to be programmed as a special-purpose machine that implements the described methods. The processor, when configured by the logic instructions to execute the methods described herein, constitutes structure for performing the described methods. Alternatively, the methods described herein may be reduced to logic on, e.g., a field programmable gate array (FPGA), an application specific integrated circuit (ASIC) or the like.

In the description and claims, the terms coupled and connected, along with their derivatives, may be used. In particular embodiments, connected may be used to indicate that two or more elements are in direct physical or electrical contact with each other. Coupled may mean that two or more elements are in direct physical or electrical contact. However, coupled may also mean that two or more elements may not be in direct contact with each other, but yet may still cooperate or interact with each other.

Reference in the specification to "one embodiment" or "some embodiments" means that a particular feature, structure, or characteristic described in connection with the embodiment is included in at least an implementation. The appearances of the phrase "in one embodiment" in various places in the specification may or may not be all referring to the same embodiment.

Although embodiments have been described in language specific to structural features and/or methodological acts, it is to be understood that claimed subject matter may not be limited to the specific features or acts described. Rather, the specific features and acts are disclosed as sample forms of implementing the claimed subject matter.

What is claimed is:

1. A display assembly, comprising:

a backlight assembly;

a first display panel proximate a first side of the backlight assembly, wherein the first display panel is to be communicatively coupled to a first touch screen controller to receive first touch screen input data from the first touch screen, the first display panel having a first resolution;

a second display panel proximate a second side of the backlight assembly, opposite the first side, wherein the second display panel is to be communicatively coupled to a second touch screen controller to receive second touch screen input data from the second touch screen, the second display panel having a second resolution; and

a display controller communicatively coupled to the first display panel and the second display panel, wherein the display controller comprises logic, at least partially including hardware logic, to:

manage first touch screen input data and second touch screen data separately when the display assembly is operating in a normal operating mode; and

in response to a determination that the display assembly is operating in a combined operation mode, to:

receive, in the display controller, touch screen data from the second display panel, wherein the touch screen data corresponds to location coordinates on the second display panel;

convert the touch screen data from the second display panel to an output corresponding to location coordinates on a virtual extended display, the virtual display panel having a third resolution corresponding to a combination of the first resolution and the second resolution; and

forward the output corresponding to the location coordinates on the virtual extended display to an input driver.

2. The display assembly of claim **1**, wherein the backlight assembly comprises:

a backlight panel;

a first light extraction layer proximate a first side of the backlight panel;

a first diffuser layer proximate the first light extraction layer;

a first light directing layer proximate the first diffuser layer;

a second light extraction layer proximate a second side of the backlight panel;

a second diffuser layer proximate the second light extraction layer; and

a second light directing layer proximate the second diffuser layer.

3. The display assembly of claim **1**, wherein the display controller further comprises logic, at least partially including hardware logic, to:

receive, in the display controller, an output from a graphics processor, wherein the output corresponds to location coordinates on the virtual extended display;

convert the output corresponding to the location coordinates on the virtual extended display to data corresponding to location coordinates on the second display panel; and

forward the data corresponding to location coordinates to the second display panel.

4. The display assembly of claim **3**, wherein:

the second display panel is to be communicatively coupled to the controller via a communication connection with the first display panel.

5. The display assembly of claim **3**, wherein:

at least one of the first display panel or the second display panel comprises a liquid crystal panel.

6. The display assembly of claim **1**, wherein:

the first display has a first resolution of M×N pixels;

the second display has a second resolution of M×N pixels; and

the extended display has a combined resolution of M×2N pixels.

7. The display assembly of claim **1**, wherein:

the first display has a first resolution of 1920×1080 pixels;

the second display has a second resolution of 1920×1080 pixels; and

the extended display has a combined resolution of 1920×2160 pixels.

8. An electronic device, comprising:

an electronic component;

a backlight assembly;

a first display panel proximate a first side of the backlight assembly, wherein the first display panel is to be communicatively coupled to a first touch screen controller to receive first touch screen input data from the first touch screen, the first display panel having a first resolution;

a second display panel proximate a second side of the backlight assembly, opposite the first side, wherein the second display panel is to be communicatively coupled to a second touch screen controller to receive second touch screen input data from the second touch screen, the second display panel having a second resolution; and

a display controller communicatively coupled to the first display panel and the second display panel, wherein the display controller comprises logic, at least partially including hardware logic, to:

manage first touch screen input data and second touch screen data separately when the display assembly is operating in a normal operating mode; and

in response to a determination that the display assembly is operating in a combined operation mode, to:

receive, in the display controller, touch screen data from the second display panel, wherein the touch screen data corresponds to location coordinates on the second display panel;

convert the touch screen data from the second display panel to an output corresponding to location coordinates on a virtual extended display, the virtual display panel having a third resolution corresponding to a combination of the first resolution and the second resolution; and

forward the output corresponding to the location coordinates on the virtual extended display to an input driver.

9. The electronic device of claim **8**, wherein the backlight assembly comprises:

a backlight panel;

a first light extraction layer proximate a first side of the backlight panel;

a first diffuser layer proximate the first light extraction layer;

a first light directing layer proximate the first diffuser layer;

a second light extraction layer proximate a second side of the backlight panel;

a second diffuser layer proximate the second light extraction layer; and

a second light directing layer proximate the second diffuser layer.

10. The electronic device of claim **8**, wherein the display controller further comprises logic, at least partially including hardware logic, to:

receive, in the display controller, an output from a graphics processor, wherein the output corresponds to location coordinates on the virtual extended display;

convert the output corresponding to the location coordinates on the virtual extended display to data corresponding to location coordinates on the second display panel; and

forward the data corresponding to location coordinates to the second display panel.

11. The electronic device of claim **10**, wherein:

the second display panel is to be communicatively coupled to the controller via a communication connection with the first display panel.

12. The electronic device of claim **10**, wherein:

at least one of the first display panel or the second display panel comprises a liquid crystal panel.

13. The electronic device of claim **8**, wherein:

the first display has a first resolution of M×N pixels;

the second display has a second resolution of M×N pixels; and

the extended display has a combined resolution of M×2N pixels.

14. The electronic device of claim **8**, wherein:

the first display has a first resolution of 1920×1080 pixels;

the second display has a second resolution of 1920×1080 pixels; and

the extended display has a combined resolution of 1920×2160 pixels.

15. A computer program product comprising logic instruction stored in a non-transitory computer readable medium which, when executed by a controller, configure the controller to perform operations comprising:

receiving, in the controller, touch screen data from a first display having a first resolution, wherein the touch screen data corresponds to location coordinates on the first display;

converting the touch screen data from the display to an output corresponding to location coordinates on a virtual extended display, the virtual display panel having a third resolution corresponding to a combination of the first resolution and a second resolution associated with a second display coupled to the first display; and

forwarding the output corresponding to the location coordinates on the virtual extended display to an input driver.

16. The computer program product of claim **15**, further comprising logic instruction stored in a non-transitory computer readable medium which, when executed by a controller, configure the controller to perform operations comprising:

receiving, in the controller, an output from a graphics processor, wherein the output corresponds to location coordinates on the extended display;

converting the output corresponding to the location coordinates on the extended display to data corresponding to location coordinates on the display; and

forwarding the data corresponding to location coordinates to the display.

17. The computer program product of claim **16**, wherein the display comprises:

a backlight assembly;

a first display panel proximate a first side of the backlight assembly, wherein the first liquid crystal panel is to be communicatively coupled to a controller; and

a second display panel proximate a second side of the backlight assembly, opposite the first side, wherein the second display panel is to be communicatively coupled to the controller,

wherein the second display panel is to be communicatively coupled to the controller via a communication connection with the first display panel.

18. A controller, comprising logic to:

receive, in the controller, touch screen data from a first display having a first resolution, wherein the touch screen data corresponds to location coordinates on the first display;

convert the touch screen data from the display to an output corresponding to location coordinates on a virtual extended display, the virtual display panel having a third resolution corresponding to a combination of the first resolution and a second resolution associated with a second display coupled to the first display; and

forward the output corresponding to the location coordinates on the virtual extended display to an input driver.

19. The controller of claim **18**, further comprising logic to:

receive, in the controller, an output from a graphics processor, wherein the output corresponds to location coordinates on the extended display;

convert the output corresponding to the location coordinates on the extended display to data corresponding to location coordinates on the display; and

forward the data corresponding to location coordinates to the display.

20. The controller of claim **19**, wherein the display comprises:

a backlight assembly;

a first display panel proximate a first side of the backlight assembly, wherein the first liquid crystal panel is to be communicatively coupled to a controller; and

a second display panel proximate a second side of the backlight assembly, opposite the first side, wherein the second display panel is to be communicatively coupled to the controller,

wherein the second display panel is to be communicatively coupled to the controller via a communication connection with the first display panel.

* * * * *

专利名称(译)	显示电子设备		
公开(公告)号	US9395575	公开(公告)日	2016-07-19
申请号	US13/710740	申请日	2012-12-11
[标]申请(专利权)人(译)	邝华耀 黄匡		
申请(专利权)人(译)	邝华耀 黄，洪		
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发明人	KWONG, WAH YIU WONG, HONG W.		
IPC分类号	G02F1/1335 G09G3/36 G02F1/1333		
CPC分类号	G02F1/1336 G09G3/36 G02F1/13338 G02F2001/133342 G09G2300/023 G09G2360/04		
审查员(译)	PHAM，VIET		
其他公开文献	US20140160365A1		
外部链接	Espacenet USPTO		

摘要(译)

在一个实施例中，显示组件包括背光组件，靠近背光组件的第一侧的第一显示板，其中第一液晶板通信地耦合到控制器，以及靠近第二侧的第二显示板。背光组件，与第一侧相对，其中第二显示面板通信地耦合到控制器。可以描述其他实施例。