US009615010B2

(12) **United States Patent**
Knepper et al.

(10) **Patent No.:** **US 9,615,010 B2**
(45) **Date of Patent:** **Apr. 4, 2017**

(54) **DISPLAY SYSTEM HAVING IMAGE CAPTURE DEVICE AND ADJUSTABLE VISIBLE LIGHT FILTER**

(71) Applicant: **Dell Products, LP**, Round Rock, TX (US)

(72) Inventors: **Lawrence E. Knepper**, Leander, TX (US); **Deeder M. Aurongzeb**, Austin, TX (US); **Christopher A. Torres**, San Marcos, TX (US); **Thomas Lanzoni**, Cedar Park, TX (US)

(73) Assignee: **Dell Products, LP**, Round Rock, TX (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 85 days.

(21) Appl. No.: **14/626,525**

(22) Filed: **Feb. 19, 2015**

(51) **Int. Cl.**
H04N 5/225	(2006.01)
H04N 5/243	(2006.01)
H04N 5/238	(2006.01)
G06F 1/16	(2006.01)
G02B 5/20	(2006.01)

(52) **U.S. Cl.**
CPC *H04N 5/2257* (2013.01); *G02B 5/208* (2013.01); *G06F 1/169* (2013.01); *G06F 1/1686* (2013.01); *H04N 5/238* (2013.01); *H04N 5/243* (2013.01)

(58) **Field of Classification Search**
CPC H04N 5/2257; H04N 5/243; H04N 5/238; G02B 5/208; G06F 1/1686; G06F 1/169
USPC 348/342
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,751,379 A	*	6/1988	Sasaki	G06F 3/0421
				250/221
2010/0026645 A1	*	2/2010	Yim	G06F 3/0421
				345/173
2010/0194890 A1	*	8/2010	Weller	B60R 1/12
				348/148
2012/0032925 A1	*	2/2012	Sekiya	G06F 3/03545
				345/175

* cited by examiner

(57) **ABSTRACT**

A display system having a visible light filter that can be enabled and disabled to preferentially filters visible light over near-field infrared light is disclosed.
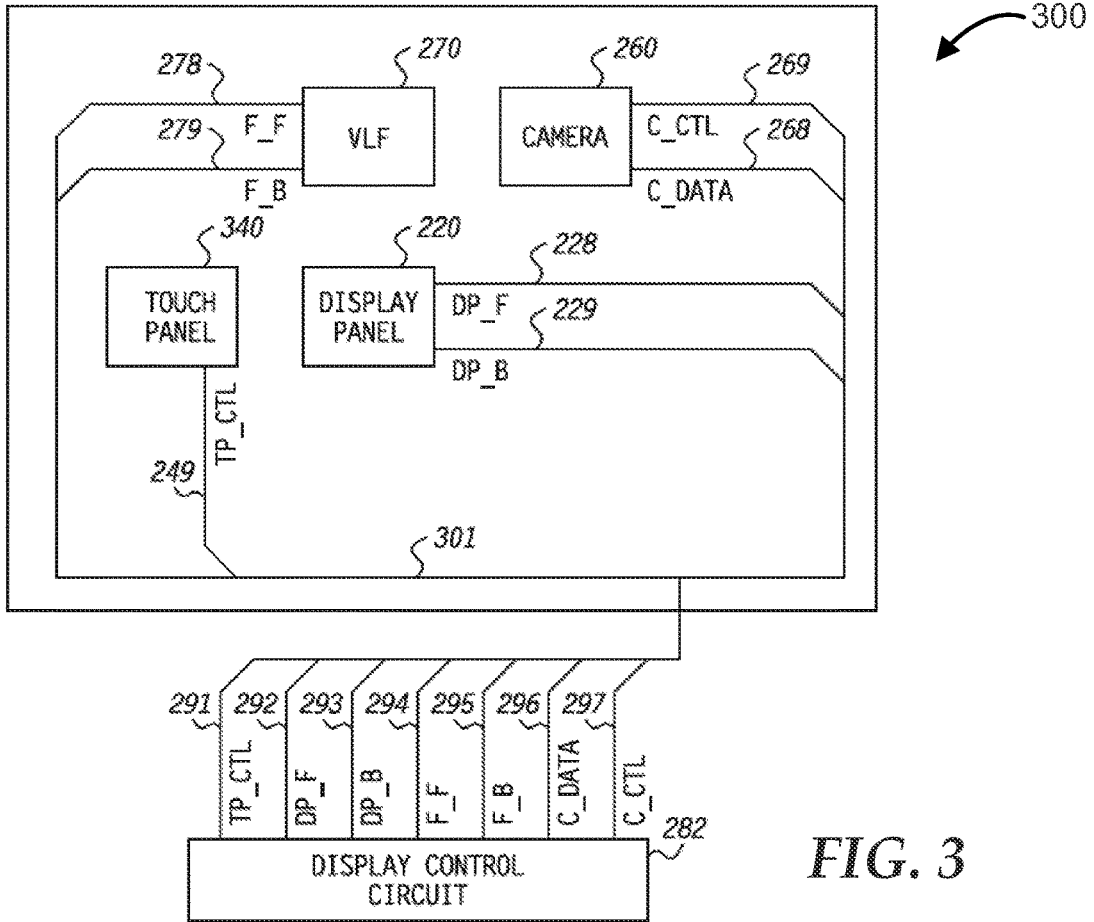
20 Claims, 8 Drawing Sheets
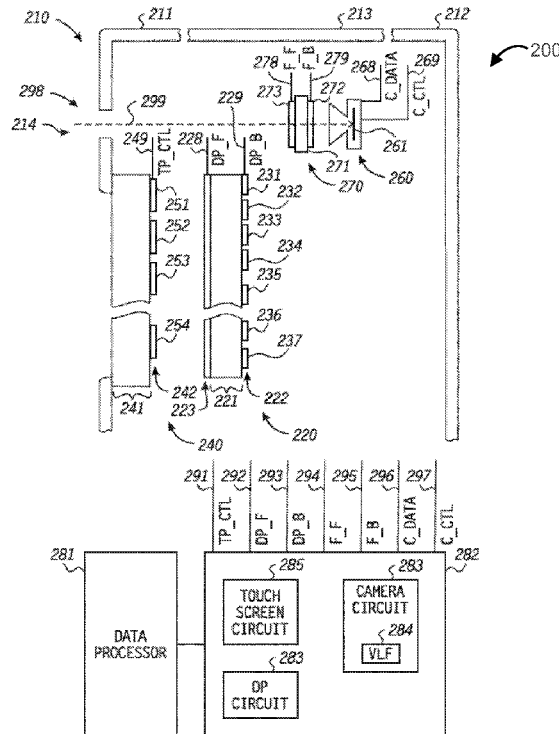
FIG. 1
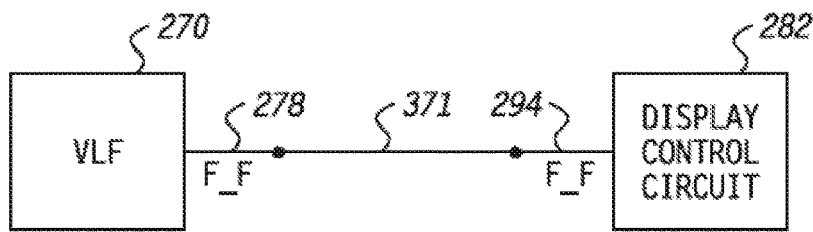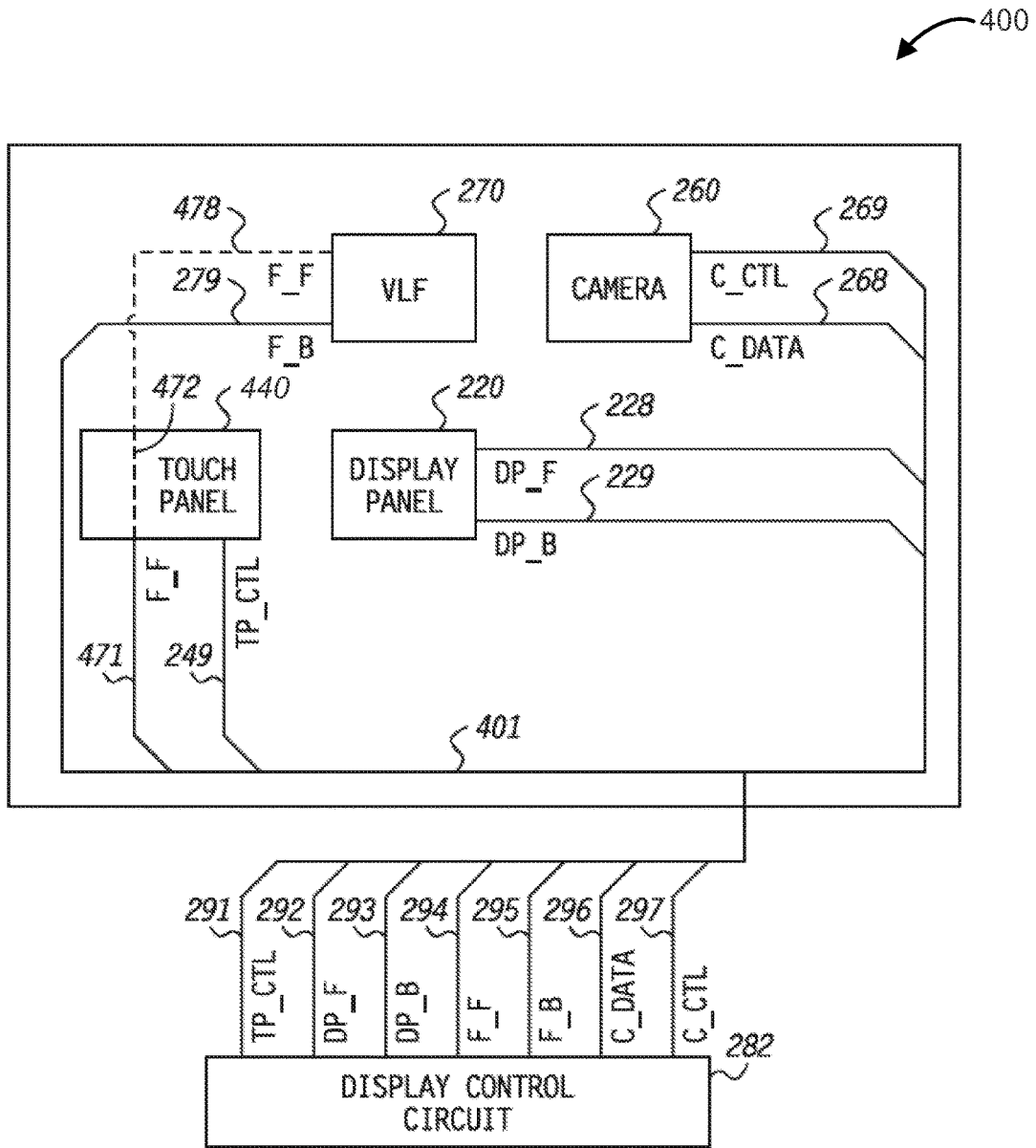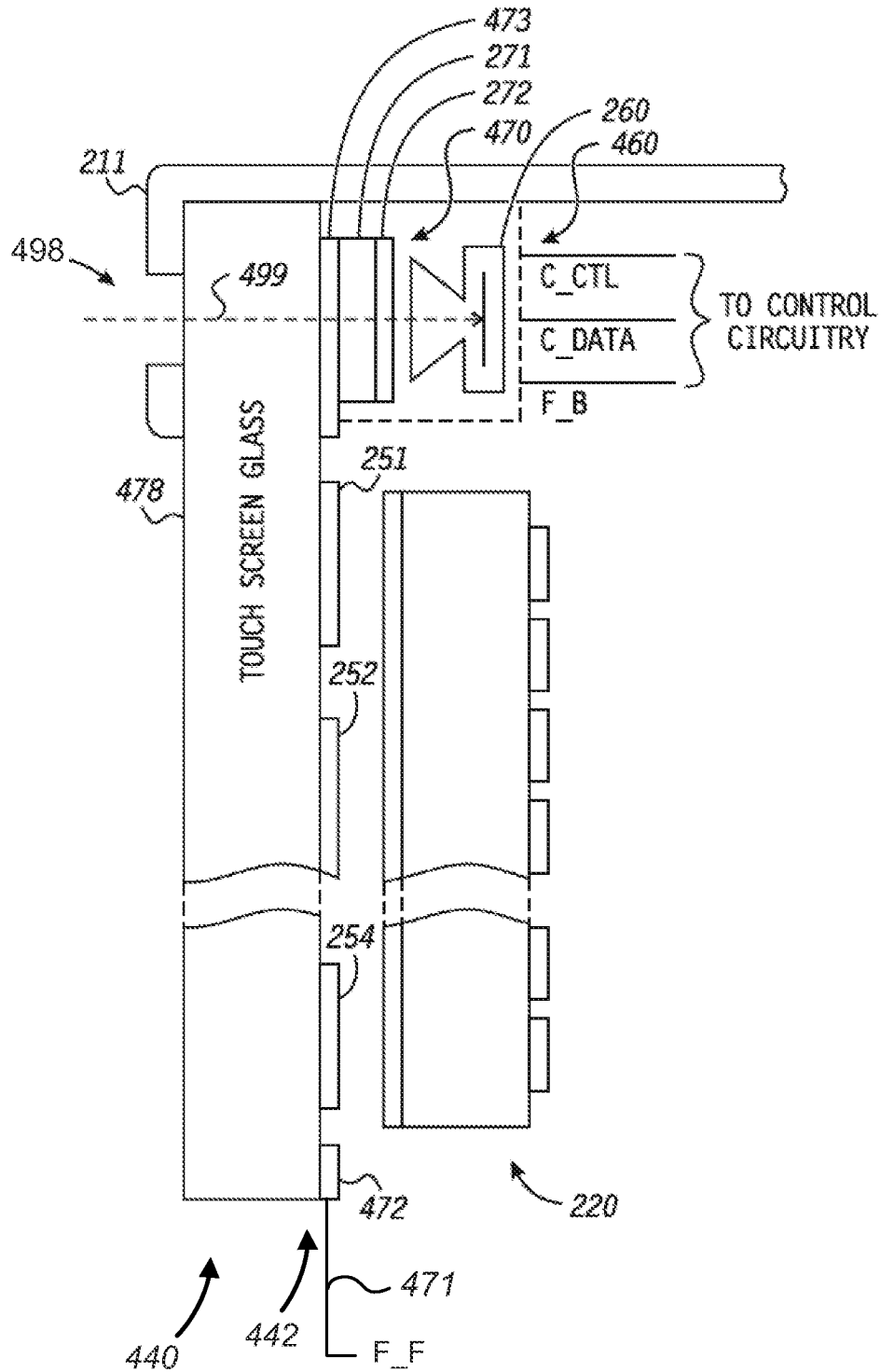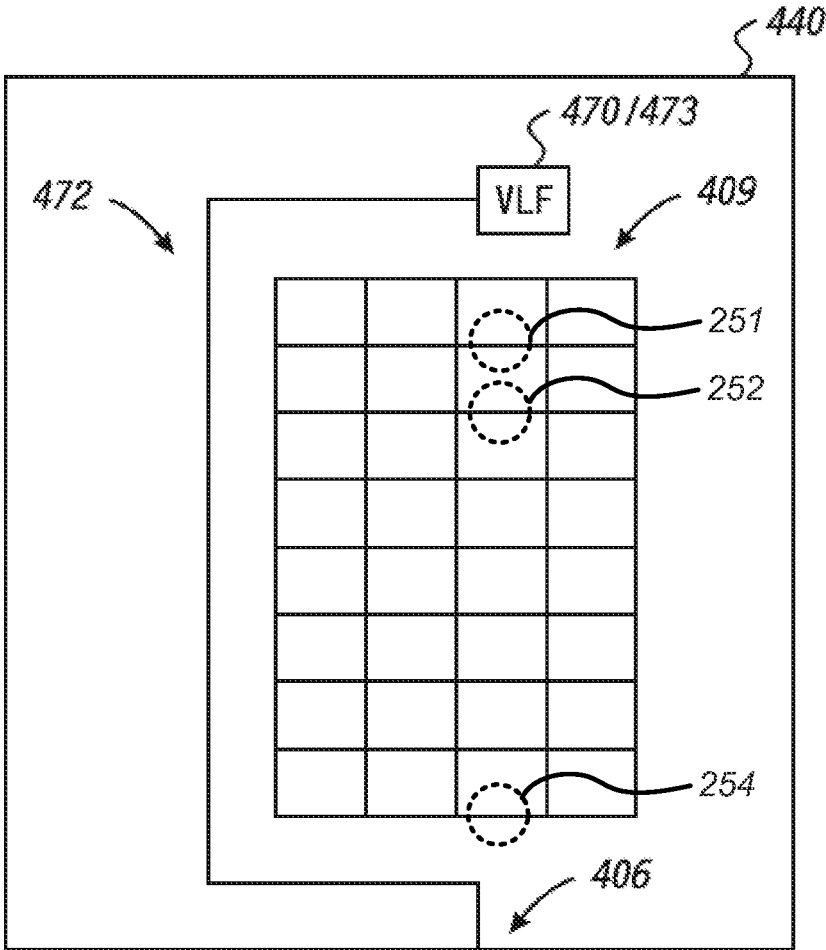
FIG. 2

300

278
270 VLF
279 F_F
F_B

260 CAMERA
269 C_CTL
268 C_DATA

340 TOUCH PANEL

220 DISPLAY PANEL
228 DP_F
229 DP_B

TP_CTL
249

301

291 TP_CTL
292 DP_F
293 DP_B
294 F_F
295 F_B
296 C_DATA
297 C_CTL
282

DISPLAY CONTROL CIRCUIT

FIG. 3

270 VLF

278 F_F

371

294 F_F

282 DISPLAY CONTROL CIRCUIT

FIG. 4

FIG. 5

FIG. 6

FIG. 7

FIG. 8

600

211
498
601
699
601
578
431
432
641   640
670   660
203
679
678
573
679

FIG. 9

740
779
702
703
799
779
701
704
251
773
771
772
770
706
TO
CAMERA

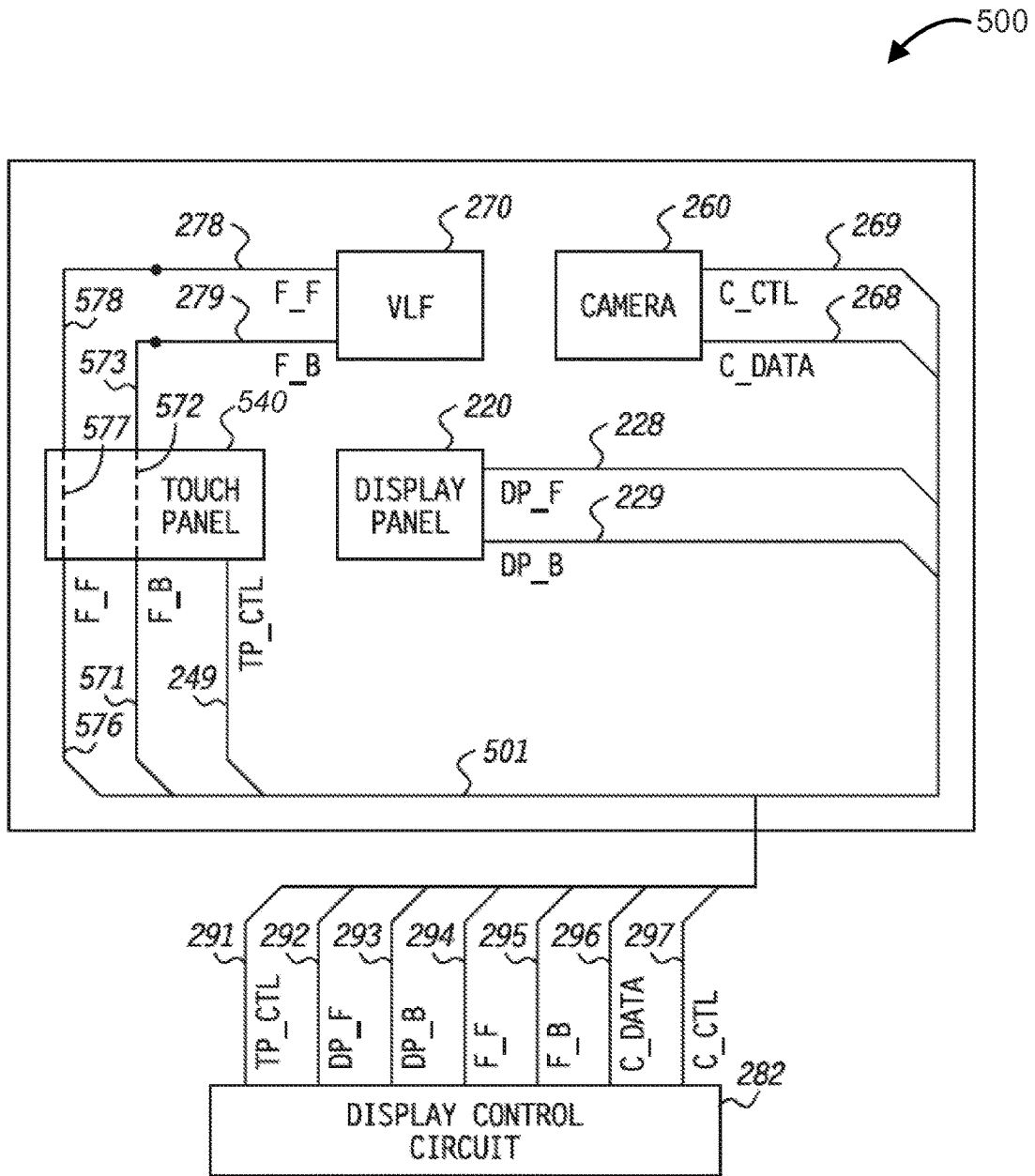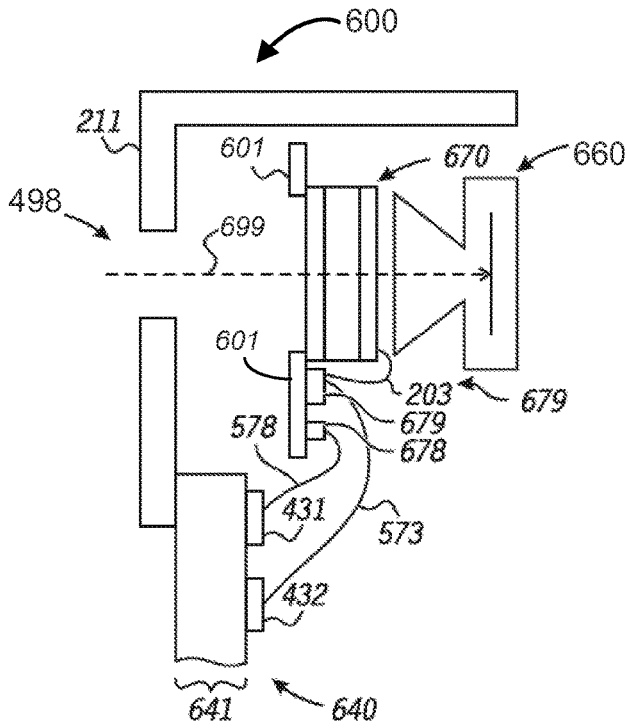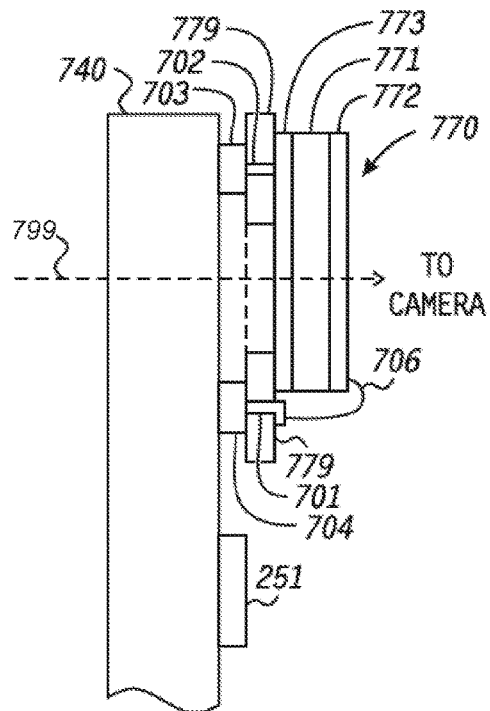**FIG. 10**

DISPLAY SYSTEM HAVING IMAGE CAPTURE DEVICE AND ADJUSTABLE VISIBLE LIGHT FILTER

FIELD OF THE DISCLOSURE

The present disclosure generally relates to displays for information handling systems, and more particularly to displays having an image capture device.

BACKGROUND

As the value and use of information continues to increase, individuals and businesses seek additional ways to process and store information. One option is an information handling system. An information handling system generally processes, compiles, stores, or communicates information or data for business, personal, or other purposes. Technology and information handling needs and requirements can vary between different applications. Thus information handling systems can also vary regarding what information is handled, how the information is handled, how much information is processed, stored, or communicated, and how quickly and efficiently the information can be processed, stored, or communicated. The variations in information handling systems allow information handling systems to be general or configured for a specific user or specific use such as financial transaction processing, airline reservations, enterprise data storage, or global communications. In addition, information handling systems can include a variety of hardware and software resources that can be configured to process, store, and communicate information and can include one or more computer systems, graphics interface systems, data storage systems, networking systems, and mobile communication systems. Information handling systems can also implement various virtualized architectures. A display of an information handling system may include various features, for example, a display may include a touch sensitive input device (a touch panel), an image capture device (a camera).

BRIEF DESCRIPTION OF THE DRAWINGS

It will be appreciated that for simplicity and clarity of illustration, elements illustrated in the Figures are not necessarily drawn to scale. For example, the dimensions of some elements may be exaggerated relative to other elements. Embodiments incorporating teachings of the present disclosure are shown and described with respect to the drawings herein, in which:

FIG. 1 illustrates particular embodiment of an information handling system;

FIG. 2 illustrates a schematic and cross-sectional view of a particular embodiment of an information handling system;

FIG. 3 illustrates a block diagram a particular embodiment of portion of FIG. 2;

FIG. 4 illustrates a block diagram of a particular embodiment of a portion of FIG. 3 in greater detail;

FIG. 5 illustrates a block diagram a particular embodiment of portion of FIG. 2 in accordance with a particular embodiment;

FIG. 6 illustrates a cross-sectional view of a portion of FIG. 5 in accordance with a particular embodiment;

FIG. 7 illustrates an overhead view of a portion of FIG. 5 in accordance with a particular embodiment;

FIG. 8 illustrates a block diagram of a portion of FIG. 7 in accordance with a particular embodiment;

FIG. 9 illustrates a cross-sectional view of a portion of FIG. 7 in accordance with a particular embodiment; and

FIG. 10 illustrates a cross-sectional view of a in accordance with a particular embodiment.

DETAILED DESCRIPTION

The following description in combination with the Figures is provided to assist in understanding the teachings disclosed herein. The description is focused on specific implementations and embodiments of the teachings, and is provided to assist in describing the teachings. This focus should not be interpreted as a limitation on the scope or applicability of the teachings.

FIG. 1 illustrates a generalized embodiment of information handling system 100. For purpose of this disclosure information handling system 100 can include any instrumentality or aggregate of instrumentalities operable to compute, classify, process, transmit, receive, retrieve, originate, switch, store, display, manifest, detect, record, reproduce, handle, or utilize any form of information, intelligence, or data for business, scientific, control, entertainment, or other purposes. For example, information handling system 100 can be a personal computer, a laptop computer, a smart phone, a tablet device or other consumer electronic device, a network server, a network storage device, a switch router or other network communication device, or any other suitable device and may vary in size, shape, performance, functionality, and price. Further, information handling system 100 can include processing resources, also referred to herein as a data processor, for executing machine-executable code, such as a central processing unit (CPU), a programmable logic array (PLA), an embedded device such as a System-on-a-Chip (SoC), or other control logic hardware. Information handling system 100 can also include one or more computer-readable medium for storing machine-executable code, such as software or data. Additional components of information handling system 100 can include one or more storage devices that can store machine-executable code, one or more communications ports for communicating with external devices, and various input and output (I/O) devices, such as a keyboard, a mouse, and a video display. Information handling system 100 can also include one or more buses operable to transmit information between the various hardware components.

Information handling system 100 can include devices that embody one or more of the devices described above, and operates to perform one or more of the methods described above. Information handling system 100 includes a processor 110, a chipset 120, a memory 130, a disk controller 160, a disk emulator 180, an input/output (I/O) interface 150, and a network interface 170. Processor 110 is connected to chipset 120 via processor interface 112. Processor 110 is connected to memory 130 via memory bus 118. Memory 130 is connected to chipset 120 via a memory bus 122. Chipset 120 to receive rendered image information. Chipset 120 is connected to display system 149 that includes a video panel 142 and a touch panel 144. The chipset 120 provides rendered image information to the video panel 142 of a display system 149 via graphics interface 149, and receives user input information from touch panel 144.

In a particular embodiment, information handling system 100 includes separate memories that are dedicated to processor 110 via separate memory interfaces. An example of memory 130 includes random access memory (RAM) such as static RAM (SRAM), dynamic RAM (DRAM), nonvolatile RAM (NV-RAM), or the like, read only memory

(ROM), another type of memory, or a combination thereof. Memory **130** can store, for example, at least one application **132** and operating system **134**. Operating system **134** includes operating system code operable to detect resources within information handling system **100**, to provide drivers for the resources, initialize the resources, to access the resources, and to support execution of the at least one application **132**. Operating system **134** has access to system elements via an operating system interface **136**. Operating system interface **136** is connected to memory **130** via connection **138**.

Battery management unit (BMU) **151** is connected to I/O interface **150** via battery management unit interface **155**. BMU **151** is connected to battery **153** via connection **157**. Operating system interface **136** has access to BMU **151** via connection **139**, which is connected from operating system interface **136** to battery management unit interface **155**.

Disk controller **160** and I/O interface **150** are connected to chipset **120** via interfaces that may be implemented, for example, using a Peripheral Component Interconnect (PCI) interface, a PCI-Extended (PCI-X) interface, a high-speed PCI-Express (PCIe) interface, another industry standard or proprietary communication interface, or a combination thereof. Chipset **120** can also include one or more other I/O interfaces, including an Industry Standard Architecture (ISA) interface, a Small Computer Serial Interface (SCSI) interface, an Inter-Integrated Circuit (I2C) interface, a System Packet Interface (SPI), a Universal Serial Bus (USB), another interface, or a combination thereof.

Disk controller **160** is connected to chipset **120** via connection **116**. Disk controller **160** includes a disk interface **162** that connects the disc controller to a hard disk drive (HDD) **164**, to an optical disk drive (ODD) **166**, and to disk emulator **180**. An example of disk interface **162** includes an Integrated Drive Electronics (IDE) interface, an Advanced Technology Attachment (ATA) such as a parallel ATA (PATA) interface or a serial ATA (SATA) interface, a SCSI interface, a USB interface, a proprietary interface, or a combination thereof. Disk emulator **180** permits a solid-state drive **184** to be connected to information handling system **100** via an external interface **182**. An example of external interface **182** includes a USB interface, an IEEE 1394 (Firewire) interface, a proprietary interface, or a combination thereof. Alternatively, solid-state drive **184** can be disposed within information handling system **100**.

I/O interface **150** is connected to chipset **120** via connection **166**. I/O interface **150** includes a peripheral interface **152** that connects the I/O interface to an add-on resource **154**, to camera **156**, and to a security resource **158**. Peripheral interface **152** can be the same type of interface as disk controller **160**, and I/O interface **150** to chipset **120**, or can be a different type of interface. As such, I/O interface **150** extends the capacity of such an interface when peripheral interface **152** and the I/O channel are of the same type, and the I/O interface translates information from a format suitable to such an interface to a format suitable to the peripheral channel **152** when they are of a different type. Add-on resource **154** can include a data storage system, an additional graphics interface, a network interface card (NIC), a sound/video processing card, another add-on resource, or a combination thereof. As an example, add-on resource **154** is connected to data storage system **190** via data storage system interface **192**. Add-on resource **154** can be on a main circuit board, on separate circuit board or add-in card disposed within information handling system **100**, a device that is external to the information handling system, or a combination thereof. Camera **156** is connected to light **159**

via connection **194**. Light **159** can be controlled to provide illumination of objects of which a photograph or video is being recorded using camera **156**.

Network interface **170** represents a NIC disposed within information handling system **100**, on a main circuit board of the information handling system, integrated onto another component such as chipset **120**, in another suitable location, or a combination thereof. Network interface **170** is connected to I/O interface **150** via connection **174**. Network interface device **170** includes network channel **172** that provides an interface to devices that are external to information handling system **100**. In a particular embodiment, network channel **172** is of a different type than peripheral channel **152** and network interface **170** translates information from a format suitable to the peripheral channel to a format suitable to external devices. An example of network channels **172** includes InfiniBand channels, Fibre Channel channels, Gigabit Ethernet channels, proprietary channel architectures, or a combination thereof. Network channel **172** can be connected to external network resources (not illustrated). The network resource can include another information handling system, a data storage system, another network, a grid management system, another suitable resource, or a combination thereof.

In accordance with at least one embodiment, a housing defines a display system that includes at least the video panel **142**, the touch panel **144**, and the camera **156** as described in greater detail with respect to FIGS. **2-10**.

FIG. **2** illustrates, in block diagram form, an information processing system that includes a display control circuitry **282** that is connected to a display system **200** and to a data processor **281**. The data processor **281** is presumed to be an instruction based data processor having one or more processing cores. Data processor **281** can provide image information to the display control circuitry **282**, which in turn processes the information to provide rendered image information to a display panel **220** of the display system **200**. Data processor **281** can also provide information to the display control system **282** indicating whether a visual light filter **270** of the display system **200** is to be enable or disabled, wherein the visual light filter **270** preferentially filters visible light as compared to near-field infrared light as will be discussed in greater detail below. The display system circuit **282** can receive user input information from the display system **200**, such as information from touch panel **240**, which can be further processed and provided to the data processor **281** for additional handling.

Display system **200** is an integrated assembly comprising a plurality of devices that can be referred to herein as components. The display system **200** is defined by a housing that includes a front frame **211** and a back frame (cover) **212**. Note that the housing portion **213** illustrated at FIG. **2** can be part of the front cover **211**, part of the back cover **212**, or a mid-frame portion. The housing physically supports various components, including a display panel **220**, a touch panel **240**, a visible light filter **270** and an image capture device **260**, also referred to as a camera.

The display system **200** includes a front-most surface that can be defined by a combination of a bezel **214** of the front frame **211** and an exposed portion of touch panel **240**. In an embodiment that does not include a touch panel, the front-most surface of the display system **200** can be defined by an exposed portion of touch panel **240**. In other embodiments, a protective layer can overlie the touch panel **240**, or display panel **220**, to define the front-most surface of the display system **200**.

The bezel **214** portion of the front frame **211** includes an opening **298** through which light can pass in route to the image sensor **261** of the image capture device **260** along a light transmission path **299** of the display system.

The display system **200** can be a stand-alone display that can be connected and disconnected to other portions of an information processing system, such as to an appropriate input/output (IO) port of a laptop or desktop computer. For example, when display system **200** is a stand-alone display, the display control circuit **282** and data processor **281** of FIG. **2** can reside within the housing of a desktop or laptop computer having an IO port that can be connected to the display system **200**. In another embodiment, the display system **200** can be a permanent portion of a specific information handling system. For example, the display system **200** can be the display of a laptop computer that is connected to a base portion of the laptop. It will be appreciated, that the display system **200** can have additional components than those indicated above. For example, the display system **200** can be an all-in-one information handling system such as a tablet device, mobile phone device, all-in-one desktop computer, and the like.

By way of example, it is presumed that the housing of the various display systems described herein is a rigid structure that provides support and protection to the various components housed therein. Thus, the various components of the display system **200** will typically be located in fixed relation to the housing, and to each other. It will be appreciated, that in other embodiments that there may be flexibility associated with the display system **200**, such as its housing its various components. The display system **200** further includes a front side opening **298** through which light based upon an image can pass in order to be captured by the camera **260**. The front side opening **298** can be through the bezel, as illustrated, or through regions or openings of the touch panel **240** and display panel **220**.

By way of example, in the following discussion the display panel **220** is presumed to be a non-flexible liquid crystal display (LCD) that includes a LCD layer **221**, a front side conductive layer, **223** and a backside conductive layer **222**. The LCD layer **221** includes a liquid crystal region where a liquid crystal material resides (not shown) that resides between a front side transparent support layer and a backside transparent support layer. The front side bias layer **223** includes one or more regions where a transparent conductor resides. The backside bias layer includes one or more regions where a transparent conductor resides. These transparent regions can be referred to as conductive regions or as conductive portions of their respective layer. The transparent conductors can comprise a metal, such as indium tin oxide, a polymer, the like, and combinations thereof.

By way of example, the front side bias layer **223** covers the entire front side of display panel **220** and is connected to an interconnect **228** to receive a signal DP_F that provides a common bias voltage. The backside bias layer of display panel **220** includes a plurality of conductive regions **231**-**237**, which can be referred to as sub-pixel electrodes, that are connected to an interconnect **229** to receive a signal DB_B that is used to provide bias voltages to each one of the sub-pixel regions **231**-**237**. Whether a particular liquid crystal region of the display panel **220** is transparent or opaque is based upon the bias level of its corresponding sub-pixel region.

The term interconnect as used herein refers to a signal communication path over which information is transmitted either directly or indirectly. For example, an interconnect can be implemented as a passive device, such as one or more

conductive traces, that transmits information directly through an interconnect, or as an active device, whereby information being transmitted is amplified or buffered, e.g., stored and retrieved such as at a first-in first-out memory or other memory device, and the like in the processes of being communicated between device. As described herein, multiple interconnects can be referred to as making up a larger interconnect that defines a signal communication path between devices. Thus an interconnect connecting the display control circuit **282** to the display panel **220** is understood to include the interconnect **228** at the display panel **200** and the interconnect **292** at the display control circuit **282**. For clarity, the term segment, or signal communication path segment, and their variants, can be used to refer to interconnects are one of a plurality of interconnects between two devices being referenced.

The touch sensitive input device **240**, also referred to as a touch panel, is a user input device is used to detect a location of the touch panel that is being touched by a user. Operation of the touch panel **240** can be based on a resistive or capacitive technology. By way of example, touch panel **240** is presumed to operate on a capacitive technology. A conductive layer **242** is resides at the back side of a transparent substrate **241** that includes a grid formed using a transparent conductor that includes the conductive regions **251**-**254**, as viewed in cross-section at FIG. **2**. The regions **251**-**254** can be referred to as conductive regions or as conductive portions of conductive layer **242**. The transparent conductor can comprise a metal, such as found in indium tin oxide, a polymer, the like, and combinations thereof.

In response to user making physical contact with the front side surface of the touch panel **240** the capacitive grid will experience a localized change in capacitance that can be detected to determine the contact location. By way of example, it is presumed that the touch location is determined by circuitry integrated at the touch panel **240** (not shown) and transmitted as information via a signal TP_CTL along interconnect **249** to the interconnect **291** of the display control circuit **282**.

Image capture device **260**, also referred to as a camera, can capture still images, moving images, the like, and combinations thereof. Light received at the image sensor **261** travels along an image transmission path **299** of the display system **200** that begins at the opening **298**. Camera **260** includes an image sensor **261**, such as a charge coupled device that can detect various frequencies of light. The image sensor **261** can detect both visible light, and near-field infrared (NFIR) light, wherein the near-field infrared light includes infrared light having a frequency below a thermal imaging region of infrared light which typically occurs at a wavelength ranging from 780 to 820 nanometers (nm).

The camera **260** is connected to an interconnect **269** to communicate control information (C_CTL) between the camera **260** and an interconnect **297** that is connected to the display control circuit **282**. The camera **260** is connected to an interconnect **268** to communicate data information (C_DATA) between the camera **260** and an interconnect **296** that is connected to the display control circuit **282**.

The visible light filter (VLF) **270** is a device that can be selectively controlled to change its transmittance value, e.g., to filter different amounts of light that passes through the filter. As illustrated, VLF **270** includes a filtering layer **271**, a front side conductive region **273** connected to an interconnect **278**, and a back side conductive region **272** connected to an interconnect **279**. The transmittance of VLF **270** can be changed by adjusting the voltages of signals F_F and F_B, received at interconnects **278** and **279**, to change the

voltage differential across the filtering layer **271**. The terms "enabled" and "disabled", and their variants, as used with respect to a visual light filter are relative terms, wherein when the VLF is disabled the visible light transmittance of the VLF is greater than when the VLF is enabled.

In addition to being selectively controllable, VLF **270** preferentially filters visible light as compared to near-field infrared (NFIR) light. Thus, a change in VLF **270** operation from an initial operational state to a subsequent operational state will result in a greater absolute change in the visible light transmittance of VLF **270** as compared to NFIR light.

The preferential filtering of visible light by VLF **270** will be better understood with reference to the following example, in which it is assumed that the transmittance of visible light and NFIR light by VLF **270** is the same, e.g., 90%, during an initial state of operation. It is assumed that VLF **270** is subsequently enabled to have a lower transmittance, e.g., filtering is enabled in a subsequent state of operation. During the subsequent state of operation, the transmittance of visible light and NFIR light by VLF is presumed to be 30% and 81%, respectively. Thus, the visible light transmittance is reduced (60 percentage points) at least twice as much as the NFIR light transmittance (9 percentage points).

The change in transmittance can also be calculated as an absolute change in transmittance. Thus, in the above example, the visible light transmittance of VLF **270** is 66% (|90%−30%|/90%), while the absolute change in the NFIR light transmittance is 10% (|90%−81%|/90%). In this example, enabling VLF **270** results in a greater absolute change of visible light transmittance as compared to NFIR light transmittance. As a further example, it is assumed that VLF **270** is subsequently disabled to return the transmittance of VLF **270** back to that of its initial state of operation. In this situation, the absolute change in the visible light transmittance is 200% (|30%−90%|/30%), and the absolute change in the NFIR light transmittance is 11% (|81%−90%|/81%). Thus, disabling VLF **270** also results in a greater absolute change of visible light transmittance as compared to NFIR light transmittance.

In FIG. **2**, the interconnect portion of signal communication paths connecting the interconnects **291-297** at the display control circuit **282** to their respective interconnects **249**, **228**, **229**, **278**, **279**, **268**, and **269** at components the display system **200** are not illustrated. However, various implementations of such an interconnect portion are illustrated in the following figures.

FIG. **3** illustrates in schematic form an information processing system that is a particular embodiment of the information processing system of FIG. **2**. The information processing system of FIG. **3** includes a display system **300** that is a particular embodiment of the display system **200** of FIG. **2**. Features of FIG. **2**, including features of the display system **300**, having the same reference numbers as features previously described are presumed to be the same. Though it will be appreciated, that these commonly numbered features may actually be different.

According to the embodiment of FIG. **3**, each of the interconnects **291-297** at display control circuit **282** are connected to their corresponding component of display system **300** with out being routed through either the display panel **220** or the touch panel **340**, as will be described below. For example, each signal communication path between the display control circuit **282** and its corresponding component of display system **300** can be a passive interconnect, such as one or more individual wires that can be integrated at a ribbon cable. The interconnect **294** can represent one or

more terminals of display control circuit **282** over which signal F_F is transmitted to interconnect **278** of VLF **270** via a ribbon cable. In FIG. **4** the interconnect between display control circuit **282** and VLF **270** includes segments **294**, **371** and **278**.

FIG. **5** illustrates in schematic form an information processing system that is a particular embodiment of the information processing system. The information processing system of FIG. **5** includes a display system **400** that is a particular embodiment of the display system **200** of FIG. **3**. Features of FIG. **5**, including features of the display system **400**, having the same reference numbers as features as previously described are presumed to be the same. Though it will be appreciated, that these features may vary.

The display system **400** varies from the display system **200** in that the signal communication path of the signal F_F travels over a different signal communication path. In particular, the communication path of the signal F_F of display system **400** includes signal communication path segments **294**, **471**, **472**, and **478**, wherein segments **472** and **478** are dashed to indicate that they are portions of the touch panel **440**. Thus, the signal communication path segments of display system **400** over which signal F_F is transmitted include: segment **294** as previously described; segment **471** that connects segment **294** to a first location of the touch panel **440**; segment **472**, which is a part of the touch panel **440** that transmits the signal F_F across the touch panel **440** in route to the visible light filter **270**; and segment **478** that is analogous to both the front side bias layer **273** of the VLF **270**, and to the interconnect **278** that is connected to the front side bias layer **273** as illustrated at FIG. **2** as will be better understood in reference to FIG. **6**. It will be appreciated that routing of segments **472** and **478** of the visible light filter **270** at the touch panel **440** can reduce the amount of interconnect segments that need to be implemented at an interconnect specific feature. For example, a dedicated interconnect, such as a wire of a ribbon cable, is no longer needed to connect segment **294** to segment **278**.

FIG. **6** illustrates, in side view, an embodiment of a portion of display system **400** that communicates signal F_F to the touch panel **440** via an interconnect that includes conductive region **471**, wherein the VLF **470** is integrated at the touch panel **440**. Features of the display system **400** having the same reference numbers as features as previously described are presumed to be the same. Though it will be appreciated, that these features may vary from those features of display system **400**.

The visible light filter **470** is integrated at the display panel **440** by virtue of having its front-side bias layer **473** reside at the transparent conductive layer **442** of the touch panel. Therefore, the bias layer **473** and the transparent touch grid, which includes features **251**, **252** and **254**, and the interconnect **471** can be made from the same material. It will be appreciated that the features **473**, **472**, **251**, **252**, and **254** can be formed simultaneously during a common process. For example, a conformal layer of a transparent conductor can be etched simultaneously to form these features. Integrating a variable light filter onto the touch panel **440** in this manner can result in a higher degree of integration. Alternatively, the interconnect **472** can be formed from a non-transparent conductive layer, so long its location does not obstruct the display field in an undesirable manner.

FIG. **7** illustrates an overhead view of touch panel **440**, including the location of the visible light filter **470**, and transparent conductive regions **473**, **251-252**, and **254**. The location of the visible light filter **470** also corresponds to the location of conductive region **473**, as previously described.

A location **406** represents the location where interconnect **472** connects to interconnect **471** (FIG. **5**)) connects conductive region **472**.

FIG. **8** illustrates in schematic form an information processing system that is a particular embodiment of the display system of FIG. **2**. The information processing system of FIG. **8** includes a display system **500** that is a particular embodiment of the display system **200** of FIG. **3**. Features of FIG. **8**, including features of the display system **500**, having the same reference numbers as features as previously described are presumed to be the same. Though it will be appreciated, that these features may vary in addition to those features of display system **500** that are described as being different.

The display system **500** varies from the display system **400** in that the signal communication paths of the both the signal F_F and of the signal F_B have signal communication paths that include portions of the touch panel **540**. In particular, segments **294**, **576**, **577**, **578** and **278** form the signal communication path for signal F_F. Segments **295**, **571**, **572**, **573** and **279** form the signal communication path for signal F_B.

FIG. **9** illustrates an embodiment of a side view of a portion of the display system **500** that communicates signals F_F and F_B from the touch panel **640** via segments **573**, **578**, and **679**, respectively. In FIG. **9**, segments **573**, **578** and **679** are illustrated to be wire portions of interconnects **278** and **279** (FIG. **2**), respectively, that connect to terminals at a circuit board **601** of the visible light filter **670**.

In an alternate embodiment, illustrated at FIG. **10**, the VLF **770** includes a circuit board **779** at which the VLF filter portion **771** and bias regions **772** and **773** are mounted. The circuit board **779** includes through-substrate vias **701** and **702** that extend from the bottom to the top of the circuit board **779** to allow the circuit board **779** to be directly attached to the touch panel **740** with vias **701** and **702** in electrical contact with the conductive regions **703** and **704**. For example, the substrate of the touch panel **749** can extend past the opening **498** to be in the light transmission path **799**, and the circuit board **779** can be attached to the touch panel **740** to contact conductive regions **703** and **704**, to allow transmission of the signal F_F and F_B respectively. The circuit board **779** is illustrated to have an opening that allows the front surface of the visible light filter **770** to be exposed to the light transmission path **699**.

In the preceding discussion, the VLF has been described as preferentially filtering visible light as compared to near-field IR light. According to an embodiment, the absolute change of visible light transmittance as compared to NFIR light transmittance when the VLF is enabled is at least twice as much. According to another embodiment, the absolute change of visible light transmittance as compared to NFIR light transmittance when the VLF is enabled is at least ten times as much. According to an embodiment, the absolute change of visible light transmittance as compared to NFIR light transmittance when the VLF is enabled is at least twenty times as much.

It will be appreciated that while the VLF filter has been described herein as preferentially filtering visible light as opposed to near-field infrared light, in another embodiment, the VLF filter can also preferentially filter far-field infrared light in a similar manner as visible light is filtered relative to near-field infrared light. Thus, a change in VLF operation from a disabled state to an enabled state can also result in a greater absolute change in the far-field infrared light transmittance of the VLF as compared to NFIR light. Thus, the VLF can act as a band-pass filter that also filters out infrared

light beyond the near-field infrared range. For example, the absolute change of infrared light transmittance beyond the NFIR wavelength as compared to NFIR light transmittance when the VLF is enabled can be at least twice as much, at least ten times as much, or at least twenty times as much.

According to an embodiment, an application determines that an identity of a user is to be determined and enables a visible light filter associated with a camera of a display system is to reduce its visible light transmittance by a greater amount than its near-field infrared transmittance. Next, the camera captures image information, such of the iris of the user, while the visible light transmittance is reduced. This information is further processed by the information handling system to verify the identity of the user. Once the identity of the user is confirmed, the application can cause the visible light filter to be disabled, wherein the transmittance of the visible light filter is returned to its original state.

The above-disclosed subject matter is to be considered illustrative, and not restrictive, and the appended claims are intended to cover any and all such modifications, enhancements, and other embodiments that fall within the scope of the present invention. Thus, to the maximum extent allowed by law, the scope of the present invention is to be determined by the broadest permissible interpretation of the following claims and their equivalents, and shall not be restricted or limited by the foregoing detailed description. Although only a few exemplary embodiments have been described in detail herein, those skilled in the art will readily appreciate that many modifications are possible in the exemplary embodiments without materially departing from the novel teachings and advantages of the embodiments of the present disclosure. Accordingly, all such modifications are intended to be included within the scope of the embodiments of the present disclosure as defined in the following claims. In the claims, means-plus-function clauses are intended to cover the structures described herein as performing the recited function and not only structural equivalents, but also equivalent structures.

What is claimed is:

1. A display system comprising:
    a housing comprising a back cover;
    a display panel attached to the housing;
    an image capture device attached to the housing, the image capture device comprising an image sensor to detect received light of an image; and
    a visible light filter attached to the housing to preferentially filter visible light provided to the image capture device as compared to near-field infrared light, wherein, in response to receiving an enabled filter signal at a first input the visible light transmittance of the visible light filter is to be reduced at least twice as much as a near-field infrared transmittance.

2. The device of claim **1**, comprising:
    a touch sensitive input device, wherein the display panel is disposed between the touch sensitive input device and the back cover.

3. The device of claim **2**, further comprises:
    a first signal communication path connected to the first input of the visible light filter that comprises a first conductive portion of the touch panel.

4. The device of claim **3**, further comprises an image transmission path that includes a first portion through the visible light filter and a second portion through the touch sensitive input device.

5. The device of claim 3, further comprises a second signal communication path connected to a second input of the visible light filter including a second conductive portion of the touch panel.

6. The device of claim 3, wherein the touch sensitive input device comprises a conductive layer along a plane substantially parallel to a front-most major surface of the touch sensitive device, the conductive layer including a second conductive portion to detect a touch at the touch sensitive input device.

7. The device of claim 6, wherein the first and second conductive portions are transparent conductors.

8. The device of claim 1, wherein a signal communication path connected to the first input of the visible light filter comprises a conductive portion of the display panel.

9. The device of claim 8, wherein the signal communication path is a transparent conductor.

10. The device of claim 1, wherein a signal communication path of the display system that is connected to the first input of the visible light filter comprises a transparent conductor.

11. The device of claim 1, further comprising:
a touch sensitive input device, wherein the display panel is disposed between the touch sensitive input device and the back cover;
the visible light filter further comprises:
a first bias layer coupled to the first input, and
a second bias layer coupled to a second, input and is spaced apart from the first bias layer, the visible light filter to have different voltage differential between the first and second bias layers when enabled than when disabled;
a control circuit comprising a first output and a second output;
a first signal communication path from the first output of the control circuit to the first input of the visible light filter; and
a second signal communication path from the second output of the control circuit to the second input of the visible light filter, wherein only one of the first control signal path and the second signal path have a conductive portion at the display panel.

12. A method comprising:
receiving a first control information at a visible light filter integrated with a display panel at a common housing;
setting the visible light filter to a first transmittance based upon the first control information, the first transmittance comprising a first near-field infrared light transmittance and a first visible light transmittance;
receiving a second control information at the visible light filter;
setting the visible light filter to a second transmittance based upon the second control information, the second transmittance comprising a second near-field infrared

light transmittance and a second visible light transmittance, in response to receiving the second control information the visible light transmittance of the visible light filter is reduced at least twice as much as the near-field infrared transmittance.

13. The method of claim 12, wherein receiving the first control information includes receiving the first control information via a transparent conductor.

14. The method of claim 12, wherein receiving the first control information includes receiving the first control information via a transparent conductor disposed at a touch sensitive module integrated at the common housing.

15. The method of claim 12, further comprising:
in response to initiating a user identity determination, providing the second control information.

16. The method of claim 15, further comprising:
in response to determining an identity of the user, receiving the first control information at the visible light filter to return the visible light filter to the first transmittance.

17. The method of claim 16, further comprising determining the identity of the user based upon an image of the user's iris obtained while the visible light filter had the second transmittance.

18. A system comprising:
a display housing comprising a back cover;
a touch sensitive input device comprising a plurality of transparent conductor regions, including first transparent conductor region;
a display panel attached to the housing, wherein the display panel is disposed between the touch sensitive input device and the back cover;
an image capture device attached to the housing, the image capture device comprising an image sensor to detect received light of an image; and
a visible light filter attached to the housing to preferentially filter visible light as compared to near-field infrared light, an input of the visible light filter connected to a signal communication path that includes the first transparent conductor region, wherein in response to receiving an enabled filter signal at the input, the visible light transmittance of the visible light filter is to be reduced at least twice as much as the near-field infrared transmittance.

19. The system of claim 18, further comprising a data processor executing code that causes the enabled filter signal to be communicated to the visible light filter as part of an operation confirming an identity of a user.

20. The system of claim 18, further comprising a data processor executing code that causes the enabled filter signal to be communicated to the visible light filter as part of an operation to receive an image of a user's iris, and to confirm an identity of the user based upon the image.

* * * * *