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(54) **MERCHANDISING COMMUNICATION AND INVENTORYING SYSTEM**

(71) Applicant: **Internet Connectivity Group, Inc.**, Lake Forest, CA (US)

(72) Inventors: **Kevin Howard**, Laguna Niguel, CA (US); **Gordon Davidson**, Irvine, CA (US)

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G06K 9/00	(2006.01)
H04N 7/18	(2006.01)

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

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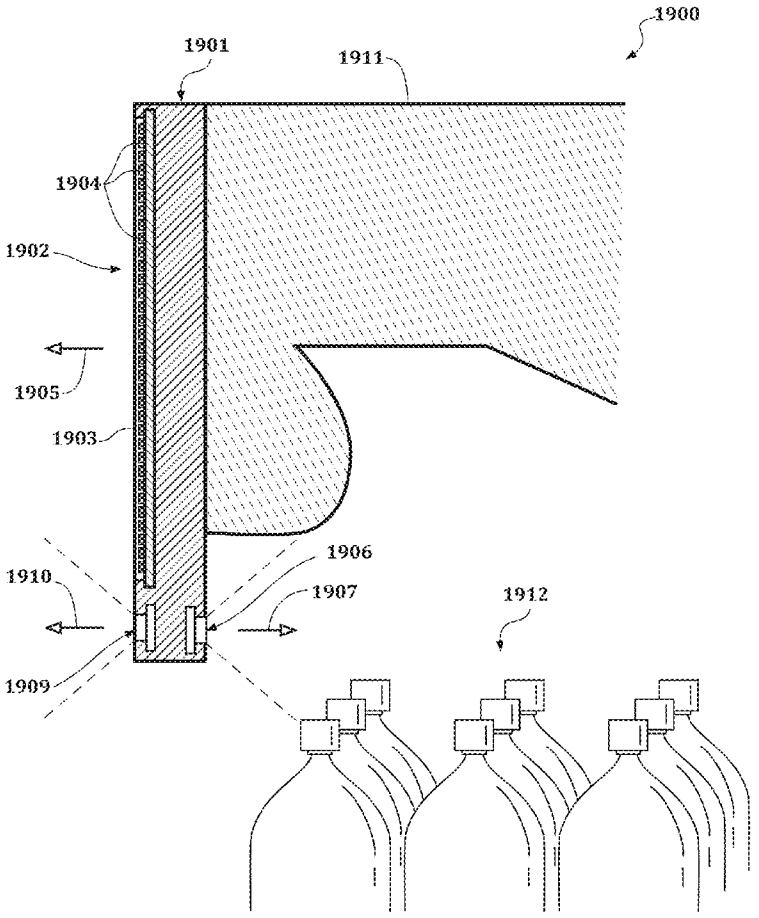
(57) **ABSTRACT**

Provided herein are display systems and units, including those configured for dynamic communication, inventorying, and monitoring environmental conditions in a physical location, such as in retail settings. Also included herein are methods for dynamically displaying product information in a physical location, such as a retail setting.



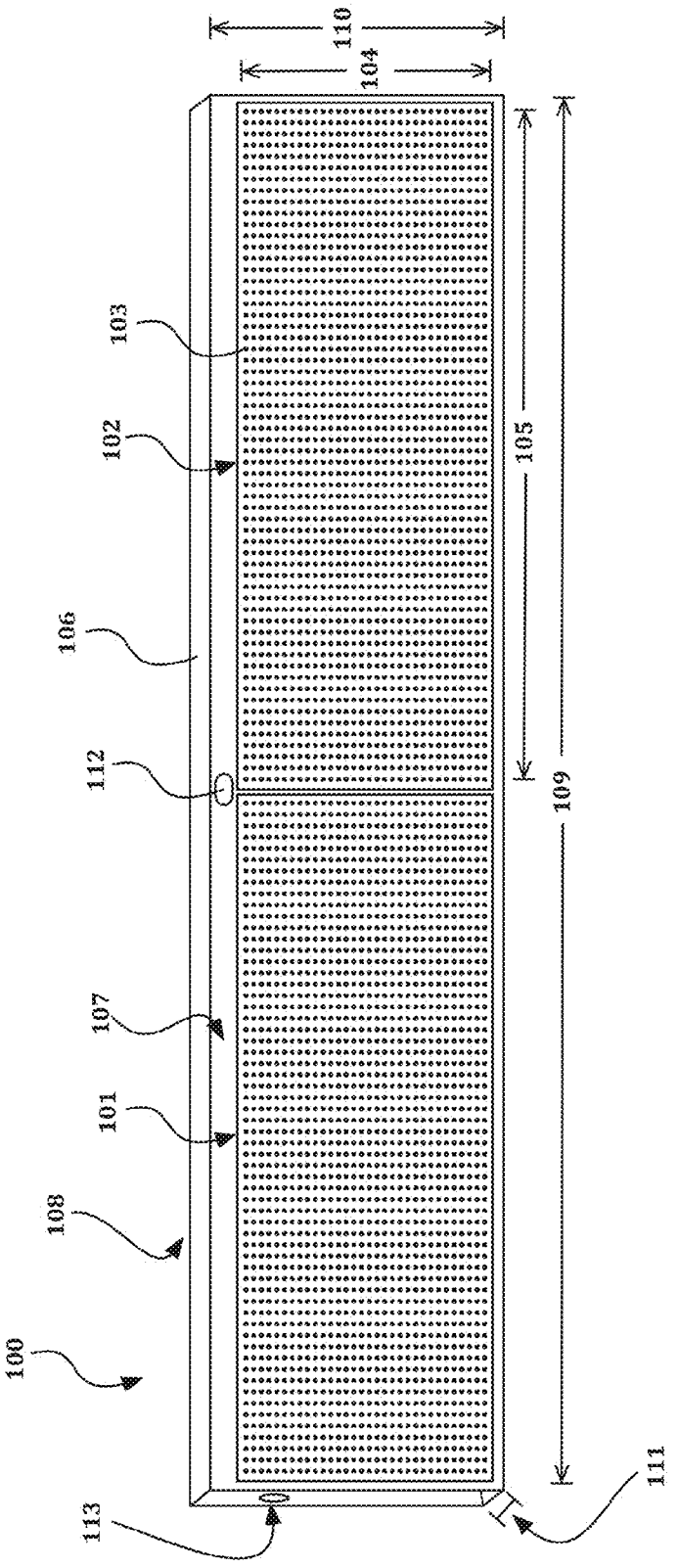


FIG. 1

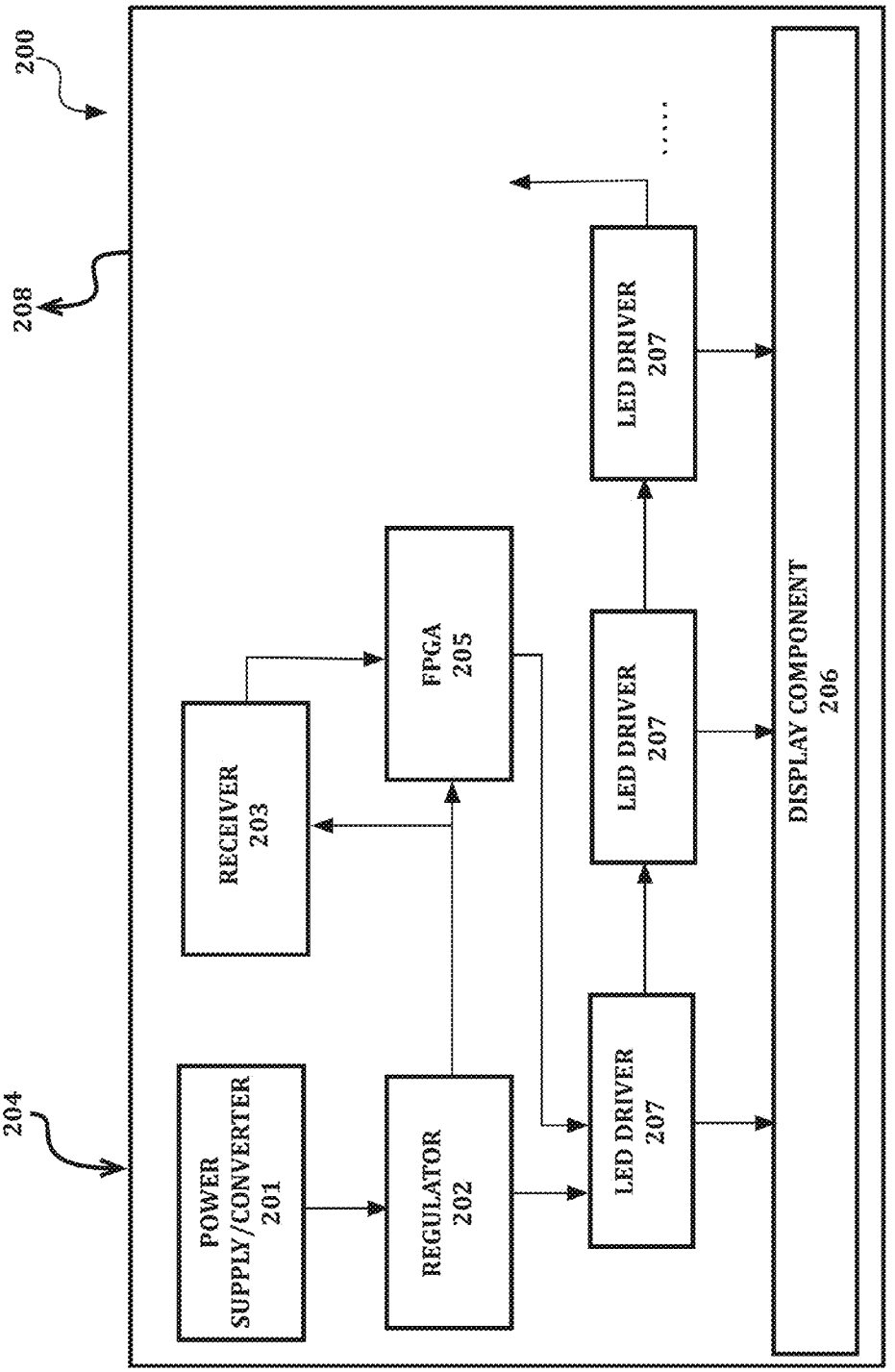

200
208
204
POWER SUPPLY/CONVERTER 201
REGULATOR 202
RECEIVER 203
FPGA 205
LED DRIVER 207
LED DRIVER 207
LED DRIVER 207
.....
DISPLAY COMPONENT 206

FIG. 2

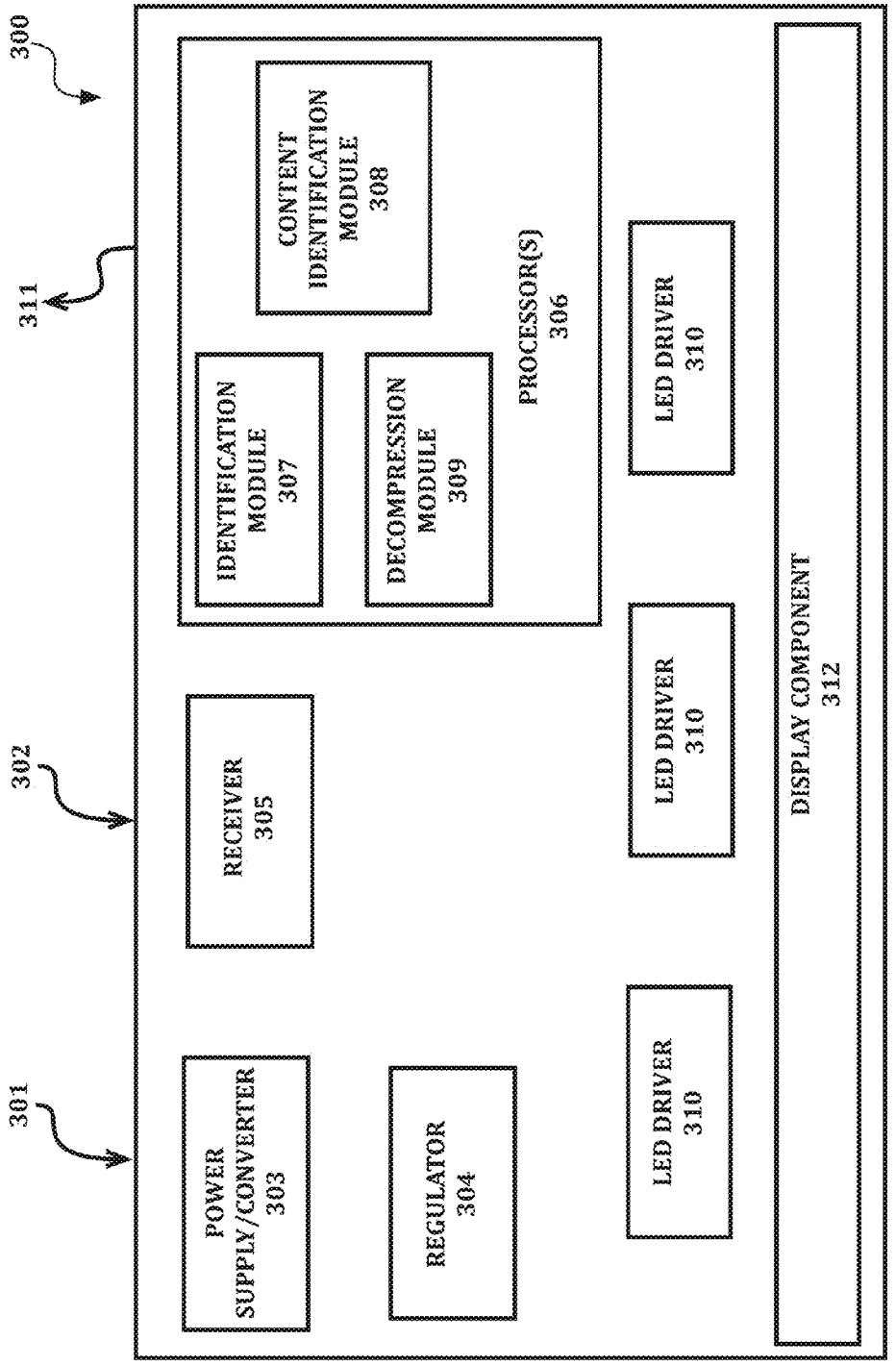

300
311
302
301
POWER SUPPLY/CONVERTER 303
RECEIVER 305
REGULATOR 304
PROCESSOR(S) 306
IDENTIFICATION MODULE 307
CONTENT IDENTIFICATION MODULE 308
DECOMPRESSION MODULE 309
LED DRIVER 310
LED DRIVER 310
LED DRIVER 310
DISPLAY COMPONENT 312

FIG. 3

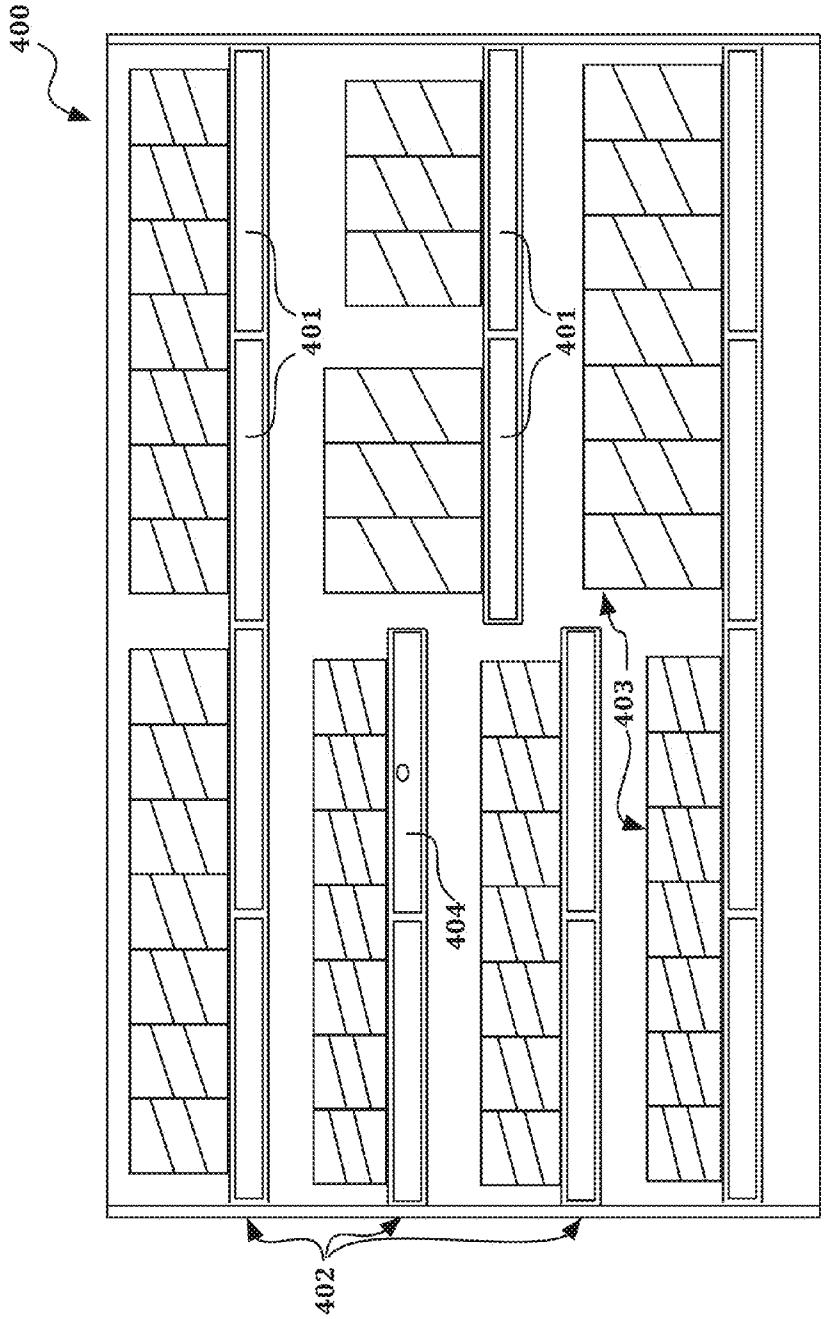


FIG. 4

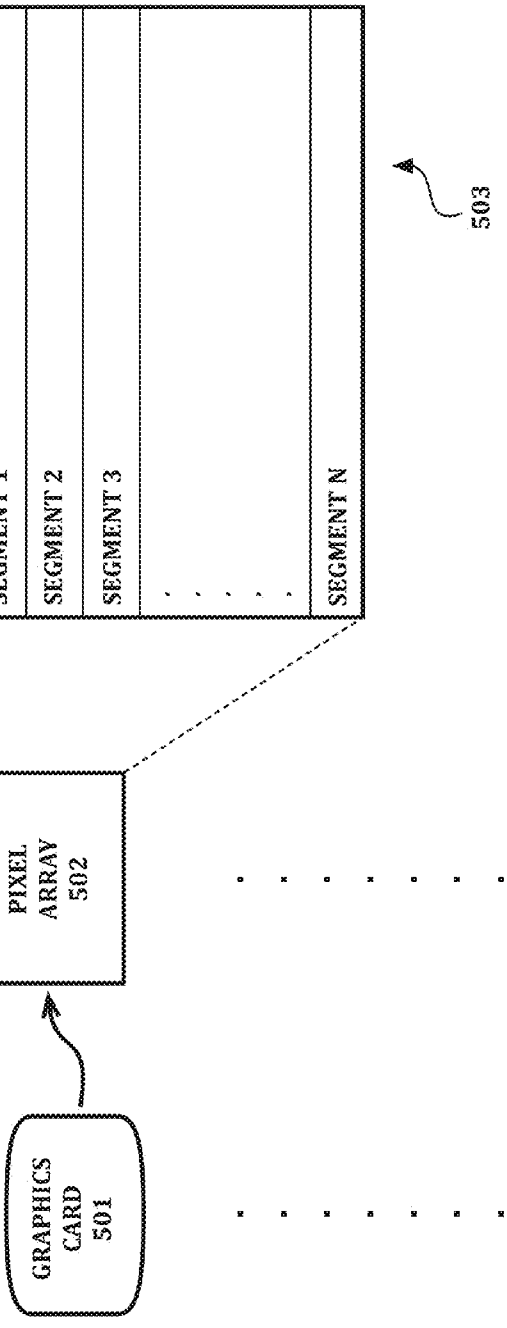

SEGMENT 1
SEGMENT 2
SEGMENT 3
SEGMENT N
503
PIXEL ARRAY 502
PIXEL ARRAY 505
GRAPHICS CARD 501
GRAPHICS CARD 504

FIG. 5

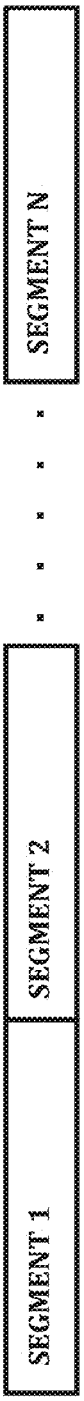


FIG. 6

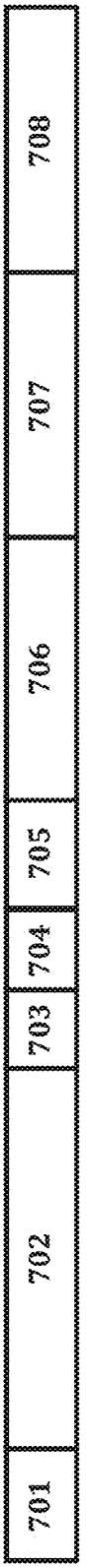


FIG. 7

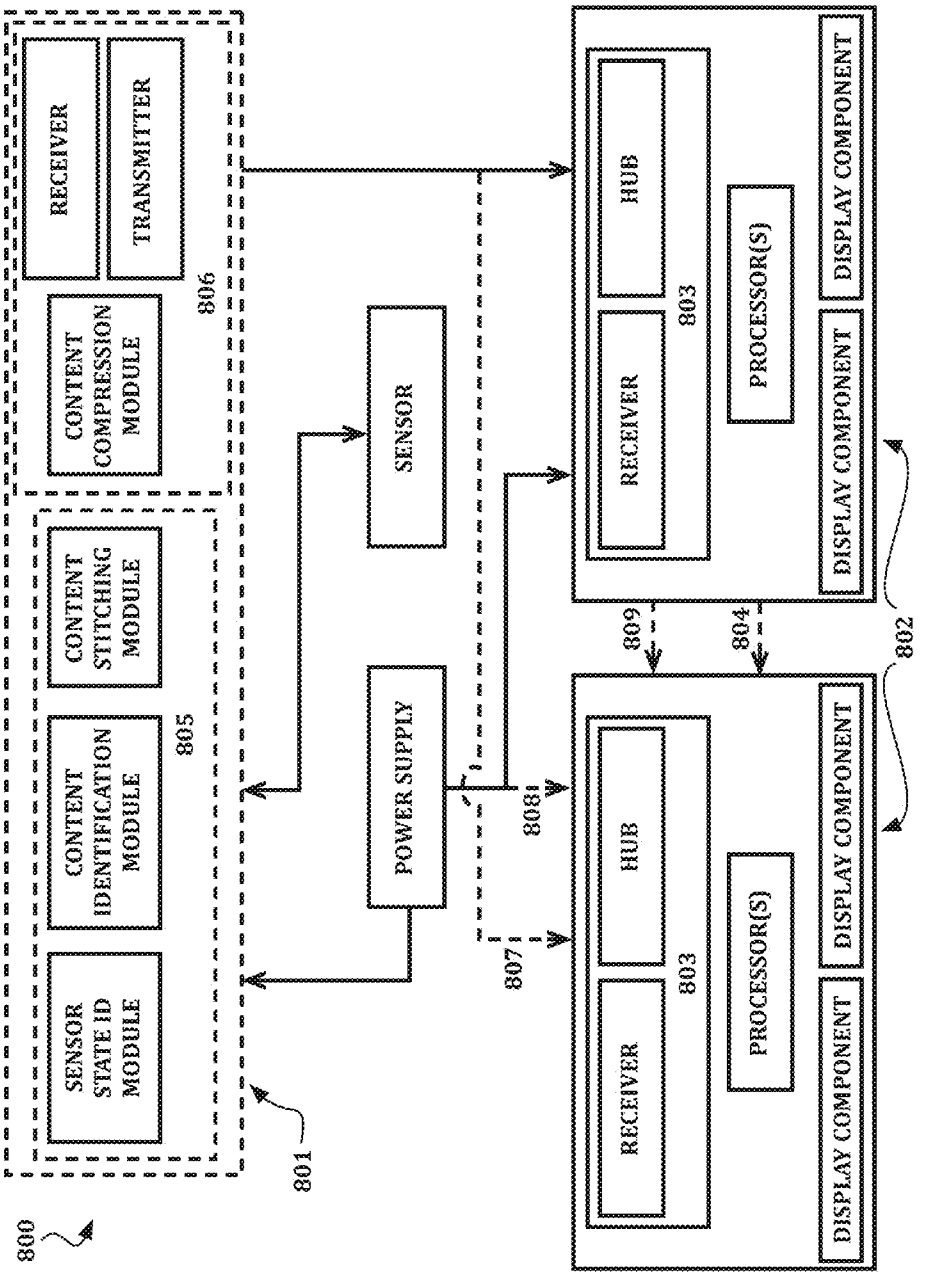

800
801
SENSOR STATE ID MODULE
CONTENT IDENTIFICATION MODULE
CONTENT STITCHING MODULE
805
CONTENT COMPRESSION MODULE
RECEIVER
TRANSMITTER
806
SENSOR
POWER SUPPLY
807
808
809
804
802
RECEIVER
HUB
803
PROCESSOR(S)
DISPLAY COMPONENT
DISPLAY COMPONENT
RECEIVER
HUB
803
PROCESSOR(S)
DISPLAY COMPONENT
DISPLAY COMPONENT

FIG. 8

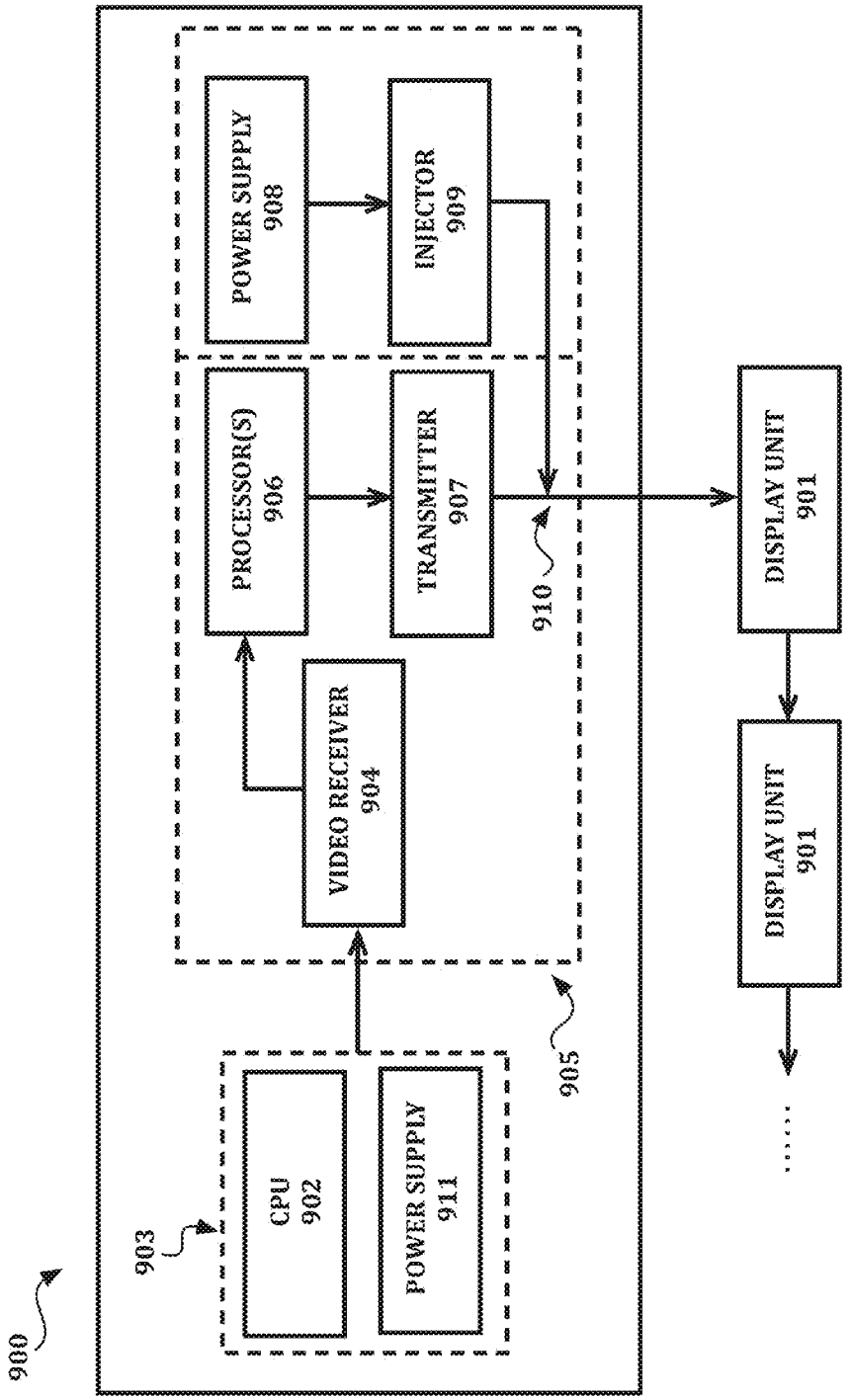

900
903
CPU
902
POWER SUPPLY
911
905
VIDEO RECEIVER
904
PROCESSOR(S)
906
TRANSMITTER
907
910
POWER SUPPLY
908
INJECTOR
909
DISPLAY UNIT
901
DISPLAY UNIT
901
.....

FIG. 9

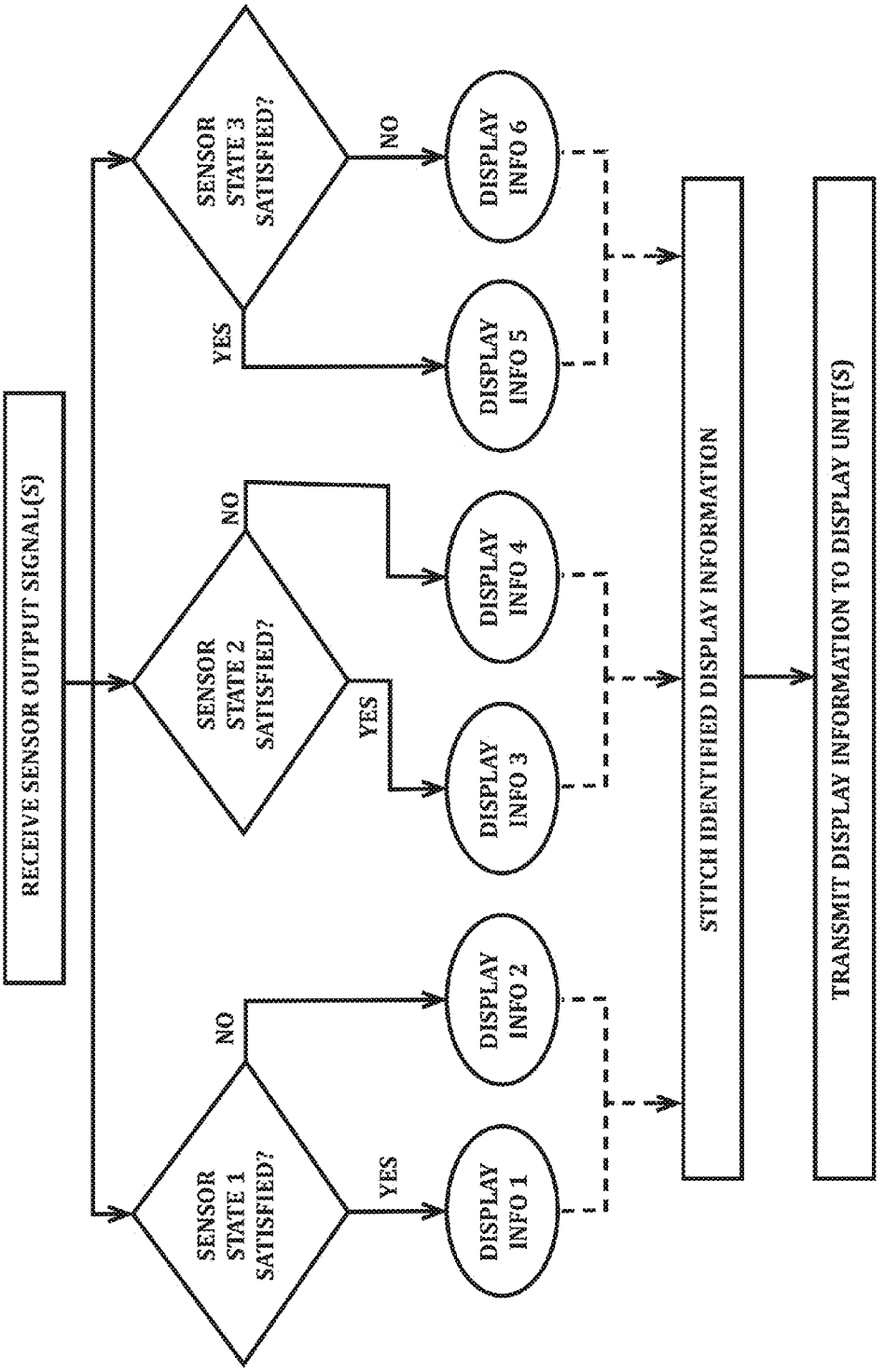

RECEIVE SENSOR OUTPUT SIGNAL(S)
SENSOR STATE 1 SATISFIED?
YES
NO
DISPLAY INFO 1
DISPLAY INFO 2
SENSOR STATE 2 SATISFIED?
YES
NO
DISPLAY INFO 3
DISPLAY INFO 4
SENSOR STATE 3 SATISFIED?
YES
NO
DISPLAY INFO 5
DISPLAY INFO 6
STITCH IDENTIFIED DISPLAY INFORMATION
TRANSMIT DISPLAY INFORMATION TO DISPLAY UNIT(S)

FIG. 10

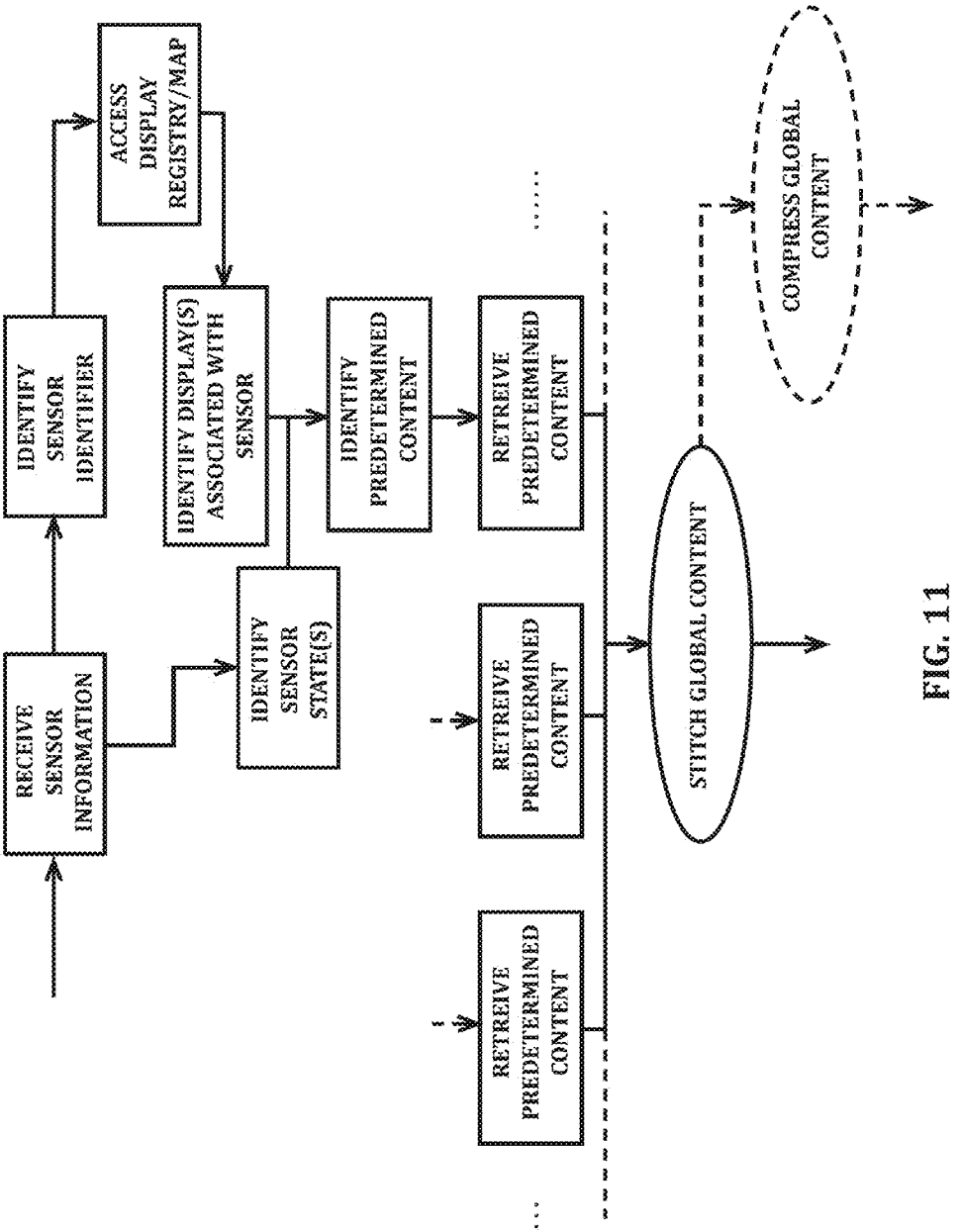

RECEIVE SENSOR INFORMATION
IDENTIFY SENSOR IDENTIFIER
ACCESS DISPLAY REGISTRY/MAP
IDENTIFY SENSOR STATE(S)
IDENTIFY DISPLAY(S) ASSOCIATED WITH SENSOR
IDENTIFY PREDETERMINED CONTENT
RETREIVE PREDETERMINED CONTENT
RETREIVE PREDETERMINED CONTENT
RETREIVE PREDETERMINED CONTENT
STITCH GLOBAL CONTENT
COMPRESS GLOBAL CONTENT

FIG. 11

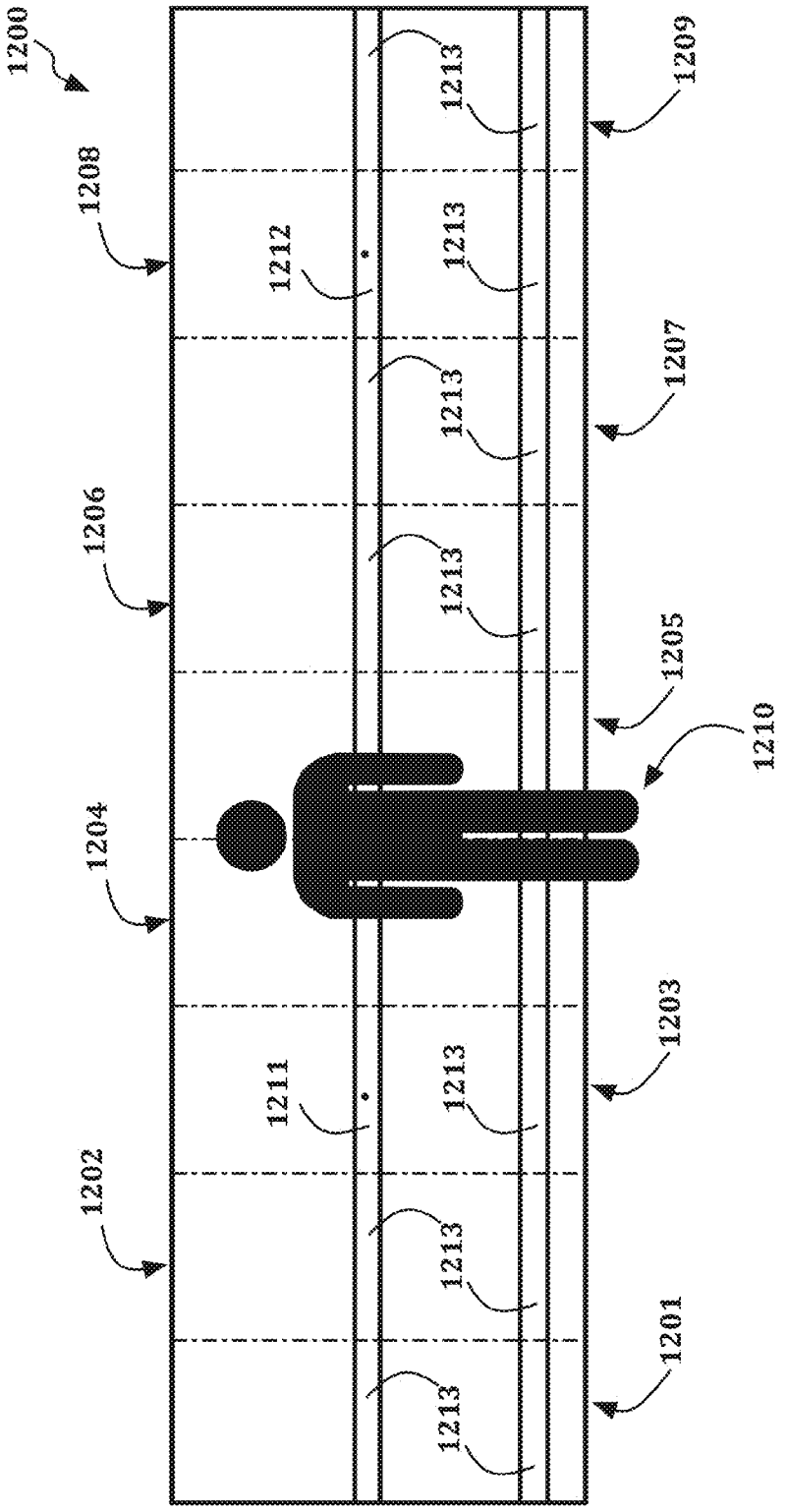

1200
1208
1206
1204
1202
1212
1211
1213
1209
1207
1205
1210
1203
1201

FIG. 12

FIG. 13

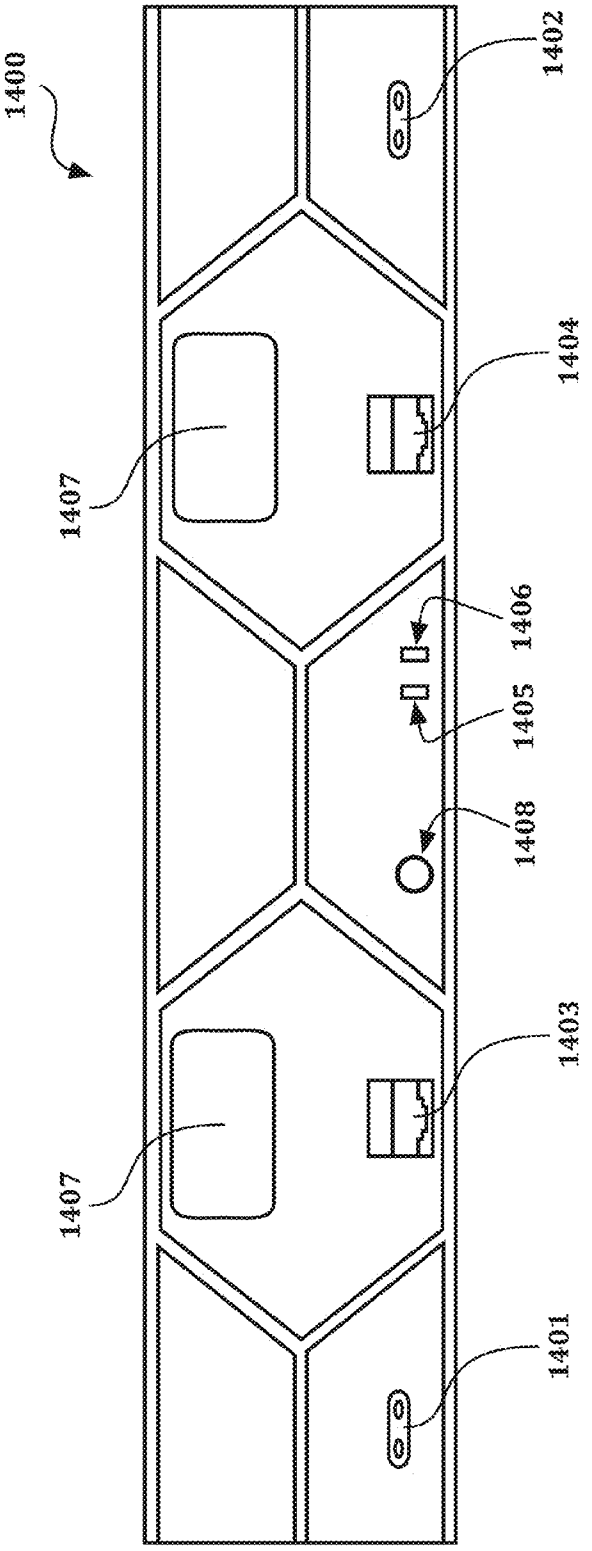


FIG. 14

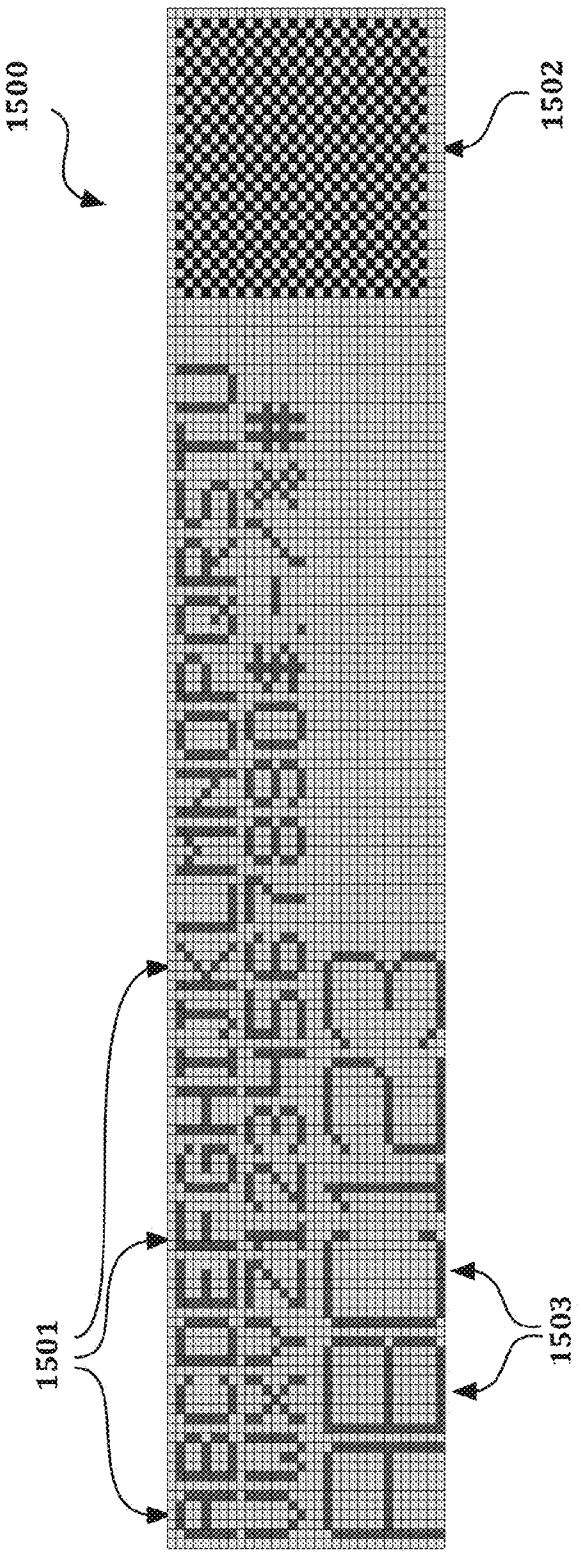


FIG. 15

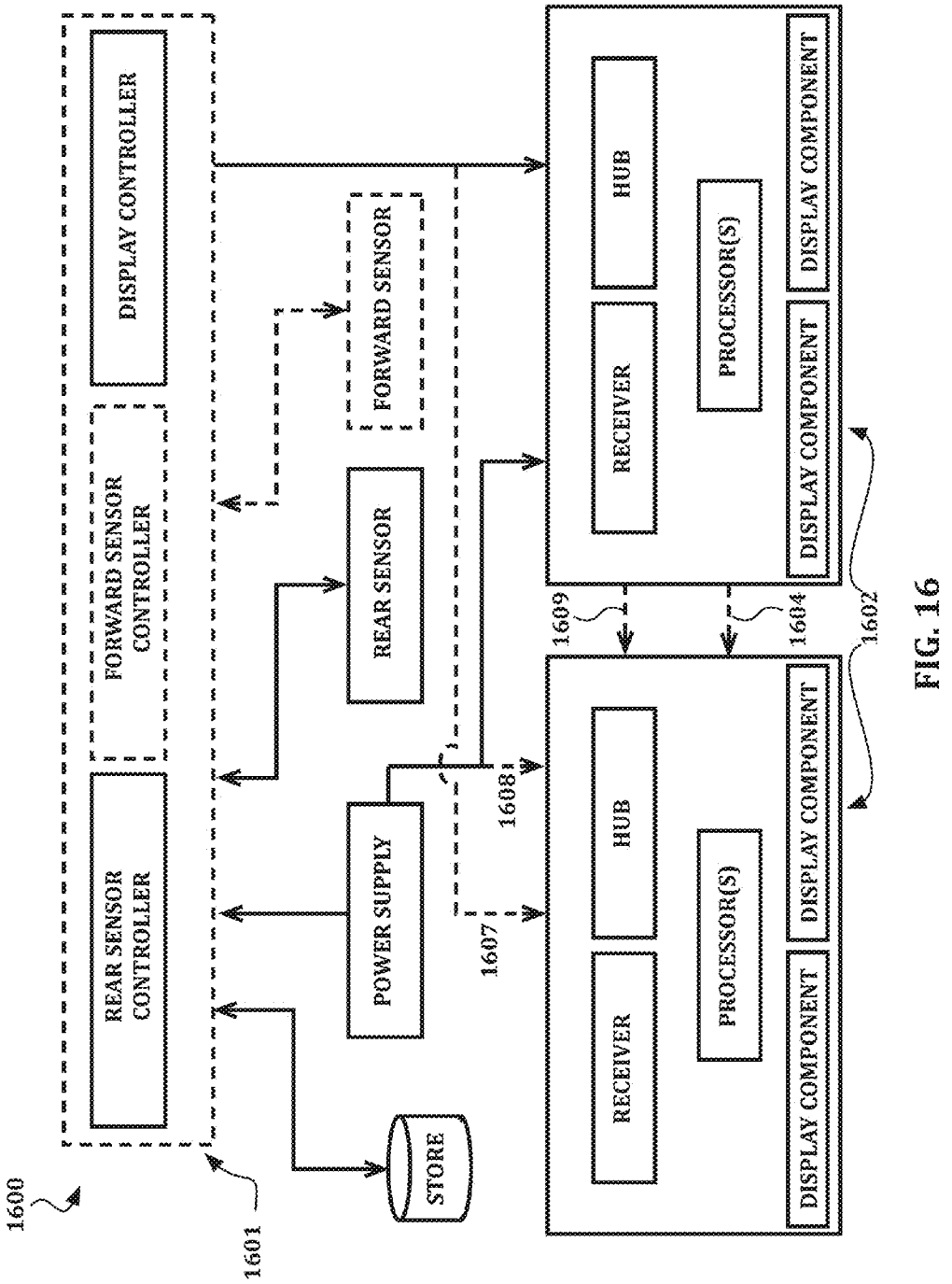

1600
1601
REAR SENSOR CONTROLLER
FORWARD SENSOR CONTROLLER
DISPLAY CONTROLLER
STORE
POWER SUPPLY
REAR SENSOR
FORWARD SENSOR
1607
1608
1609
1604
1602
RECEIVER
HUB
PROCESSOR(S)
DISPLAY COMPONENT
DISPLAY COMPONENT
RECEIVER
HUB
PROCESSOR(S)
DISPLAY COMPONENT
DISPLAY COMPONENT

FIG. 16

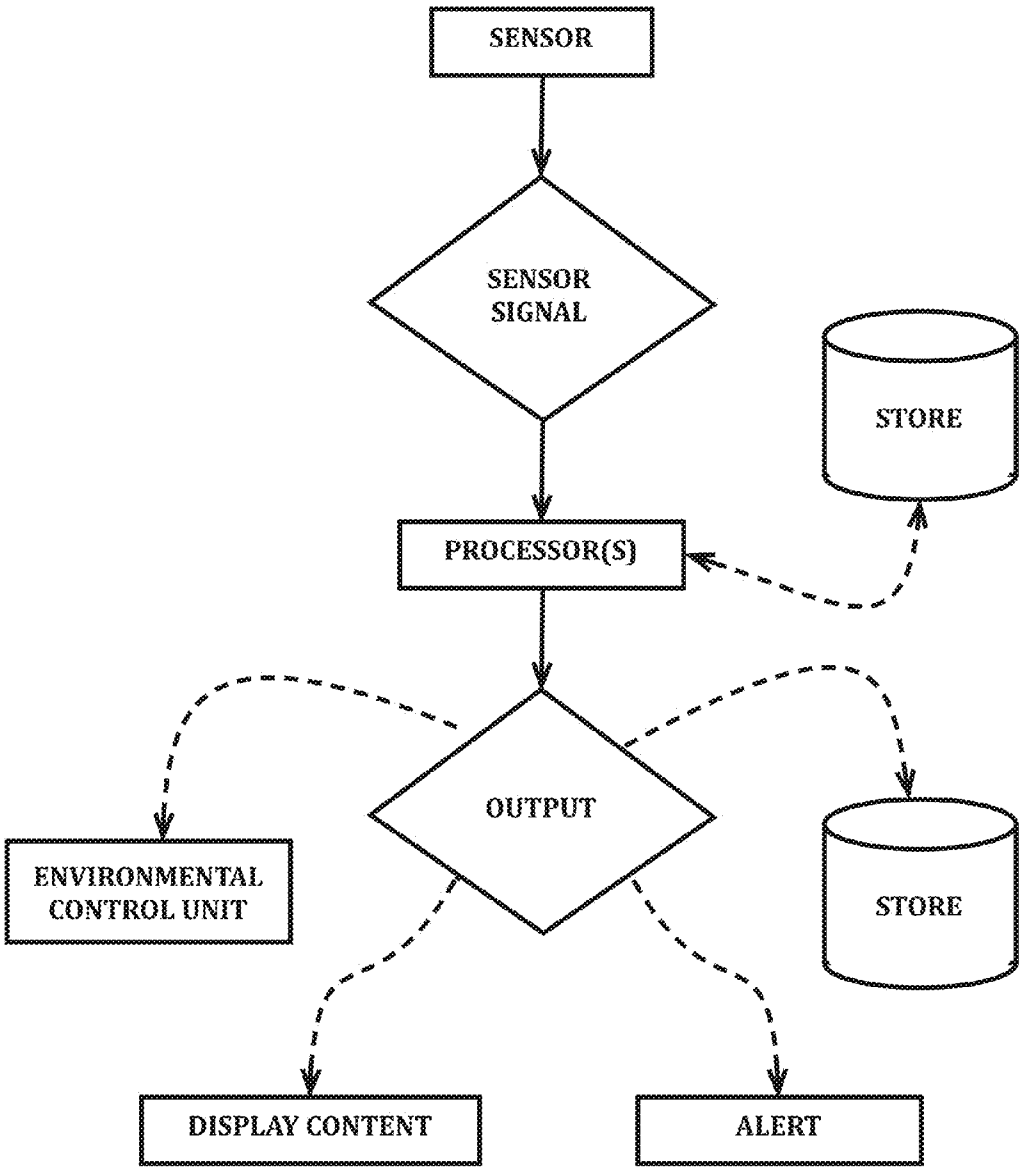

SENSOR
SENSOR SIGNAL
STORE
PROCESSOR(S)
OUTPUT
ENVIRONMENTAL CONTROL UNIT
STORE
DISPLAY CONTENT
ALERT

FIG. 17

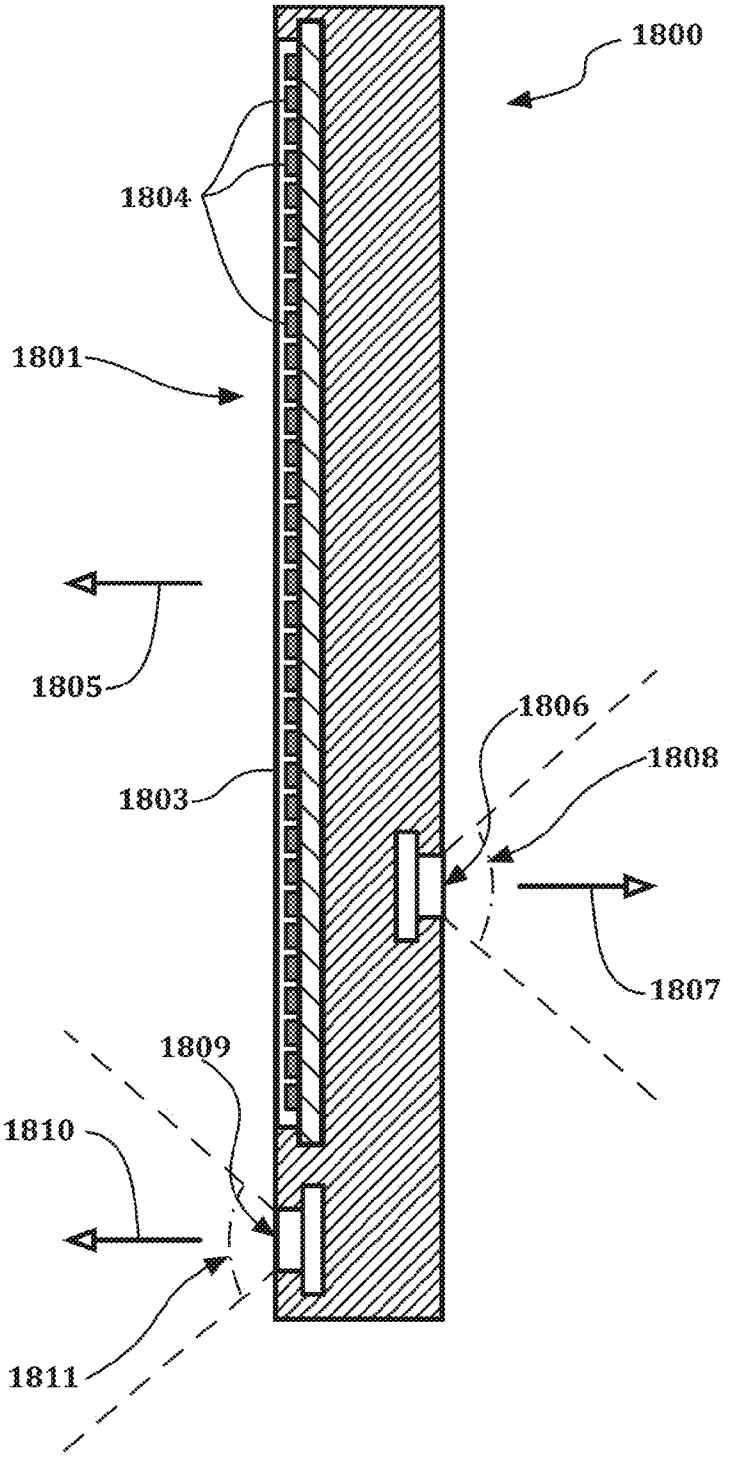


FIG. 18

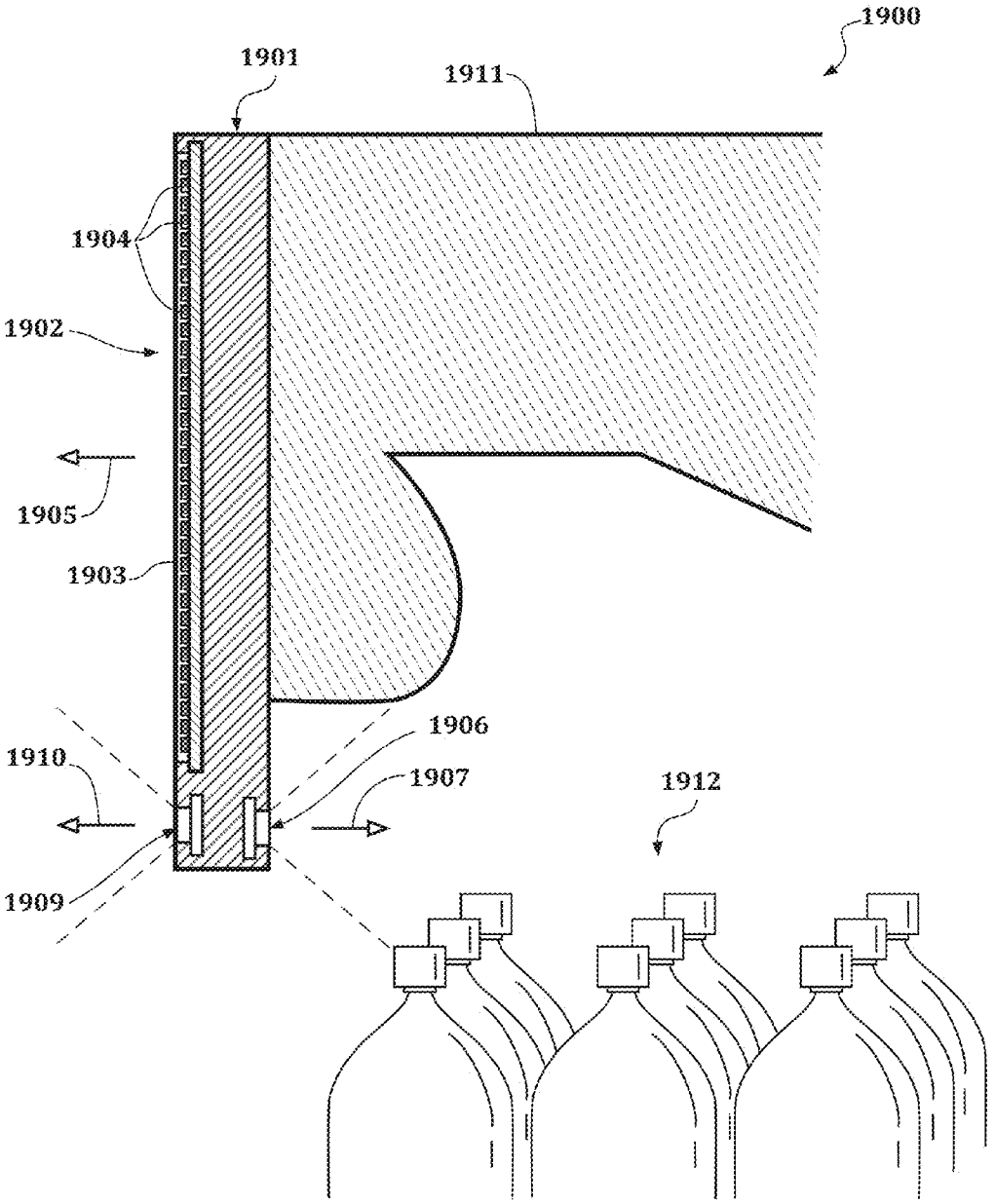


FIG. 19

MERCHANDISING COMMUNICATION AND INVENTORYING SYSTEM

CROSS-REFERENCE

[0001] This application claims the benefit of U.S. Provisional Application Nos. 62/031,258, filed 31 Jul. 2014, and 62/190,580, filed 9 Jul. 2015, both of which are incorporated herein in their entireties.

FIELD

[0002] The disclosure relates to a systems and methods for conveying content to and displaying content on merchandising communication systems and systems and methods for monitoring various environments, particularly retail environments.

BACKGROUND OF THE INVENTION

[0003] There are a variety of retail options for displaying a variety of information in retail environments, including, pricing, labeling, promotions, etc. Traditionally, this information has been provided using print systems, including slide-in paper system, plastic label systems, adhesive label systems, etc. More recently, there has been increased interest in utilizing digital or electronic systems to display such information.

[0004] The utilization of high definition display technology, including plasma displays, LCD displays (including those backlit by light emitting diodes (LEDs)), etc., in such applications was considered, but such systems are expensive, limiting their scope of commercial adoption. For example, many retail outlets have large numbers of shelves that require the display of information. Systems described in US 2014/0139548 utilize only a single display strip per aisle for displaying the prices of products on a multiple shelves. This approach may alleviate some of the cost-prohibitive nature of such devices, but leaves a great deal to be desired as the prices are no longer located adjacent the product, resulting in frustrated customers having to search for prices. In addition, such systems utilize displays that are not only expensive to install, but to replace. US 2010/0012600 suggests the use of such displays protrude into the aisles where customers can knock the displays off and/or otherwise damage the displays. The solution there was to provide a large housing below the shelf to secure the electronics and protect them from being damaged. However, these large systems are even more difficult and expensive to transport and install, and do not provide optimal display surface areas.

[0005] The utilization of less complex and cheaper displays have also been considered, including e-paper displays (EPD), and thin-film-transistor liquid crystal displays (TFT LCD). However, such solutions are not one continuous strip. Therefore, a retailer cannot manage and communicate with an entire shelf display or multiple shelf displays in a single action. Instead, such digital and print displays, while possibly being adequate for displaying pricing information, product information, etc., they must be managed individually and do not have the ability to display complete aisle cross-branding, customer communication, display true or full-spectrum color, or full motion video and/or animation. Typical TFT displays for such applications are limited to displays that are 480 pixels wide by 272 pixels high, limiting the viability of such solutions. With graphics cards having a 2048 pixel wide by 1152 pixel high capability, such displays would need to be linked together with multiple displays and multiple graphics cards, requiring sophisticated and expensive synchronization software. Further, such systems would be limited to a maximum of twelve displays, equivalent to a five-foot section of tethered displays, through a single display server. In addition, such displays have relatively poor brightness—e.g., generally only up to about 25 NITS—and angle and distance legibility parameters—e.g., generally up to a maximum of about 2-3 feet at a 90 degree viewing angle and about 1-2 feet at a 25 degree viewing angle.

SUMMARY OF THE INVENTION

[0006] Provided herein are displays, components thereof, and systems thereof. In specific embodiments, such displays, components and systems are used or useful in retail applications. In some embodiments, such displays are cost effective, while having a low profile, being impact resistant, having continuous display capabilities, having full color capabilities, having excellent brightness parameters, and/or having excellent visibility parameters, as well as other advantageous features. Further, by including sensor capabilities, systems and display units provided herein are able to provide dynamic merchandising and experiences, as well reduce labor and capital investment costs associated with inventorying, controlling product environments (e.g., to reduce product spoilage and waste), and the like.

[0007] In some embodiments, provided herein is a display system (e.g., dynamic retail display system) comprising a sensor (e.g., an inventorying sensor (e.g., camera, RFID sensor, a sensor film (e.g., a pressure sensor film, a resistive sensor film, a capacitive sensor film, or the like), etc.) (e.g., the system being configured to use sensor signals to identify product location and/or product inventory), environmental sensor(s)—e.g., humidity sensor, temperature sensor, etc.—and combinations thereof) and one or more display unit (e.g., a display unit or strip described herein). In specific instances, the system or display unit comprises a sensor (e.g., a display unit of the system comprising the camera integrated therein) and a display surface (e.g., both of which are, in exemplary embodiments, combined into a display unit). In some embodiments, the display surface (e.g., LED array) is configured to face in a first direction and a camera (e.g., lens thereof) is configured to face in a second direction (e.g., a direction about 90 degrees to 180 degrees or about 135 degrees to about 180 degrees opposed to the first direction). In certain embodiments, the sensor is configured to provide output signals to a controller, the sensor output signals conveying information regarding objects (e.g., retail products) configured in proximity to (e.g., within about 10 feet, within about 5 feet, or within about 3 feet, such as behind, below, and/or behind) the display unit (e.g., on a shelf behind, or behind and below, the display unit). In more specific instances, the system comprises a first display unit comprising a first display surface (e.g., an LED array described herein) and a first camera, the first display surface configured to face a first direction and the first camera configured to face in a second (e.g., opposed) direction; and a second display surface (e.g., an LED array described herein) and a second camera, the second display surface configured to face a third direction and the second camera configured to face in a fourth (e.g., opposed) direction. In some instances, the first and third directions are the same or different, and the second and fourth directions are the same or different. As used herein, a camera refers to any device suitable for capturing images and/or video.

[0008] In certain embodiments, the controller comprises a module configured to identify objects in proximity to a sensor (e.g., camera, RFID sensor, a sensor film (e.g., a pressure sensor film, a resistive sensor film, a capacitive sensor film, or the like), or the like) or display unit of the system (e.g., products or merchandise located on the shelf to which the display unit is attached and/or the products located on a shelf below the shelf to which the display unit is attached). In specific embodiments, the controller comprises a module configured to identify whether or not a misplaced or an out of place object is in proximity to a sensor or display unit of the system. In certain embodiments, the controller comprises a module configured to access a data store comprising information regarding an object assigned to be in proximity to the sensor (e.g., camera) or display unit and a module configured to determine whether or not an object in proximity to the sensor (e.g., camera) or display unit corresponds to the object assigned to be in proximity to the sensor (e.g., camera) or display unit, based on the information conveyed to the controller by the sensor (e.g., camera) output signal (e.g., by comparing an image of an object captured by the camera and conveyed via the output signal to the controller to an image of an object assigned to be in proximity to the camera—such image being stored, e.g., in a data store, and accessed by a controller module). In specific embodiments, the controller comprises a sensor identification module configured to identify the sensor from which the sensor information is conveyed, a module configured to access a data store comprising information associating an object (e.g. product) with the identified sensor (e.g., camera), and a module configured to determine whether or not an object in proximity to the sensor (e.g., camera) corresponds to the object assigned to be in proximity to the camera. In some embodiments, the controller further comprises a module configured to send an alert output signal to display or otherwise trigger an alert if an unassigned object is identified as being in proximity to the sensor (e.g., camera). In some embodiments, the alert is optionally displayed on a display unit described herein, or on a separate user interface, such as a person computer, tablet, or the like.

[0009] In some embodiments, the controller comprises a module configured to determine (e.g., qualitatively or quantitatively) the amount of an object (e.g., product or merchandise) in proximity to a sensor (e.g., camera) of the system (e.g., products or merchandise located on the shelf to which the display unit is attached and/or the products located on a shelf below the shelf to which the display unit is attached), e.g., based on the information conveyed in the sensor output signal (e.g., by comparing an image of an object captured by the camera and conveyed via the output signal to the controller to an image of an object assigned to be in proximity to the camera—such image being stored, e.g., in a data store, and accessed by a controller module—an determining the number of such objects are present in the captured image). In specific embodiments, the controller comprises a module configured to count (i.e., qualitatively determine) the number of objects in proximity to a sensor (e.g., camera) of the system (e.g., using spatial recognition software). In certain embodiments, the controller comprises a module configured to access a data store comprising information regarding an object (e.g., product or merchandise) assigned to be in proximity to the sensor (e.g., camera) and a module configured to determine the amount of the object (e.g., product or merchandise) in proximity to the sensor (e.g., camera), e.g., based on the information conveyed to the controller by the sensor output signal. In specific embodiments, the controller comprises a sensor identification module configured to identify the sensor from which the sensor information is conveyed, and a module configured to access a data store comprising information associating an object (e.g. product or merchandise) with the identified sensor (e.g., camera), and a module configured to determine the amount of the object in proximity to the sensor (e.g., camera). In some embodiments, the controller further comprises a module configured to compare the amount of the object in proximity to the sensor (e.g., camera) to a predetermined parameter (e.g., a value or range, such as a minimum value). In some embodiments, the controller further comprises a module configured to send an alert output signal (e.g., to a display, a light, an audio receiver, a personal computer, a database, or the like) if the amount of the object meets or fails to meet a predetermined parameter (e.g., falls below a minimum value, such as to facilitate re-ordering and/or re-stocking). In some embodiments, the alert is optionally displayed or otherwise signaled on a display unit described herein, on a separate user interface, such as a person computer, tablet, or the like, an alert light (e.g., an LED), a speaker (e.g., for audio alerts), or the like. In certain embodiments, the controller comprises a module configured to record the amount of object in proximity to the sensor (e.g., periodically, such as daily) to a data store (e.g., so as to allow inventory tracking of a product—in some instances, the controller further comprises a module configured to track inventory of a product).

[0010] In some embodiments, a system or display unit provided herein comprises an environmental sensor (e.g., a temperature sensor, a humidity sensor, or a combination thereof). In specific embodiments, a system provided herein comprises a controller comprising a module configured to determine an environmental state in proximity to the sensor (e.g., in proximity to a display unit of the system). In certain embodiments, the environmental sensor is configured to provide output signals to a controller, the output signals conveying information regarding an environmental state (e.g., temperature and/or humidity) in proximity to (e.g., behind, below, and/or behind) the sensor (e.g., in proximity to the display unit, particularly wherein the sensor(s) are housed within the display unit). In some embodiments, the controller comprises a module configured to determine the status of an environmental state (e.g., the temperature or the humidity) in proximity to the sensor based on the information conveyed to the controller by the environmental output signals (e.g., from the environmental sensor(s)). In some embodiments, the controller comprises a module configured to compare the status of the environmental state (e.g., temperature and/or humidity) in proximity to the environmental sensor to a predetermined parameter (e.g., a minimum temperature, a maximum temperature, a minimum humidity, a maximum humidity, or the like). In specific embodiments, the controller comprises a sensor identification module configured to identify the sensor from which the sensor information is conveyed, a module configured to access a data store comprising information associating an object (e.g. product) with the identified sensor, and a module configured to compare the status of the environmental state in proximity to the sensor to a predetermined parameter. In some embodiments, the controller further comprises a module configured to send an alert output signal (e.g., to a display, a light, an audio receiver, a personal computer, a database, or the like) if the status of the environmental state satisfies (or fails to satisfy) a predetermined parameter (e.g., to facilitate environmental control of the retail environment). In some embodi-

ments, the alert is optionally displayed or otherwise signaled on a display unit described herein, on a separate user interface, such as a person computer (e.g., a monitor thereof), tablet, or the like, an alert light (e.g., an LED), a speaker (e.g., for audio alerts), or the like. In certain embodiments, the controller comprises a module configured to record the status of the environmental state in proximity to the sensor (e.g., periodically, such as weekly, daily, nightly, or the like) to a data store, such as the hard drive of a personal computer, a cloud, or the like (e.g., so as to allow tracking of an environmental state, such as temperature and/or humidity). In specific embodiments, environmental units are particularly useful in refrigerated units.

[0011] In certain embodiments, the sensor (e.g., rear facing camera) is configured to provide output signals, the output signals conveying information regarding a state of an operating parameter (e.g., an inventory level and/or product or merchandise placement). In certain embodiments, the sensor (e.g., camera) conveys information suitable for determining inventory levels using, e.g., spatial recognition software, and/or product identification using, e.g., label and/or barcode recognition software, or other desired information. In specific embodiments, the sensor (e.g., camera) is configured to detect (or convey information about) product or merchandise in proximity to the sensor (e.g., camera) (e.g., on a shelf below and behind a unit housing the camera, on a shelf to which a unit housing a camera is affixed or otherwise attached, or the like). Further, in some embodiments, the display unit, e.g., sensor (e.g., camera) thereof, comprises a module configured to store and/or determine a sensor (e.g., camera) identifier associated with (e.g., the location of) the sensor (e.g., camera) (e.g., in and/or near which display units the sensor is located). In specific instances, the sensor identifier is a dynamic identifier, such as an identifier assigned based on the order in which multiple sensors (e.g., cameras) of the system are manually connected to the system

[0012] In certain embodiments, a system or display unit (e.g., strip) provided herein further comprises an additional sensor, the additional sensor configured to provide sensor output signals, the sensor output signals conveying information regarding a state of an operating parameter (e.g., of the display unit or sensor). In certain embodiments, the sensor is a motion detector, a camera (e.g., configured to detect motion and/or facial features—i.e., facial recognition), or any suitable sensor for detecting an object or person in proximity to the display, and/or detecting a state of an object or person in proximity to the display. In specific embodiments, the sensor is configured to detect a person located in front of the display and/or in front of closely adjacent displays (e.g., wherein a system comprising multiple display units is provided). In some embodiments, the sensor is configured to detect a predetermined state of a person located in front of the display and/or in front of closely adjacent displays (e.g., wherein a system comprising multiple display units is provided). In specific embodiments, provided herein is a system comprising multiple display units, at least one display unit comprising a sensor. Further, in some embodiments, the display unit, e.g., sensor thereof, comprises a module configured to store and/or determine a sensor identifier associated with (e.g., the location of) the sensor (e.g., in and/or near which display units the sensor is located). In specific instances, the sensor identifier is a dynamic identifier, such as an identifier assigned based on the order in which multiple sensors of the system are manually connected to the system.

[0013] In specific instances, the additional sensor is a camera (e.g., wherein a display unit of the system comprising the camera integrated therein) configured to detect the presence of persons and/or objects in proximity to a display surface (e.g., the camera and the display surface both being, in exemplary embodiments, combined into a display unit). In some embodiments, the display surface (e.g., LED array) is configured to face in a first direction and the camera (e.g., lens thereof) is configured to face in a second direction (e.g., the first and second direction being the same, or being within 0 degrees to about 75 degrees of one another). In certain embodiments, the camera is configured to provide output signals to a controller, the output signals conveying information regarding objects and/or persons configured in proximity to (e.g., in front of) the display unit (e.g., in an aisle in front of—including, e.g., directly in front of and adjacently in front of, and the like). In more specific instances, the system comprises a first display unit comprising a first display surface (e.g., an LED array described herein) and a first camera, the first display surface configured to face a first direction and the first camera configured to face in a second (e.g., similar) direction; and a second display surface (e.g., an LED array described herein) and a second camera, the second display surface configured to face a third direction and the second camera configured to face in a fourth (e.g., similar) direction. In some instances, the first and third directions are the same or different, and the second and fourth directions are the same or different. In specific instances, the system comprises a sensor configured to provide output signals to a controller, the output signals conveying information regarding the state of an operating parameter, the controller configured to identify the state of an operating parameter (e.g., identify the status of a predetermined sensor state, such as motion, no motion, and captive (e.g., as determined by identification of a face using facial recognition software)) and to provide predetermined display information (content) to the one or more display unit of the system based on the identified sensor state.

[0014] In some embodiments, provided herein is a system (e.g., a retail display system) comprising any display described herein, camera (e.g., rear facing camera), an optional additional sensor (e.g., forward facing camera), and a controller. In various embodiments, the controller comprises one or more controller units that when taken together comprise the features and/or perform the functions described herein. In some embodiments, the controller comprises an output configured to provide global system display information to one or more display unit (e.g., multiple display units). In certain embodiments, the controller comprises an input configured to receive a sensor output signal (e.g., from one or more sensor (e.g., a forward facing and/or rear facing camera) of one or more display unit described herein).

[0015] In some embodiments, the system, e.g., controller thereof, comprises a sensor state identification module configured to identify or monitor a sensor state (e.g., of an operating parameter) of a sensor thereof (e.g., configured to detect sensor states and/or interactions). For example, in certain embodiments, the sensor state identification module is configured to detect whether or not a person is in proximity to a display unit of the system (e.g., the display unit in which the sensor is located, or an adjacent or otherwise nearby display unit) (e.g., wherein the sensor state operating parameter is near or not near one or more display unit of a system described herein). In further or additional embodiments, the sensor state identification module is configured to detect

whether or not inventory level of a product are low (e.g., below a predetermined level) or high (e.g., above a predetermined level) and/or whether or not a product is misplaced. In some embodiments, a system provided herein further comprises a sensor state information module configured to identify predetermined information to be provided to (or displayed on) a display unit based on whether or not a predetermined sensor state (e.g., of an operating parameter) of a sensor has been satisfied.

[0016] In specific embodiments, provided herein is a display system comprising a first camera, a second camera and one or more display unit. In specific embodiments, the display unit comprises the first camera, the second camera (or other sensor configured to detect persons or evidence of persons (e.g., motion, heat, or the like), such as customers, in front of or in viewable proximity of the display surface), and a display surface (e.g., the display surface comprising an LED array described herein). In some embodiments, the display surface (e.g., LED array) is configured to face a first direction, the first camera (e.g., lens thereof) is configured to face a second direction (e.g., a direction about 90 degrees to 180 degrees or about 135 degrees to about 180 degrees opposed to the first direction—a rear facing direction), and the second camera (e.g., lens thereof) is configured to face a third direction (e.g., a direction 0 degrees to about 90 degrees or 0 degrees to about 75 degrees or about 0 to about 45 degrees of the first direction—a forward facing direction). In certain embodiments, the first camera is configured to provide first output signals to a first controller, the first output signals conveying information regarding objects (e.g., retail products) configured in proximity to (e.g., behind, below, and/or behind) the display unit (e.g., on a shelf behind, or behind and below, the display unit), and the second camera is configured to provide second output signals to a second controller (e.g., a sub-controller unit of the system controller), the second output signals conveying information regarding the state of an operating parameter. Further, in specific embodiments, the second controller is configured to identify the state of an operating parameter (e.g., identify the status of a predetermined sensor state, such as motion, no motion, and captive (e.g., as determined by identification of a face using facial recognition software)) and to provide predetermined display information (content) to the display unit based on the identified state of the operating parameter. In further embodiments, the system further comprises an environmental sensor (e.g., a temperature sensor, a humidity sensor, or both). In specific embodiments, the environmental sensor is configured to provide environmental sensor output signals to a third controller (e.g., a sub-controller unit of the system controller). In some embodiments, the third controller comprising a module configured to determine an environmental state in proximity to the sensor (e.g., in proximity to a display unit of the system). In various embodiments, the first, second, and third controllers are optionally taken together in a single device (e.g., a single computer or control unit), or in any combination of devices.

[0017] In some embodiments, provided herein is a display system (e.g., a retail display system) comprising a first display unit and a second display unit, the first display unit comprising a display surface (e.g., an LED display surface described herein), a forward facing camera (e.g., facing in a direction within 0 to about 75 degrees of the direction in which the display surface is facing), and a rear facing camera (e.g., facing in a direction of about 90 to about 180 degrees opposed to the direction in which the display surface is facing); and the second display unit comprising a display surface (e.g., an LED display surface described herein), and a rear facing camera (e.g., facing in a direction of about 90 to about 180 degrees opposed to the direction in which the display surface is facing). In specific embodiments, the system comprises at least one first display unit and multiple second display units. In some instances, given the open configuration in front of a display unit, a single forward facing or forward detecting sensor (e.g., camera) is able to be configured to detect the state of an operating parameter (e.g., for determining target—customer—proximity) for several display units, whereas the rear facing sensors (e.g., cameras) are situated closely to the objects (e.g., shelved merchandise behind the display units), affording them less field of view. Therefore, in some instances, it is desirable to reduce the number of forward detecting sensors in a system provided herein in order to further enhance affordability of the system. In some embodiments, a system provided herein comprises at least 2 rear facing sensors to every 1 forward detecting sensor. In more specific embodiments, the ratio is at least 4:1 or at least 8:1.

[0018] In specific embodiments, display units and display surfaces described herein comprise light emitting diode (LED) displays. In specific embodiments, the light emitting diode display comprises a viewable surface comprising light emitting diode pixels. Generally, it is to be understood that such displays are not to be confused with liquid crystalline displays (LCDs) that are backlit with light emitting diodes (LEDs), but are often referred to in the art as LED displays. Thus, in certain embodiments, LED displays provided herein are non-LCD LED displays, or displays that do not comprise an LCD viewable surface.

[0019] Provided in certain embodiments herein is a display unit, such as a high aspect ratio display strip. In specific embodiments, such display units are configured for use in a retail environment, such as being configured to be affixed to or integrated with a retail shelving system. In other embodiments, high aspect ratio display strips provided herein are optionally configured to be utilized in other applications, including being configured to be affixed to or integrated with non-retail shelving systems.

[0020] In some embodiments, provided herein is an LED display unit (e.g., LED display strip). Generally, the LED display unit comprises an array of viewable LED pixels, and an input configured to receive (or be connected to receive) display information. In some instances, the input is configured to receive display information from a controller, e.g., directly from the controller, via another LED display unit (e.g., by daisy chaining therethrough), or the like. In some embodiments, the display information is global system display information, such as display information for multiple display units—e.g., multiple display units connected to a common controller. In some embodiments, the display unit further comprises a display component output configured to provide display information to the array of viewable LED pixels (e.g., or an LED display component body, the LED display component being the component body, such as a circuit board, of the unit comprising the array of LED pixels mounted or embedded therein/thereon). In specific embodiments, the display information provided to the LED pixel array is the display information received by the display unit, or a subset thereof. In specific embodiments, such as wherein multiple display units are controlled by a controller, the LED display unit is configured to receive global system display

information and provide local display information (a subset of the global system display information) to the LED pixel array. In further embodiments, a display unit provided herein comprises one or more processor (e.g., a FPGA) configured to execute one or more program modules. An exemplary program module comprises, by way of non-limiting example, a content identification module configured to identify the local display information (e.g., identify the subset of global system display information that is to be display on the specific display unit). Additional non-limiting, exemplary display unit program modules that are optionally included in the display units provided herein are found throughout this disclosure.

[0021] In specific embodiments, provided herein is a (e.g., high aspect ratio) light emitting diode (LED) display unit (e.g., a retail display unit) comprising a receiving card and an array of LED pixels. In some embodiments, the receiving card comprises a circuit board, the circuit board comprising an input and an output (e.g., mounted thereon). In specific embodiments, the first input of the receiving card is configured to receive or to be connected to receive display information (e.g., global display information, a subset thereof to be locally displayed on the display unit). In certain embodiments, the array of LED pixels is in the form of a circuit board comprising the array of LED pixels mounted thereon or embedded therein. In further embodiments, the circuit board comprising the LED array further comprises one or more (e.g., multiple) LED drivers. In some embodiments, the output of the receiving card is configured to convey display information (e.g., local display information, such as a subset of the global display information received at the receiving card) to the LED array (e.g., circuit board comprising the same). In further or additional embodiments, the unit further comprises a second array of LED pixels and the receiving card further comprising a second output (e.g., mounted thereon), the second output of the receiving card being configured to convey display information (e.g., local display information, such as a subset of the global display information received at the receiving card) to the second LED array (e.g., circuit board comprising the same). In further or additional embodiments, the display unit further comprises a sensor (e.g., a forward facing camera and a rear facing camera). In specific embodiments, the sensor(s) comprises an output configured to convey or to be connected to convey an output signal (e.g., to a controller or a sensor control unit thereof). In further or additional embodiments, the display unit further comprises a housing defined with one or more opening. In specific embodiments, the housing is defined with one or more opening by which the LED array(s) are exposed (e.g., externally exposed, such as to be viewable external to the display unit). In specific embodiments, a single opening exposes all LED arrays of the display unit. In some embodiments, the housing further defines a camera opening (e.g., on the opposite surface as the LED opening(s)) through which a camera (e.g., lens thereof) is exposed (e.g., externally exposed, such as to allow the camera to detect and/or identify objects (e.g., products or merchandise) behind the display unit, or the LED array thereof). Specific optional details of the display unit are described throughout this disclosure. In specific embodiments, however, the arrays have a pixel pitch of about 2.5 mm or less (e.g., about 2 mm or less, or about 1.8 mm to about 1.9 mm, or about 1.875 mm). In further or additional specific embodiments, the display unit having an aspect ratio (length/height) of about 2 or more (e.g., about 2.5 or more, or about 3 or more).

[0022] Any suitable length and height are optionally utilized, such as a height of about 30 mm to about 250 mm and a length of about 100 mm to about 2000 mm. In certain retail applications, a height suitable for display in the front of a shelf is preferred. Most preferably, the height is not so large as to block merchandise from being viewed and is not so large as to be easily bumped when removing merchandise from a shelf. In specific embodiments, the display height is about 50 mm to about 150 mm. In more preferred embodiments, the height is about 50 mm to about 105 mm. In specific embodiments, the height is about 60 mm to about 70 mm, e.g., about 65 mm. Further, in certain applications, a length suitable for display in the front of a shelf is also preferred. Longer shelves are desirable in some instances so as to minimize the number of units required. However, shorter units are desirable in some instances for versatility in more shelving configurations, to minimize replacement costs when a display is broken, or otherwise malfunctions or ceases all or some operational capabilities, etc. In some preferred embodiments, the display length is about 150 mm to about 1500 mm. In more preferred embodiments, the display length is about 200 mm to about 500 mm. In still more preferred embodiments, the display length is about 275 mm to about 350 mm. In other retail applications (e.g., hardware stores with long continuous shelving configurations), longer strips are preferred in some instances. In some embodiments, display strips provided herein have lengths of about 1 m to about 1.5 m, e.g., about 1.2 m to about 1.25 m. In some embodiments, the high aspect ratio LED strip has an aspect ratio (i.e., length/height) of at least 2.5. In more specific embodiments, the aspect ratio is at least 3. In still more specific embodiments, the aspect ratio is at least 4.

[0023] Any suitable depth of display unit (e.g., strip) is optionally utilized. In preferred embodiments, the depth of the display strip is small enough to limit its protrusion into an aisle and to reduce risk of aisle traffic bumping into the strip and potentially damaging it. The LED displays and systems provided herein allow for low profile (i.e., low depth) displays to be provided, without losing their cost effectiveness. In some embodiments, the depth of the display is less than 50 mm, e.g., less than 30 mm. In still more preferred embodiments, the depth of the display is less than 25 mm. In yet more preferred embodiments, the depth of the display is less than 20 mm. In certain instances, displays have a preferred depth of about 10 mm to about 25 mm, e.g., about 15 mm to about 20 mm.

[0024] In some embodiments, provided herein are LED displays (e.g., a component of a display unit or strip described herein) comprising an array of viewable LED pixels. In further embodiments, provided herein are systems and display units or strips comprising one or more such LED display (also referred to herein as an LED display component). In specific embodiments, the LED pixel comprises a red light emitting diode, a green light emitting diode, or a blue light emitting diode. In more specific embodiments, the LED pixel comprises a red light emitting diode, a green light emitting diode, and a blue light emitting diode. In certain embodiments, the light emitting diode is a light emitting diode chip. In specific embodiments, the LED display component comprising a conductive substrate (e.g., a printed circuit board (PCB) (e.g., a metal core printed circuit board (MCPCB))) comprising multiple light emitting diode chips mounted on or embedded in a substrate (e.g., using chip on board technologies). The chip is optionally mounted to the substrate using any suitable tech-

nique, such as by affixing the chip with an electrically conductive adhesive (e.g., an epoxy, an acrylic, a cyanoacrylate, a silicone, a urethane acrylate, or the like comprising a conductive filler, such as silver, nickel, carbon, or the like) or using any other suitable technique, such as soldering. In some embodiments, it is possible to reduce the pixel pitch (i.e., the distance between the center of one pixel to the center of adjacent pixel(s)). In some embodiments, any suitable LED technology is optionally utilized, e.g., multiple cups chip on board (MCOB), chip on board (COB) LED, surface mounted device (SMD) LED, wired LED, or the like. In preferred embodiments, the pixel pitch of any LED display or display unit provided herein is about 3.0 mm or less. In more preferred embodiments, the pixel pitch is about 2.5 mm or less. In still more preferred embodiments, the pixel pitch is about 2.0 mm or less. In yet more preferred embodiments, the pixel pitch is about 1.9 mm or less (e.g., about 1.875 mm).

[0025] In certain embodiments, the array of viewable LED pixels has a first number of pixels in the first dimension and a second number of pixels in a second dimension. In some embodiments, the first (height) dimension comprises about 24 pixels or more. In preferred embodiments, the first (height) dimension comprises about 30 pixels or more (e.g., about 32 pixels). In more preferred embodiments, the first (height dimension comprises about 30 to about 60 pixels. Generally, about 30 or more pixels are preferred to provide minimum desired display requirements, providing for at least three lines of text with minimal visible text defect. Any suitable number of pixels is present in the second (length) direction. Pixel pitch in the second (length) dimension is preferably about the same as the pixel pitch in the dimension, the number of pixels being determined thereby and by the length of the display unit. In certain embodiments, the number of LED pixels in the second dimension is about 100 or more. In preferred embodiments, the number of LED pixels in the second dimension is about 100 to about 500, e.g., about 120 to about 200 or about 160.

[0026] In some embodiments, the legibility of displays provided herein are superior over EPD and LCD TFT type displays, while remaining cost effective and having full color capabilities. In certain embodiments, the maximum legality distance of a display provided herein at a viewing angle of 90 degrees is about 5 feet or more. In more preferred embodiments, the maximum legality distance of a display provided herein at a viewing angle of 90 degrees is about 10 feet or more. In more specific embodiments, the maximum legality distance of a display provided herein at a viewing angle of 90 degrees is about 20 feet or more. In certain embodiments, the maximum legality distance of a display provided herein at a viewing angle of 25 degrees is about 2 feet or more. In more preferred embodiments, the maximum legality distance of a display provided herein at a viewing angle of 90 degrees is about 5 feet or more. In more specific embodiments, the maximum legality distance of a display provided herein at a viewing angle of 90 degrees is about 8 feet or more.

[0027] In some embodiments, the brightness of the LED displays provided herein can be configured to provide improved viewability and an improved viewing experience, relative to other systems, such as EPD, TFT, and similar systems. In some embodiments, the display units (e.g., LED pixel arrays thereof) provided herein are configured to have a brightness of about 500 NITS or more, such as about 800 NITS or about 1000 NITS. In certain instances, while display units described herein have high brightness capabilities (e.g., about 500 NITs or more, such as about 800 NITS or about 1000 NITS), the display is configured to run at lower brightness levels (e.g., to save energy) (e.g., about 25% to about 100% brightness capability), such as about 200 NITS or more, e.g., about 300 NITS to about 400 NITS.

[0028] In some embodiments, the viewable surface of the LED display component comprises an array of viewable LED pixels and a coating (e.g., a conformal coating in which the LED pixels or components thereof are embedded in the coating). In certain embodiments, the coating comprising any suitable material, such as an epoxy, a polyurethane, an acrylic, a silicone, or a combination thereof. In some embodiments, such coatings serve to protect the LED components from impact damage or environmental damage (e.g., from humidity, mildew, thermal variation, liquid spills, etc.).

[0029] In preferred embodiments, the display unit(s) (e.g., strips) comprise at least a first and a second light emitting diode (LED) display component. In certain instances, the use of a first and a second light emitting diode (LED) display component further facilitates cost effective display replacement options, such as when a display component become damaged or otherwise has less than optimal or desired functionality. In such instances, replacement of a display component is optionally effected without replacing the entire display unit or even the entire display portion of the display unit.

[0030] In certain embodiments, a display unit (e.g., strip) provided herein comprises an input configured to receive display information (e.g., display information to be displayed on the display unit and, optionally, to be displayed on one or more additional display unit(s)). In some embodiments (e.g., in a system comprising multiple display units), the input is configured to receive global system display information. Generally, global system display information comprises the display information to be displayed on one or more LED display units (and, optionally, additional display types). In some embodiments, the global system display information comprises the display information to be displayed on multiple display units. In certain embodiments, the global system display information is provided to multiple display units in any suitable manner. For example, in some embodiments, the global system display information is directly provided to the inputs of the multiple LED display units. In other embodiments, the information is provided to the multiple LED display units by daisy chaining the information through one or more of the multiple display units.

[0031] In some embodiments, a display unit (e.g., strip) provided herein further comprises an output configured to provide display information (e.g., global system display information) to an additional display (e.g., an LED display unit described herein)—such as in a daisy-chaining manner. In certain embodiments wherein the LED display unit is present in a multiple display unit system, the output is configured to provide display information (e.g., global system display information) to an input configured to receive display information of a second LED display unit.

[0032] In certain embodiments, a display unit (e.g., strip) comprises an output configured to provide local display information. In certain embodiments, local display information is specific to the display unit. In some embodiments, local display information is a subset of the global system display information. In other embodiments, local display information is specific to an LED display component. In some embodiments, the output is configured to provide local display information to an LED display component of the display unit. In

specific embodiments, the display unit comprises a first output configured to provide local display information (e.g., first local display information) to a first LED display component and a second output configured to provide local display information (e.g., second local display information) to a second LED display component.

[0033] In some embodiments, the display unit comprises an identification module (e.g., hardware, software, firmware, or the like) configured to store and/or determine an identifier associated with the display unit, or of display components thereof (e.g., in certain instances wherein a display unit comprises multiple display components). In specific embodiments, the identifier is associated with the location of the display unit within a system comprising the display unit and at least one additional display (e.g., additional display units or strips of the type described herein). In certain embodiments, the identification module identifies the location of the display unit, such as the location in a system comprising multiple display units, including one or more of the LED display units described herein and, optionally, additional display unit types.

[0034] In some embodiments, the display unit(s) comprises a content identification module configured to identify the information (e.g., video, images, text, and/or the like) to be displayed at the identified location. In specific embodiments, the content identification module identifies a subset of information to be decompressed by the decompression module and displayed at the identified location. In some such embodiments, the decompression module de-compresses (e.g., only) the subset of information received that is to be displayed at the identified location.

[0035] In some embodiments, the display unit (e.g., strip) comprises a content identification module that is configured to identify the local display information (e.g., as-received or decompressed information) to be displayed on the display unit. In specific embodiments, one or more content identification module is configured to identify local display information to be displayed on a first LED display component and a second LED display component. In more specific embodiments, a single content identification module is configured to identify local display information for both a first and a second LED display component. In other specific embodiments, a first content identification module is configured to identify first local display information for (e.g., to be displayed on) a first LED display component and a second content identification module is configured to identify second local display information for (e.g., to be displayed on) a second LED display component.

[0036] In some embodiments, the display unit (e.g., strip) comprises an information decompression module that is configured to decompress compressed display information. In specific embodiments, the information decompression module is configured to decompress compressed global system display information, or a subset thereof, received by the display. In specific embodiments, the information decompression module is configured to decompress local display information (e.g., decompress information identified by the content identification module as being local display information for the identified display).

[0037] In certain embodiments, modules described herein are program modules, one or more processors configured to execute such program modules. In various embodiments, processors provided herein are units capable of executing and/or configured to execute program modules and include, by way of non-limiting example, computer processing units (CPUs), graphics processing units (GPUs), field-programmable gate arrays (FPGAs), and combinations thereof. In other embodiments, modules are, optionally, hardware modules, firmware modules, or other suitable modules. In various embodiments, modules comprise a combination of program and hardware modules.

BRIEF DESCRIPTION OF THE DRAWINGS

[0038] FIG. **1** illustrates a front perspective view of an exemplary high aspect ratio LED display unit comprising an array of viewable LED pixels.

[0039] FIG. **2** illustrates various components of an exemplary display unit provided herein.

[0040] FIG. **3** illustrates various components of an exemplary display unit provided herein.

[0041] FIG. **4** illustrates an exemplary retail shelving system comprising multiple display units provided herein.

[0042] FIG. **5** illustrates an exemplary segmentation schematic of graphic card display configurations into smaller height segments used in the display units and systems provided herein.

[0043] FIG. **6** illustrates an exemplary logical layout on one or more shelf face using a segmented graphics card configuration.

[0044] FIG. **7** illustrates an exemplary segmented content configuration of an exemplary system provided herein.

[0045] FIG. **8** illustrates components and modules of an exemplary system provided herein.

[0046] FIG. **9** illustrates components and modules of an exemplary system provided herein.

[0047] FIG. **10** illustrates modules of an exemplary controller or system provided herein, or steps of an exemplary method provided herein.

[0048] FIG. **11** illustrates modules of an exemplary controller or system provided herein, or steps of an exemplary method provided herein.

[0049] FIG. **12** illustrates an exemplary configuration of single sensors detecting multiple sensor states, e.g., in multiple sensor zones.

[0050] FIG. **13** illustrates an exemplary depiction of a retail store aisle comprising one or more retail display system provided herein.

[0051] FIG. **14** illustrates a rear view of an exemplary display unit provided herein.

[0052] FIG. **15** illustrates an exemplary LED array of a display unit provided herein, with exemplary text configurations for display thereon.

[0053] FIG. **16** illustrates an exemplary system comprising a controller and one or more display unit.

[0054] FIG. **17** an exemplary system or process configured to provide an output signal to a sensor controller, and the optional output results thereof.

[0055] FIG. **18** illustrates a cross sectional view of an exemplary display unit provided herein.

[0056] FIG. **19** illustrates a cross sectional view of an exemplary shelving system comprising a display unit provided herein.

DETAILED DESCRIPTION OF THE INVENTION

[0057] In certain embodiments, the light emitting diode displays provided herein is a high aspect ratio light emitting diode display strip, systems comprising the same and com-

ponents thereof. In specific embodiments, the display strips are useful for and/or configured for retail applications, such as to be integrated with or attached to retail scaffold, such as (e.g., the front surface of) a shelf. In specific applications, the shelf is a retail shelf.

[0058] FIG. **1** illustrates an exemplary high aspect ratio LED display unit **100** provided herein. The exemplary display unit comprises a first LED display component **101** and a second LED display component **102**. Each exemplary display unit comprises an array of LED pixels **103**, the array comprising 32 LED pixels in a first dimension **104** and 80 LED pixels in a second dimension **105**, the display unit as a whole comprising an array of 160 LED pixels by 32 LED pixels. In addition, the exemplary display unit comprises a housing body **106**, comprising a front surface **107** and rear surface **108** and having a length **109**, a height **110**, and a depth **111**. The front and rear surfaces are optionally flat or contoured, depending on the specific application. The exemplary display unit further comprises a forward facing (e.g., positioned to face outward from the front surface of the) sensor (e.g., motion detector or camera) **112** situated in an approximately central position along the length of the display unit. In some embodiments, the sensor (e.g., camera) is located in a forward facing position on an upper portion of the display unit (e.g., as displayed in FIG. **1**), on a lower portion of the display unit (e.g., if the display unit of FIG. **1** were flipped over), or any other suitable position. In exemplary embodiments, the display unit **100** comprises one or more chaining (e.g., daisy-chaining) connectors **113**, e.g., configured to receive and/or convey, provide or transmit display information (e.g., to additional display units—not illustrated). FIG. **14** illustrates the rear surface of an exemplary display unit **1400** provided herein. In some instances, the display unit comprises a power input **1401** and a power output **1402** (e.g., a simple two pin power connector, such as Molex), e.g., configured to daisy chain power to one or more additional display unit. In certain instances, the display unit comprises a display information input **1403** and a display information output, e.g., configured to daisy chain data to one or more additional display unit. In some instances, the display unit further comprises one or more data input and/or output **1404** and **1405** (e.g., a USB type output, such as USB 3.0, USB 2.0, mini USB, micro USB, or the like), such as a sensor information output and/or a sensor information input (e.g., configured to receive and/or convey sensor information from one or more sensor). In specific instances, the two data outputs **1404** and **1405** are data outputs for conveying output signals away from the display unit **1400** from the forward sensor **112** and the rear sensor **1408**. In some instances, display units provided herein are integrated with a shelving system, or the like, and in other instances, the display units are configured to be capable of being attached to retail scaffold, such as a shelf (e.g., the front edge thereof), e.g., using one or more bracket or magnet **1407**.

[0059] As illustrated in the cross-sectional view of FIG. **18**, in some embodiments, a display unit **1800** provided herein comprises a display surface **1801** (e.g., comprising an LED array, which is optionally coated **1803**, such as with a resin to protect the LED pixels **1804**) is configured to face in a first direction **1805** and the camera **1806** (e.g., lens thereof) is configured to face in a second direction **1807** (e.g., a direction about 90 degrees to 180 degrees or about 135 degrees to about 180 degrees opposed to the first direction). In specific embodiments, the first and second directions are parallel and opposed (i.e., 180 degrees opposed), such as illustrated in FIG. **18**. In some instances, the camera **1806** has an angle of view **1808** (e.g., any suitable angle 180 degrees or less, such as about 120 degrees), the second direction **1807** bisecting the angle of view **1808**. In some embodiments, the display unit further comprises a second camera **1809**, configured to face in a third direction **1810** (e.g., a direction 0 degrees to about 90 degrees aligned with the first direction). In some instances, the second camera **1809** has an angle of view **1811** (e.g., any suitable angle 180 degrees or less, such as about 60 degrees), the third direction **1810** bisecting the angle of view **1811**. In some embodiments, the first direction and third direction are aligned within 0 degrees of each other (i.e., parallel as illustrated in FIG. **18**). In other embodiments, the first and third directions are aligned within 90 degrees of one another (e.g., within 60 degrees, within 45 degrees, within 30 degrees, or the like of one another).

[0060] In certain embodiments, such as illustratively displayed by way of non-limiting example in FIG. **19**, the display unit **1901** comprising a viewable display **1902** (e.g., comprising an array of coated **1903** and viewable LED pixels **1904**) is attached to or integrated with a shelf **1911** and is configured to face in a first direction **1905**. In some embodiments, provided herein is a shelving system (e.g., retail shelving system) comprising a plurality of shelves comprising one or more display unit attached to or integrated therewith. In some embodiments, the display unit comprises a first sensor configured to detect product in proximity to the display unit. In specific embodiments, the first sensor is a camera **1906** configured to face a second direction **1907**, e.g., in a rear facing direction, as discussed herein. In some embodiments, provided herein is a system (e.g., inventorying system) wherein a camera is affixed to or integrated with a shelving unit and is configured to capture and/or convey information about objects (e.g., product or merchandise) situated in proximity to (e.g., on a shelf below) the camera. In specific embodiments, the camera is integrated with a display unit provided herein, the camera being configured to be accepted into the display unit housing on the lower half, e.g., lower third or lower quarter, of the housing. In some embodiments, this configuration allows the camera to hang below the bottom face of a shelf and/or be in a better position to view objects in proximity to the camera. In certain embodiments, the first sensor is configured to detect objects **1912** (e.g., product or merchandise) in proximity to the display unit or first sensor and to send output signals (e.g., to a system controller) conveying information about the objects in proximity to the first sensor. In some embodiments, a system controller (not illustrated in FIG. **19**) comprises a module configure to compare sensor information received from the first sensor (e.g., an image of an object captured by a camera) to information (e.g., retrieved from a data store) about an object assigned to be in proximity to the first sensor (e.g., and a module configured to access a data store configured to store accessible information regarding objects assigned to be in proximity to the sensor). In some embodiments, the module is configured to compare images of the objects in proximity to the sensor to images of objects assigned to be in proximity to the sensor. In other specific embodiments, (e.g., wherein the sensor is an RFID sensor) the module is configured to compare RFIDs of objects in proximity to the sensor or display unit to RFIDs of objects assigned to be in proximity to the sensor or display unit. In yet other specific embodiments, (e.g., wherein a sensor film is placed on the shelf to which the display unit is attached or integrated) the module is config-

ured to compare a sensor state (e.g., weight) of the objects present on the shelf to information about the state (e.g., weight of) an object assigned to be on the shelf (and, e.g., a module configured to divide the total weight on the shelf by the weight of an object assigned to be on the shelf to arrive at the number of objects assigned to be on the shelf that are on the shelf). In still other specific embodiments, the module is configured compare the amount of space taken up proximity to the sensor (e.g., on a shelf) compared to the amount of space taken up by each object assigned to be in proximity to the sensor. For example, a module is configured to look for a pattern on the shelf (e.g., markers on a shelf). As an example, when the shelf is empty, each foot of shelving has x (10-1000, such as 216—one by one inch for an 18" deep shelf per 1' of shelf) number of markers (e.g., actual markers—such as dots, or a program construct thereof), and none of the markers are obstructed by product. In some instances, the module is configured to compare the number of markers obstructed to the number of markers each object assigned to be at the location would obstruct if located on the shelving. As such, in some embodiments, a controller module herein is configured to count visible markers on a shelf, compare the number of markers assigned to be in proximity to the sensor to the number of markers visible, and further compare the number of non-visible markers to the number of markers obstructed by an object in proximity to the sensor (e.g., in order to make a determination of the number of assigned objects—product or merchandise—in proximity to the sensor). In addition, in some embodiments, the display unit comprises a sensor configured to detect the sensor state of an operable parameter of the content displayed on the display unit, such as, e.g., a motion detector, forward facing camera (e.g., the configuration of which is described herein, particularly facing in a third direction **1910**, such as that is within 90 degrees of the first direction), or other sensor suitable for detecting the presence of a person (e.g., customer in a retail environment) in proximity to the display unit.

[0061] In some embodiments, provided herein is a display unit comprising a power supply (e.g., a DC/DC converter or an AC/DC converter). In certain embodiments, a display unit provided herein is configured to receive power and display information via a single source, such as over Ethernet. In other embodiments, a display unit provided herein is configured to receive power and display information via different sources. In some embodiments, display units provided herein further comprise power regulators, e.g., to ensure a stable voltage provided to the display unit components. In some embodiments, display units provided herein additionally comprise one or more LED driver, e.g., configured to control the current provided to the LED array, which in some instances reduces the risk of LED failure.

[0062] Display units provided herein are configured to receive display information from wired and/or wireless sources. In certain embodiments, the display unit(s) (e.g., strip) comprises a receiver for receiving information (e.g., digital information). In various embodiments, the receiver comprises an input, such as a wired information input (e.g., a port) (e.g., a USB (e.g., USB 1.0, USB 2.0, USB 3.0) input, a modular connector input (e.g., 4 position 4 contact (4P4C), 6P6C, 6P2C, 6P4C, 6P6C, 8P8C, 10P10C, or similar modular connector)), an Ethernet input, a cat5 input, a cat5e input, a cat6 input, a micro USB input, a mini USB input, a registered jack (e.g., rj11) input, a component input, a RCA input, a coaxial input, a digital visual interface (DVI) input, a video graphics array (VGA) input,) a wireless information (e.g., WiFi, 4G, 3G) input, or the like. In certain embodiments, the receiving module is configured to receive compressed information.

[0063] Further, display units provided herein generally comprise one or more processor configured to execute one or more program module. In specific embodiments, the processor is a field programmable gate array or suitable microprocessor. In some embodiments, the one or more processor is configured to execute an identification module configured to store and/or access a stored identifier associated with the display strip in which the processor is located. In specific embodiments, the identifier is associated with the location of the display strip. In further embodiments, the one or more processor is configured to execute an identification module configured to determine an identifier associated with the display strip in which the processor is located. In certain embodiments, the one or more processor is configured to execute a content identification module configured to identify local display information to be displayed on the display unit in which the processor is located. In some embodiments, the local display information is a subset of global system display information received by the display unit receiver. In certain embodiments, the one or more processor is configured to decompress global system display information or a subset thereof—such as the identified local display information.

[0064] FIG. **2** illustrates an exemplary display unit **200** provided herein, wherein the display unit is configured to receive power and display information over Ethernet (using Ethernet protocols, or using a cat5, cat5e, cat6 or similar Ethernet type cable using other suitable protocols). The display unit comprises an optional power supply or power converter **201** configured to receive integrated display information and power **204**, and an optional power regulator **202** configured to provide a suitable power source to the display unit (e.g., various components thereof). In some embodiments, the power supply or power converter is configured to convert received DC voltage to a suitable DC voltage (e.g., about 3 Vdc to about 5 Vdc) and the power regulator is configured to regulate the voltage (e.g., at about 3 Vdc to about 5 Vdc). The exemplary display unit **200** further comprises a display information receiver **203**, such as the Ethernet receiver illustrated, and a processor **205**, such as the FPGA illustrated. In certain embodiments, the processor **205** is configured to determine the display information to be displayed on the LED array **206**. Optional LED drivers **207** are also included. Display information and power are optionally provided to additional display units via any suitable technique, such as daisy chaining **208** (e.g., using a T568B Ethernet cable, or any other suitable cable).

[0065] FIG. **3** illustrates another exemplary display unit **300**, wherein the display unit is configured to receive power in a first (power) input **301** (e.g., receive AC power) and display information in a second (information) input **302** (e.g., receiving compressed display information). The display unit comprises an optional power supply **303** (e.g., converting AC power to DC power, such as about 3 Vdc to about 5 Vdc) connected to the power input **301**, and an optional power regulator **304** connected to the power supply **303** and configured to provide a suitable power source to the display unit (e.g., various components thereof). The information input **302** is connected to a receiver (information receiver) **305**. The display unit comprises one or more processor (e.g., FPGA) **306** configured to execute one or more program modules

configured to identify local display content to be displayed on the display unit (i.e., the LED array thereof **312**). In some embodiments, the program modules comprise a display identification module **307**, a content identification module **308**, and a decompression module **309**. Optional LED drivers **310** are also included. Display information and power are optionally provided to additional display units via one or more output **311** using any suitable technique, such as daisy chaining.

[0066] FIG. **4** illustrates a retail system **400** comprising multiple display units **401** provided herein. The display units are optionally affixed to and/or integrated with retail shelving **402**. As is illustrated, given the cost effective nature of the displays, it is possible to utilize the display units **401** provided herein to provide specific display content for each product **403** on the shelves, even when the shelves are in complex configurations. In some embodiments, the system comprises one or more display unit comprising a sensor **404** (e.g., camera) configured to detect a sensor state, such as proximity to the sensor or a display unit comprising the sensor, and/or near a display unit comprising the sensor. In some instances, only a single sensor comprising display unit is needed to detect, for example, proximity to several (e.g., nearby) display units. For example, while each or multiple display units of a system optionally comprise a sensor, FIG. **4** illustrates a single display unit comprising a sensor **404**. In some embodiments, by reducing the number of display units comprising a sensor, an even more cost effective system is achieved.

[0067] FIG. **5** illustrates an exemplary segmentation schematic of graphic or sending card display configurations into smaller height segments used in the display units and systems provided herein. As illustrated, an exemplary graphics (or sending) card **501** (e.g., QWXGA graphics card) provides image content to a pixel array **502** (e.g., 2048×1152). In specific instances, a single QWXGA graphics card of 2048×1152 supports 2,359,296 pixels in a system provided herein. Optionally, other graphics (or sending) cards are alternatively utilized to prepare other segmentation schemes. Other graphics cards or sending cards supporting various graphics arrays, such as XGA (1024×768), WXGA (1366×768), XGA+ (1152×864), WXGA+ (1440×900), SXGA (1280×1024), SXGA+ (1400×1050), WSXGA+ (1680×1050), UXGA (1600×1200), WUXGA (1920×1200), and many other types are optionally utilized. In specific embodiments, graphics or sending cards provided herein support a system comprising more pixels. For example, in some embodiments, dual sending cards provided herein support twice as many pixels. Further, in some embodiments, the system is configured to provide failover (e.g., by being configured to provide display information to a first and a last display unit of the system), thereby support half as many pixels. Segmentation of such a 2048×1152 array provides, for example, forty eight (48) segments **503** for display units having a height of 24 pixels. In other examples, using such a segmentation scheme is used to provide content to 36 segments for display units having a height of 32 pixels. In some embodiments, systems provided herein are configured as continuous displays (e.g., limited only by the display size desired), e.g., utilizing such techniques. FIG. **6** illustrates the logical layout on a shelf face of such a segmentation configuration (e.g., to create a width of greater than the pixel array width generally supported by a specific graphics card, such as a width greater than 2048 for QWXGA graphics cards). In some embodiments, provided in a system, e.g., a controller thereof, is a segmentation module configured to segment a graphics array to provide display content for a high aspect ratio system display array (e.g., a system display array of greater than that typically supported by the graphics card). In such embodiments, segmentation allows for a single graphics card to provide display content to a very high aspect ratio system display array of 98,304×24 for displays having a height of 24 pixels (e.g., up to over 900 display units having an LED array of 160×24) or 73,728×32 for displays having a height of 32 pixels (e.g., up to over 450 display units having an LED array of 160×32). Further, as illustrated in FIG. **5**, with additional (n) graphics cards **504**, additional display content is optionally provided to additional (n) arrays **505** that are similarly segmented. As is illustrated in FIG. **7**, however, global and local display content is not limited by the segment or display sizes. In some instances, content segments optionally span two or more adjacently configured display units. Depending on how the products are arranged, for example, segmented content (**701**-**708**) is optionally stitched together (e.g., by a stitching module discussed herein) in any suitable manner.

[0068] In some embodiments, provided herein is a display system comprising one or more display unit and a controller. FIG. **16** illustrates an exemplary system **1600** comprising a controller **1601** and one or more display unit **1602**. A single controller is illustrated comprising a plurality of controller subunits combined to serve the function of the system controller. In some instances, a controller comprises one or more processor configured to execute one or more controller program module. Exemplary program modules comprise, by way of non-limiting example, a sensor state identification modules (e.g., configured to monitor or detect sensor states, including operating parameters thereof), content identification module (e.g., configured to identify predetermined information to be provided to the one or more system display units based on the status of a sensor state), a content stitching module (e.g., configured to stitch the predetermined information (e.g., corresponding to local display information to ultimately be displayed at the display unit(s)) together, such as to form a global system display information, a content compression module (e.g., configured to compress display information), or combinations thereof. In some instances, a controller provided herein further comprises a transmitter configured to provide global system display information (e.g., compressed or not), to one or more system display unit **1602**. As illustrated, in some embodiments, a display unit (e.g., display strip) comprises a receiver configured to receive display information (e.g., global system display information or local display information). As further illustrated, in certain embodiments, a display unit (e.g., display strip) comprises one or more output (e.g., an output hub as illustrated) configured to provide display information (e.g., local display information) to one or more display component (two display components are illustrated, but units comprising a single or more than two display components are contemplated). In certain embodiments, a display unit provided herein comprises a receiver and an output (e.g., configured to provide display information to the display components). In some instances, the output is an output hub, as illustrated in FIG. **16**, configured to provide display information to more than one display component of the display unit. In certain embodiments, a display unit provided herein further comprises one or more processor (e.g., FPGA) configured to execute program modules, such as any one or more of the various display unit program modules discussed herein. In certain embodiments,

a display unit provided herein comprises an output configured to convey or transmit display information **1604** (e.g., global system display information) to another system display unit (e.g., by daisy-chaining). In other embodiments, a controller **1601** provided herein optionally provides display information (e.g., global system or local display information) directly **1607** to individual display units. In some embodiments, a system provided herein comprises one or more power supply. In certain embodiments, the system comprises at least one power supply (e.g., a switching power supply configured to convert AC to DC, such as about 5 Vdc) configured to provide power to one or more display unit and at least one power supply configured to provide power to the controller. In some instances, the system comprises one or more power supply that is configured to provide power directly **1608** to one or more display units, configured to provide power directly to a first display unit and chained **1609** to a second display unit, or a combination thereof. In certain embodiments, the system **1600** further comprises one or more sensor, e.g., configured to provide sensor output signals (e.g., the sensor output signals conveying information regarding a sensor state—e.g., a state of an operating parameter) to a controller **1601**. In specific instances, the controller **1601** comprises a display controller subunit configured to provide predetermined display information to one or more display unit of the system. In some instances, the display controller provides display information to the one or more display units based on the sensor state of the system. In certain embodiments, the system comprises a forward and/or rear sensor configured to convey information to one or more sensor controller, such as a rear sensor controller and/or forward sensor controller as illustrated in FIG. **16**. In some instances, the sensor controller(s) comprise a module configured to determine the sensor state(s) (which is then optionally used by the display controller to determine the display information to convey to the one or more display units). In specific embodiments, the display controller is configured to retrieve display information from a data store based on the sensor state(s) identified by the sensor controller(s). In some embodiments, the display controller is configured to retrieve display information from a data store based on the sensor state(s) identified by a forward sensor controller (e.g., based on sensor information conveyed from one or more forward facing sensor). In certain embodiments, the rear sensor controller is configured to receive rear sensor signals from one or more rear facing sensor (e.g., a sensor facing in a direction about 90 degrees to 180 degrees opposed to the viewable surface of the display unit/component), and comprises a module configured to identify the number of product or merchandise in proximity to the sensor and/or identify any misplaced products or merchandise. In some embodiments, identification of such information (e.g., sensor states) is utilized by system modules configured to determine display information provided to the displays, and/or to write a record of such information to a data store, which information is accessible by a personal computer, a tablet, or the like (e.g., used to keep inventory records). Similar systems and methods are optionally utilized for if environmental sensors are used in addition to or instead of a rear-facing sensor (e.g., camera). In some instances, power is provided to the sensor via a controller power supply (as illustrated—such as through a USB connection) or a display unit power supply. In other instances, a sensor comprises it's own power supply. In certain embodiments, one or more display unit of the system comprises the sensor mounted therein or thereon.

[0069] As more generally illustrated in FIG. **17**, in some embodiments, provided herein is a system comprising a sensor configured to provide an output signal to a sensor controller, the output signal conveying information regarding a state in proximity to sensor (or a display unit comprising the sensor). In specific embodiments, the sensor is a camera (e.g., a rear facing camera), or an environmental sensor (e.g., a humidity or temperature sensor). In certain embodiments, the sensor controller comprises one or more processor configured to execute one or more sensor controller program module. In specific embodiments, the sensor is a rear facing camera (e.g., the camera is configured to face in a direction about 90 degrees to 180 degrees opposed to the viewable display surface of one or more display unit of the system, such as the viewable display surface of a display unit in which the sensor is housed) and the one or more sensor controller program module comprises a module configured to determine whether any objects (e.g., products or merchandise) in proximity (e.g., within about 10 feet, about 5 feet, or about 3 feet) of the sensor are out of place (e.g., a first module configured to access a data store comprising information about what objects are assigned to be in proximity to the sensor and a second module configured to compare the objects in proximity to the sensor to the objects assigned to be in proximity to the sensor); a module configured to determine the amount of objects there are in proximity to the sensor (e.g., a first module configured to access a data store comprising information about what objects are assigned to be in proximity to the sensor and a second module configured to count or approximate the number of object assigned to be in proximity to the sensor are actually in proximity to the sensor); or a combination thereof. In other specific embodiments, the sensor is an environmental sensor (e.g., a temperature and/or humidity sensor) and the one or more sensor controller program module comprises a module configured to determine the status of an environmental state (e.g., temperature and/or humidity) in proximity to the sensor; a module configured to determine whether the environmental state is outside an acceptable level (e.g., temperature above a predetermined value, temperature below a predetermined value, humidity above a predetermined value, humidity below a predetermined value, or any combination thereof) in proximity (e.g., within about 10 feet, about 5 feet, or about 3 feet) of the sensor (e.g., a first module configured to access a data store comprising information about predetermined acceptable environmental conditions (e.g., temperature and/or humidity) in proximity to the sensor and a second module configured to compare the environmental conditions in proximity to the sensor to the acceptable environmental conditions assigned to be in proximity to the sensor); or a combination thereof. In some embodiments, the sensors comprise both a rear facing camera and an environmental sensor. In some embodiments, the sensor controller further comprises one or more module configured to record or write the determined condition (e.g., amount of an object, and/or temperature and/or humidity) to a data store (e.g., a hard drive, cloud storage, or the like); to send an alert output signal (e.g., to a display, a light, an audio receiver, a personal computer, a database, or the like), e.g., if a determined condition (e.g., amount of an object, temperature, and/or humidity) fails to satisfy a predetermined (acceptable) condition; or a combination thereof. In some specific embodiments, the sensor controller further comprises a module configured to send an output signal to an environmental control unit (e.g., temperature control unit (e.g., refrigeration unit) or humidity control

unit) in proximity to the sensor. In further specific embodiments, the system further comprises an environmental control unit (e.g., temperature control unit or humidity control unit) configured to receive the output signal and adjust the environmental conditions (e.g., temperature and/or humidity) in proximity to the sensor.

[0070] FIG. **8** illustrates an exemplary system **800** comprising a controller **801** and one or more display unit **802**. A single controller is illustrated comprising a plurality of components, however, several controller subunits are optionally combined to serve the function of the controller. In some instances, a controller comprises one or more processor **805** configured to execute one or more controller program module. Exemplary program modules comprise, by way of non-limiting example, a sensor state identification modules (e.g., configured to monitor or detect sensor states, particularly operating parameters thereof), content identification module (e.g., configured to identify predetermined information to be provided to the one or more system display units based on the status of the sensor state(s)), a content stitching module (e.g., configured to stitch the predetermined information (e.g., corresponding to local display information to ultimately be displayed at the display unit(s)) together, such as to form a global system display information, a content compression module (e.g., configured to compress display information), and combinations thereof. In some instances, a controller provided herein further comprises a transmitter configured to provide global system display information (e.g., compressed or not), to one or more system display unit **802**. In certain embodiments, a system (e.g., controller thereof) provided herein comprises a sending card **806** configured to receive global system display information (e.g., in video format via AVI), a content compression module configured to compress the global system display information, and a transmitter configured to provide the global system display information to a system display unit **802**. As illustrated, in some embodiments, a display unit (e.g., display strip) comprises a receiver configured to receive display information (e.g., global system display information or local display information). As further illustrated, in certain embodiments, a display unit (e.g., display strip) comprises one or more output (e.g., an output hub as illustrated) configured to provide display information (e.g., local display information) to one or more display component. In certain embodiments, a display unit provided herein comprises an integrated receiver/hub card, wherein the receiver input and the hub outputs are configured into a single card **803**. In some embodiments, integrating the receiver and display output hub allows further compacting of the display unit, which, in some instances, reduces the chances of the display unit being impacted and/or damaged, requiring replacement. In certain embodiments, a display unit provided herein further comprises one or more processor (e.g., FPGA) configured to execute program modules, such as any one or more of the various display unit program modules discussed herein. In certain embodiments, a display unit provided herein comprises an output configured to convey or transmit display information **804** (e.g., global system display information) to another system display unit (e.g., by daisy-chaining). In other embodiments, a controller **801** provided herein optionally provides display information (e.g., global system or local display information) directly **807** to individual display units. In some embodiments, a system provided herein comprises one or more power supply. In certain embodiments, the system comprises at least one power supply (e.g., a switching power supply configured to convert AC to DC, such as about 5 Vdc) configured to provide power to one or more display unit and at least one power supply configured to provide power to the controller. In some instances, the system comprises one or more power supply that is configured to provide power directly **808** to one or more display units, configured to provide power directly to a first display unit and chained **809** to a second display unit, or a combination thereof. In certain embodiments, the system **800** further comprises one or more sensor, e.g., configured to provide sensor output signals (e.g., the sensor output signals conveying information regarding a sensor state—i.e., a state of an operating parameter) to a controller **801**. In some instances, power is provided to the sensor via a controller power supply (as illustrated) or a display unit power supply. In other instances, a sensor comprises it's own power supply. In certain embodiments, one or more display unit of the system comprises the sensor mounted therein or thereon.

[0071] FIG. **9** illustrates an exemplary controller **900** configured to provide power and display information to one or more display unit **901** provided herein. In some instances, a controller provided herein comprises one ore more processor (e.g., a CPU) **902** and one or more power supply **911** therefor. In some embodiments, a computer **903**, such as a personal computer (PC), comprises the one or more processors and power supply therefor. In certain instances, program modules, such as modules configured to detect or monitor operating parameters (such as sensor states) of the system or display units thereof, identify predetermined information to be displayed on the various display units of the system based on the status of the operating parameters, stitch the predetermined information together to generate global system display information, and/or the like, are executed by the one or more processors **902** of the computer **903**. In some instances, the computer **903** is configured to transmit or convey a video signal conveying global system display information to a video receiver **904** (e.g., of a sending card **905**). In some embodiments, the system (e.g., sending card thereof **905**) comprises one or more processor **906** (e.g., FPGA) configured to compress the global system display information (e.g., to allow for transmission of large quantities of content over various cable types, such as Ethernet cables, which also allows integrated transmission of display information and power to the display units). In some instances, the system (e.g., sending card thereof) further comprises a transmitter **907** (e.g., Ethernet transmitter) configured to provide global system display information to one or more system display unit. Further, in some embodiments, such as wherein Ethernet cables (or other cables capable of transmitting information and power, such as USB) are utilized, a power supply **908** and injector **909** are configured to inject power into a cable **910** (e.g., a T568B Ethernet cable, or any other cable suitable for transmitting display information and power) configured to transmit display information to a display unit. In various embodiments, the power supply and injector are optionally included together with, or separate from, a sending card comprising the video receiver, processor(s), and transmitter.

[0072] FIG. **10** illustrates a schematic of modules described herein configured to receive sensor output signal (e.g., from one or more sensor), identify the status of one or more sensor state (e.g., proximity) associated with one or more display units (e.g., proximity to one or more display units), identify display information corresponding to the identified sensor state(s), and stitch together display information correspond-

ing with the sensor states (e.g., wherein more than one predetermined display information is identified as corresponding to one or more sensor state). In some instances, a single sensor provides output signal that conveys information regarding the sensor state of one or more display unit. For example, in some embodiments, Sensor State 1 corresponds to proximity to a first display unit, Sensor State 2 corresponds to proximity to a second display unit, and Sensor State 3 corresponds to proximity to a third display unit. In certain embodiments, once global system display information has been stitched together, it is transmitted to the one or more display units.

[0073] In some embodiments, provided herein is a method for displaying (e.g., interactively displaying) product information in a physical location, such as a retail store (i.e., at a brick-and-mortar merchant). In specific embodiments, the product information is displayed at the front edge of one or more shelf of the location. For example, in some embodiments, it is possible to display such product information in such a manner by affixing or integrating one or more display unit provided herein with one or more shelf at the location. Display units and systems provided herein make it possible to display such information in a cost effective manner. In some embodiments, once one or more display unit, such as an LED display unit provided herein, is mounted at the location (e.g., affixed to or integrated with a shelf of the location), it is possible to display (e.g., interactively display) product information at the location.

[0074] In some embodiments, provided herein is a method for dynamically displaying product information in a physical location to a person or customer physically located at the location. In some embodiments, the method comprises providing one or more display unit and one or more sensor at the location (e.g., affixed to and/or integrated with shelving units thereof). In certain embodiments, the method comprises:

[0075] i. receiving a sensor output signal from a sensor, the sensor output signal conveying information regarding a sensor state (e.g., location of and/or proximity of a person or customer, such as in relation to the sensor) of the sensor;

[0076] ii. determining a sensor state based on the received output signals from the sensor;

[0077] iii. identifying predetermined display information associated with the identified sensor state from a display information store (e.g., database); and

[0078] iv. providing the predetermined display information to the one or more display units.

[0079] In certain embodiments, a controller (e.g., comprising one or more controller units), such as described herein, receives the sensor output signal, determines the sensor state, and identifies the display information. In some embodiments, the process further comprises displaying video, images, and/or text associated with the display information on the one or more display units.

[0080] In specific embodiments, the sensor output signal further comprises information that identifies the sensor from which the output signal originated. In some instances, this is useful in system comprising multiple display units and multiple sensors. In certain embodiments, the method further comprises determining the identity of the sensor based on the information that identifies the sensor (a sensor identifier) from which the output signal originated. In some embodiments, the process further comprises determining the display unit(s) associated with the sensor (e.g., a display unit or display units in which the sensor is located and/or nearby the sensor or display unit in which the sensor is located). In certain embodiments, the display unit(s) associated with the sensor are determined by accessing a display registry or map, and correlating the sensor identified or sensor identifier with display unit(s) associated with the sensor identified or sensor identifier.

[0081] In certain embodiments, a method provided herein comprises identifying predetermined display information associated not only with the identified sensor state, but also with the identified display unit(s), from a display information store (e.g., database). In some embodiments, multiple display units and multiple sensors are present in the system, e.g., being operated by a controller. In certain embodiments, a process or system provided herein comprises receiving or one or more module configured to receive multiple sensor output signals, each sensor output signal convening information regarding one or more sensor state. In some embodiments, a process or system provided herein comprises determining or a module configured to determine multiple sensor states based on the received output signals from the sensors. In some embodiments, a process or system provided herein comprises identifying or a module configured to identify predetermined display information associated with the identified sensor states from a display information store (database). In certain embodiments, a process or system provided herein comprises providing or one or more transmitter or output configured to provide the predetermined display information to the one or more display units.

[0082] In specific embodiments, the sensor output signals further comprise information that uniquely identifies the sensors from which the unique output signals originated. In certain embodiments, the method or a system provided herein further comprises determining or a module configured to determine the identity of the sensors based on the information that identifies the sensors (or a sensor identifier) from which the output signal originated. In some embodiments, the method or a system further comprises determining or a module configured to determine the display unit(s) associated with each sensor (e.g., a display unit or display units in which each sensor is located and/or nearby the sensors or display unit in which the sensors are located). In certain embodiments, the display unit(s) associated with the sensors are determined by accessing a display registry or map, and correlating the sensors identified or sensor identifiers with display unit(s) associated with the sensors identified or sensor identifiers.

[0083] As illustrated in FIG. **11**, in certain embodiments, predetermined display information is identified and retrieved based on the sensor states identified from multiple sensors. In some instances, once the multiple iterations of predetermined multiple display information is retrieved it is stitched in global system display information and optionally compressed for dissemination to the display units. In certain embodiments, the global system display unit is stitched in a logical order (e.g., as illustrated in FIG. **5** and FIG. **6**) to allow for correlation with the correct display information with the correct display units, e.g., based on which display unit(s) are associated with which sensors, as well as how (e.g., order, location, etc.) the display units are associated with the sensors (which can be determined, e.g., by accessing a display unit registry and/or map).

[0084] FIG. **12** illustrates an exemplary retail system **1200** provided herein comprising a first display unit **1211** compris-

ing a first sensor (e.g., camera), a second display unit **1212** comprising a second sensor (e.g., camera), and multiple additional display units **1213**. In some instances, the first sensor **1211** is configured to detect multiple sensor states, such as in sensor zones **1201-1205**. In some instances, sensor output signals from the sensor in display unit **1211** comprise information regarding sensor states in sensor zones **1201-1205**. For example, in the illustration, a person is located in front of the shelving system in sensor zones **1204** and **1205**. For example, therefore, the sensor in display unit **1211** is configured to send output signals comprising information about sensor states **1201-1205**, and, receiving that information, the controller comprises a module configured (e.g., based on the sensor identity or identifier and the sensor state information) to identify the sensor state of sensor zone **1201** as having no person in sensor zone **1201**, identify the sensor state of sensor zone **1202** as having no person in sensor zone **1202**, identify the sensor state of sensor zone **1203** as having no person in sensor zone **1203**, identify the sensor state of sensor zone **1204** as having a person **1210** in sensor zone **1204**, and identify the sensor state of sensor zone **1205** as having a person **1210** in sensor zone **1205**. In such examples, the controller is also configured to receive information from a second sensor (in display unit **1212**), and one or more module configured to identify the sensor state of sensor zones **1206-1209** as having no person located therein. In some instances, based on such sensor state identification, e.g., using system components and/or modules or processes described herein, specific display information for the various display units in the various sensor zones of the system is identified, retrieved, and stitched into global system display information that is provided to the system display units (e.g., wherein the display units are configured to identify the subset of global display information that is local thereto, and display such local display information). FIG. **13** illustrates an exemplary depiction of a retail store aisle comprising one or more retail display system provided herein.

[0085] In certain embodiments, display information provided to the display units and systems described herein is any suitable display information, including, by way of non-limiting example, video, images, text, and combinations thereof. As discussed herein, in preferred embodiments, display units provided herein comprise an array of LED pixels, the array having a height of 30 pixels or more. As illustrated in FIG. **15**, such array sizing allows for up to at least 4 lines of aesthetically pleasing text, with spacing between the text. In addition, good quality resolution images (such as product logos, QR codes, and the like) and video can also be displayed. In certain embodiments, display units and systems thereof (or processors thereof) are configured to display text fonts having a height of (at least) 7 pixels and a width of up to (at least) 5 pixels **1501**. In some embodiments, larger fonts are optionally utilized, such as those having a height of 14 pixels and a width of up to 10 pixels **1503**. In some embodiments, QR Codes have a height and width of up to 29 pixels **1502**. In certain embodiments, a display unit provided herein provides a single content segment (or tag) that extends along the entire width of the unit (e.g., 160 pixel wide segment **1500** of the unit illustrated in FIG. **15**). In other embodiments, a display unit herein is optionally divided into multiple content segments, such as half the display unit (e.g., an 80 pixel wide segment), a quarter (e.g., a 40 pixel wide segment), or any suitable fraction of the display unit.

[0086] In various embodiments, display units and systems described herein are configured to alter display content (e.g., alter display information provided to the display units) based on a sensor state of the display unit or system. In some instances, as discussed herein, such sensor states include identifying "motion" or "no motion." In further embodiments, sensor states include (and/or a sensor, e.g., camera, provided herein is configured to be able to detect), by way of non-limiting embodiment, "motion," "no motion," and "captive" (e.g., as determined by identifying a face—i.e., facial recognition). Other exemplary sensor states include, by way of non-limiting example, "in proximity" or "not in proximity." In some embodiments, exemplary sensor states (e.g., based on information received from a rear facing camera) include "item out of place," "no item out of place," "inventory low," "inventory high," and/or "inventory acceptable." In certain embodiments, exemplary sensor states (e.g., based on information received from environmental sensors, such as temperature and/or humidity sensors) include, by way of non-limiting example, "temperature acceptable," "temperature high," "temperature low," "humidity acceptable," "humidity high," and/or "humidity low." Generally, based on such determinations, systems provided herein comprise program modules configured to identify and provide specific display information (content) to the display unit(s) thereof. For example, in some instances, when a sensor state is identified as "no motion" for one or more display unit, the system is configured to provide specific (and predetermined) display information, such as logos or decals of the products located at (e.g., on a shelf at, above, or below) the display units identified as having a sensor state of "no motion," but when the sensor state is identified as "motion" for the one or more display unit, the system is configured to provide different, specific (and predetermined) display information, such as text describing the product(s), the price of the product(s), and optionally a QR code for the product(s) located at (e.g., on a shelf at, above, or below) the display unit(s) identified as having a sensor state of "motion." In other exemplary embodiments, when a sensor state is identified as an environmental state being below or above acceptable levels, an inventory state being below an acceptable level, or an item is out of place, the system is configured to provide specific (and predetermined) display information, such as a type of alert—e.g., a generic alert—e.g., that there is an "unacceptable" sensor state, or a specific alert depending on the "unacceptable" state identified.

What is claimed is:

1. A retail display system comprising:

a. a display unit, the display unit comprising a viewable display surface configured to face in a first direction;

b. a camera, the camera configured to face a second direction, the second direction being about 90 degrees to about 180 degrees opposed to the first direction; and

c. a sensor controller, the camera being configured to provide an output signal to the sensor controller, the output signal conveying information regarding objects in proximity to the camera, and the sensor controller comprising:

an input configured to receive the output signal; and

one or more processors configured to execute sensor controller program modules, the sensor controller program modules comprising:

one or more module configured to determine whether an object in proximity to the camera is out of place, based on the information conveyed by the output signal; and/or

one or more module configured to determine the amount of an object in proximity to the camera, based on the information conveyed by the output signal.

2. The system of claim **1**, the display unit having an aspect ratio of at least 2:1.

3. The system of claim **1**, the display surface comprising an array of viewable LED pixels.

4. The system of claim **3**, the LED pixels having a pixel pitch of less than 2.5 mm and the array has a height of at least 30 pixels.

5. The system of claim **1**, the second direction being about 160 degrees to about 180 degrees opposed to the first direction.

6. The system of claim **1**, the display unit being attached to or integrated along a front edge of a retail shelf and the output signal of the camera conveying information regarding objects located on the retail shelf.

7. The system of claim **1**, the display unit being attached to or integrated along a front edge of a first retail shelf and the output signal of the camera conveying information regarding objects located on a second retail shelf configured below the first retail shelf.

8. The system of claim **1**, wherein the system comprises one or more module configured to determine whether an object in proximity to the camera is out of place comprising:

a. a module configured to identify objects in proximity to the camera;

b. a module configured to access a data store comprising information regarding an object assigned to be in proximity to the camera; and

c. a module configured to determine whether an object in proximity to the camera corresponds to the object assigned to be in proximity to the camera.

9. The system of claim **1**, wherein the system comprises one or more module configured to determine the amount of an object in proximity to the camera.

10. The system of claim **1**, the display unit comprising a housing defined with at least one opening; the display surface and the camera received in the housing; and the display surface and a lens of the camera being exposed by the at least one opening.

11. The system of claim **1**, further comprising an environmental sensor, the environmental sensor configured to provide environmental output signals conveying information regarding the environment in proximity to the environmental sensor to the sensor controller.

12. The system of claim **11**, wherein the environmental sensor comprises a humidity sensor and a temperature sensor.

13. The system of claim **1**, further comprising a second camera, the second camera configured to face a third direction, the third direction being aligned within 0 degrees to about 90 degrees of the first direction, the second camera configured to convey output signals to a display controller.

14. The system of claim **13**, wherein the third direction is aligned within 0 degrees to about 30 degrees of the first direction.

15. The system of claim **1**, further comprising

a. a second camera, the second camera configured to face a third direction, the third direction being aligned within 0 degrees to about 45 degrees of the first direction;

b. a first housing defined with at least one opening; the display surface, the camera, and the second camera being received in the first housing; and the at least one opening exposing the display surface, a lens of the camera, and a lens of the second camera;

c. a second display unit, the second display unit comprising a second housing, the second housing receiving a second viewable display surface configured to face in a fourth direction, a third camera being configured to face in a fifth direction, the fifth direction being about 90 degrees to 180 degrees opposed to the fourth direction, and a fourth camera being configured in a sixth direction, the sixth direction being aligned within 0 degrees to about 45 degrees of the fifth direction, the third camera being configured to convey third output signals to the sensor controller;

d. a display controller, the second camera being configured to convey second output signals to the display controller, the fourth camera being configured to convey fourth output signals to the display controller, the second and fourth output signals conveying information regarding a state of one or more operating parameter, and the display controller comprising one or more processors configured to execute display controller program modules, the display controller program modules comprising:

a module configured to determine the state of the operating parameter(s) based on the information regarding the state of the operating parameter(s) in the second and/or fourth output signals; and

a module configured to identify display information to be provided to the display unit and the second display unit, based on the status of the one or more operating parameter(s).

16. The system of claim **15**, wherein the state of the one or more operating parameter is whether or not a face is detected and/or whether or not motion is detected.

17. A high aspect ratio light emitting diode (LED) retail display unit comprising:

a receiving card comprising a first circuit board, the first circuit board comprising a first input, and a first output mounted thereon, the first input configured to receive or to be connected to receive first display information;

an LED display component comprising a second circuit board comprising a first and a second surface, an array of first LED pixels mounted on or in the first surface, and a second input configured to receive display information and mounted on the second surface, the first output configured to covey second display information to the second input, and the first surface being configured to face a first direction;

a sensor configured to provide or to be connected to provide a sensor output signal, the sensor output signal conveying information regarding motion and/or a person in proximity to the display unit;

a camera configured to provide or to be connected to provide a camera output signal, the camera output signal conveying information regarding the identity and/or quantity of objects in proximity to the display unit, the camera being configured to face a second direction, the second direction being about 90 degrees to 180 degrees opposed to the first direction; and

a housing defined with at least one opening, the receiving card, the display component, and the sensor received in the housing, and the first surface and a lens of the camera being exposed by the at least one opening,

the array of LED pixels having a pixel pitch of about 2.5 mm or less the display unit having an aspect ratio (length/height) of about 2 or more; and the first and second display information being the same or different.

18. The display unit of claim **17**, wherein

the receiving card further comprises a second output mounted thereon;

the display unit further comprises a second LED display component comprising a third circuit board comprising a third and a fourth surface, a second array of second LED pixels mounted on or in the third surface, and a third input configured to receive display information and mounted on the fourth surface, the second output configured to covey third display information to the third input, the second array of second LED pixels having a pixel pitch of about 2.5 mm or less, and the first and second, and third display information being the same or different.

19. The display unit of claim **17**, further comprising a third output configured to be connected to and convey first display information to an additional display, the additional display being the same as or different from the display unit.

20. The display unit of claim **17**, further comprising an environmental sensor, the environmental sensor configured to provide or to be connected to provide an environmental sensor output signal, the environmental sensor output signal conveying information regarding the environment in proximity to the display unit.

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