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(54) **SHOPPING FACILITY ASSISTANCE SYSTEMS, DEVICES, AND METHODS TO IDENTIFY SECURITY AND SAFETY ANOMALIES**

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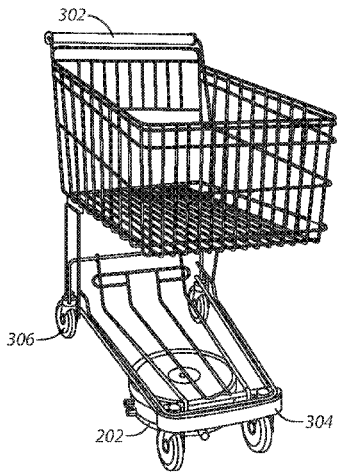
(57) **ABSTRACT**

A central computer system is configured to simultaneously task various ones of a plurality of motorized transport units to temporarily attach to a corresponding mobile item container and to move the temporarily-attached mobile item container in a retail shopping facility in correspondence to the movement of an authorized consumer while also receiving and analyzing video input provided by video cameras that are included with at least some of the motorized transport units to identify security and safety anomalies in the retail shopping facility. By one approach, the central computer system identifies security and safety anomalies in the retail shopping center by characterizing contents of images as being either expected or unexpected and as being either potentially harmful or not potentially harmful. So configured the central computer system is able to not only identify anomalies but assess a degree of threat posed by a given anomaly.

**18 Claims, 7 Drawing Sheets**



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See application file for complete search history.

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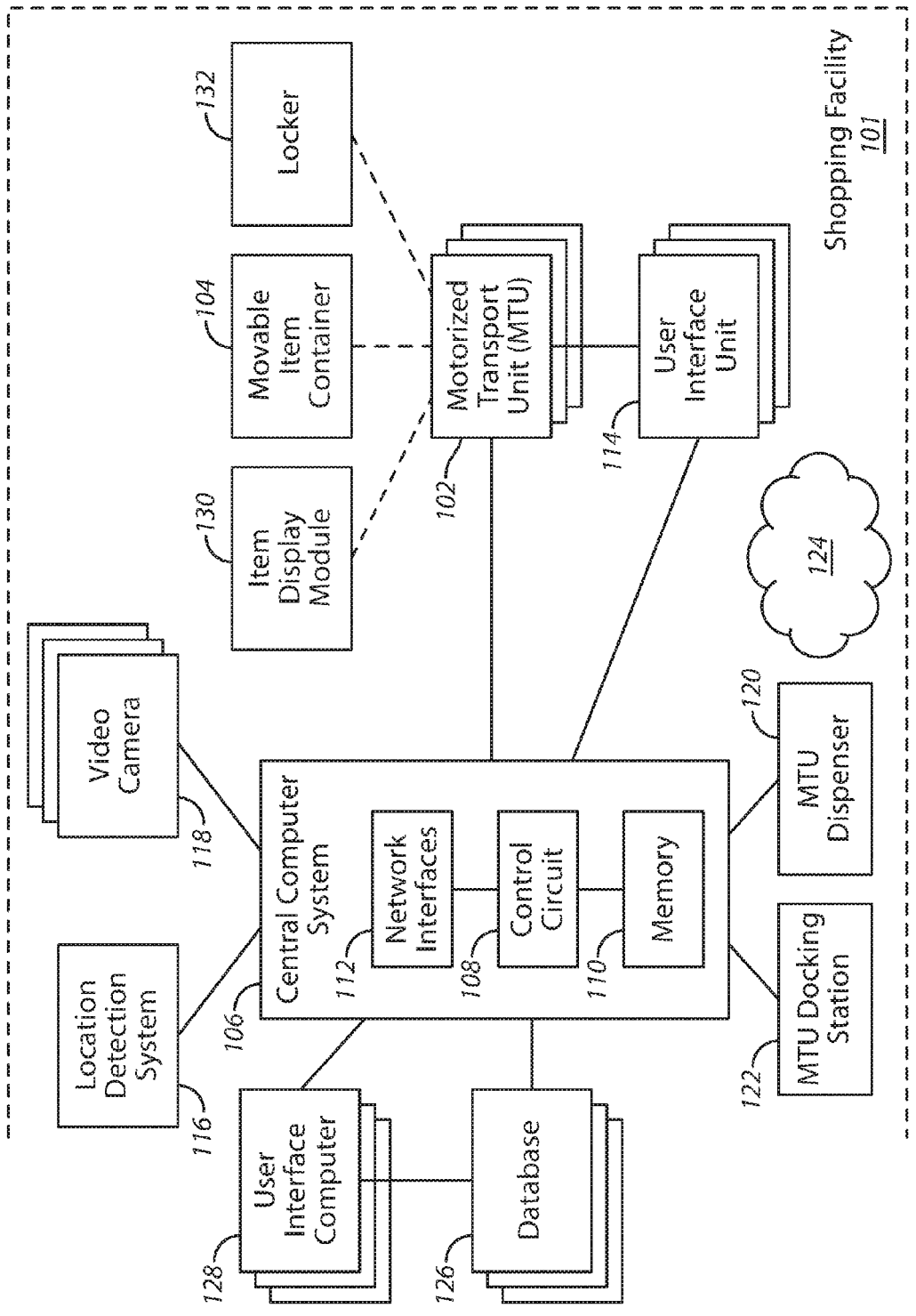
Shopping Facility
101
100
Locker
132
Movable Item Container
104
Item Display Module
130
Motorized Transport Unit (MTU)
102
User Interface Unit
114
124
Video Camera
118
Location Detection System
116
Central Computer System
106
Network Interfaces
112
Control Circuit
108
Memory
110
MTU Dispenser
120
MTU Docking Station
122
User Interface Computer
128
Database
126

FIG. 1

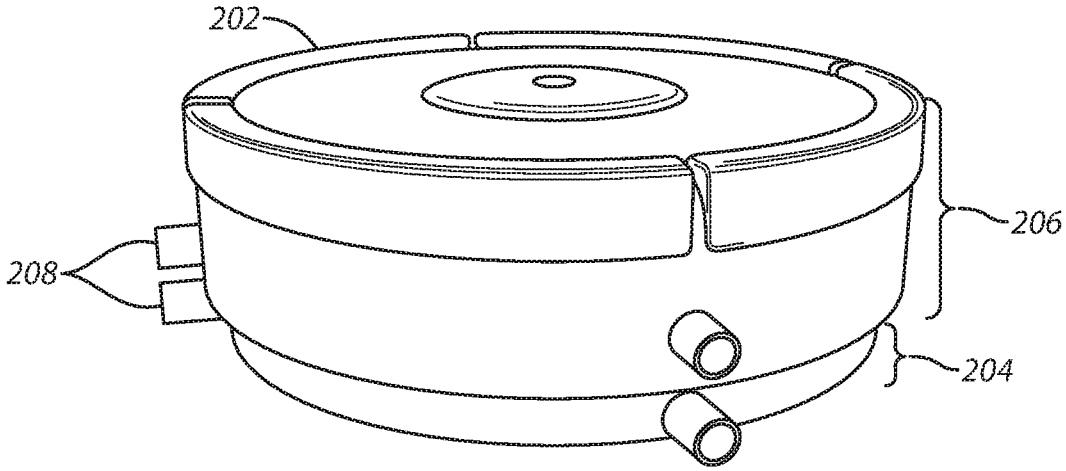


FIG. 2A

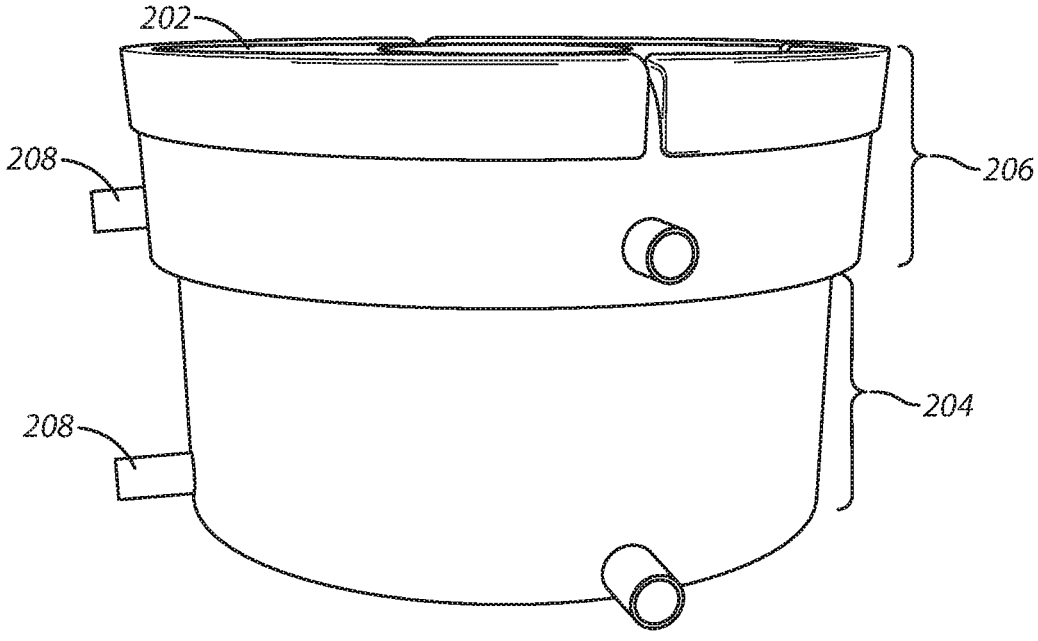


FIG. 2B

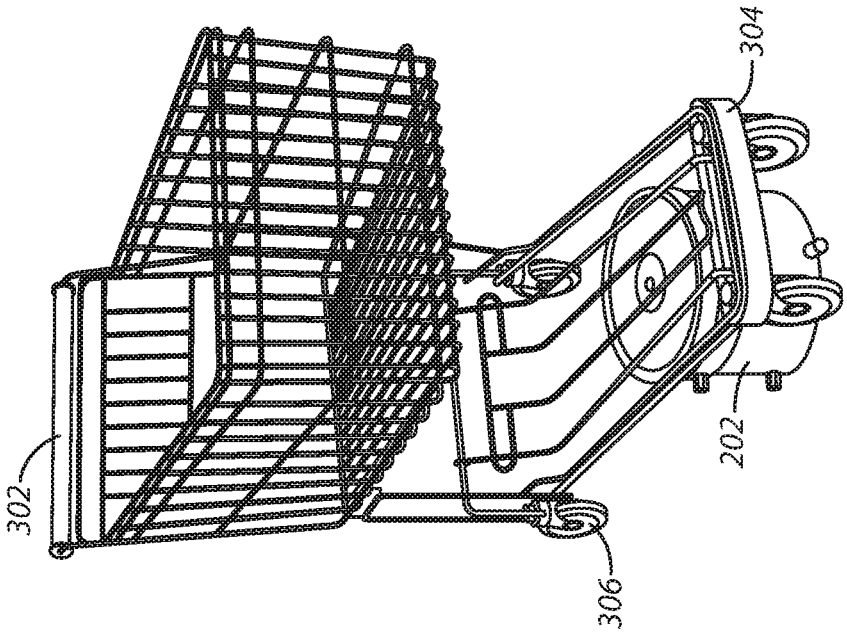


FIG. 3B

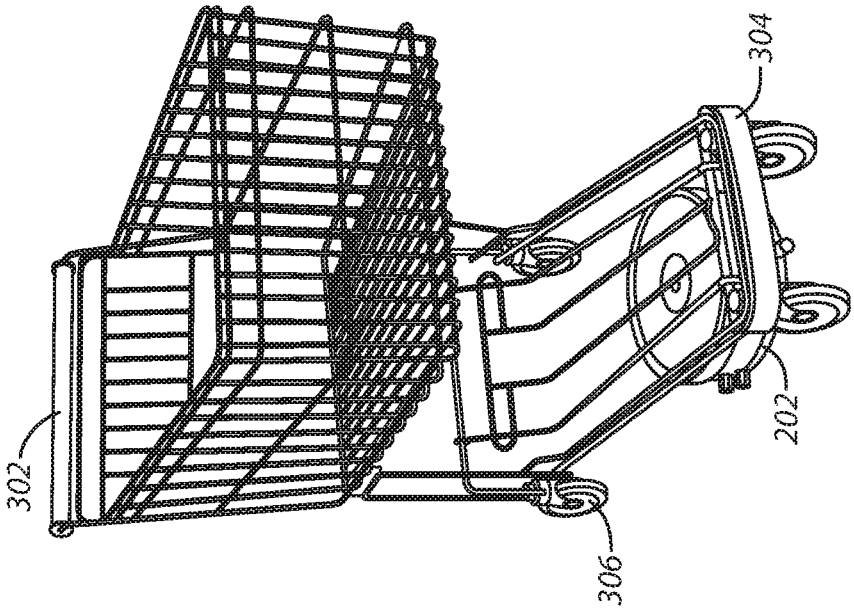


FIG. 3A

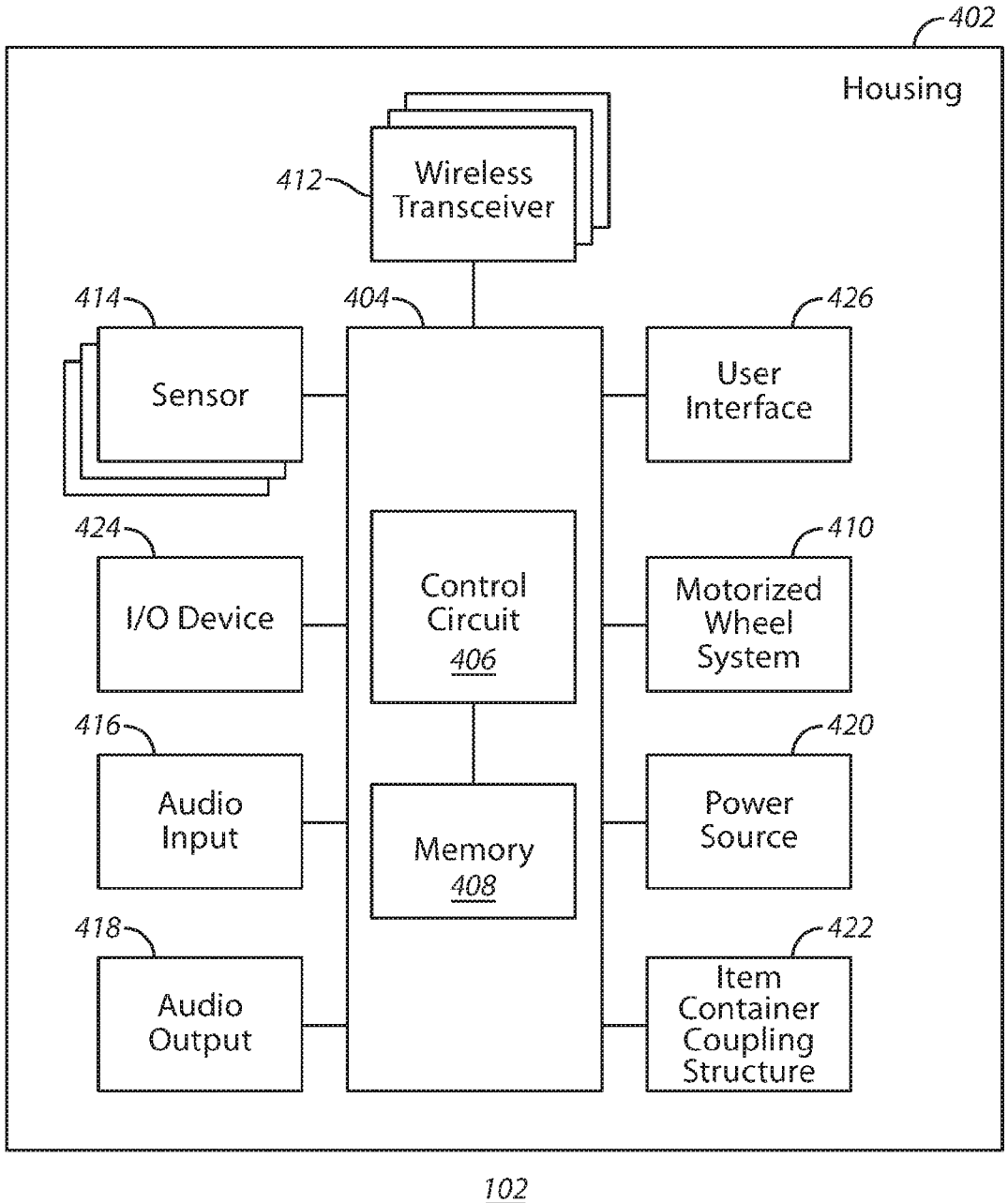
402
Housing
412
Wireless Transceiver
414
Sensor
404
426
User Interface
424
I/O Device
Control Circuit
406
410
Motorized Wheel System
416
Audio Input
Memory
408
420
Power Source
418
Audio Output
422
Item Container Coupling Structure
102

FIG. 4

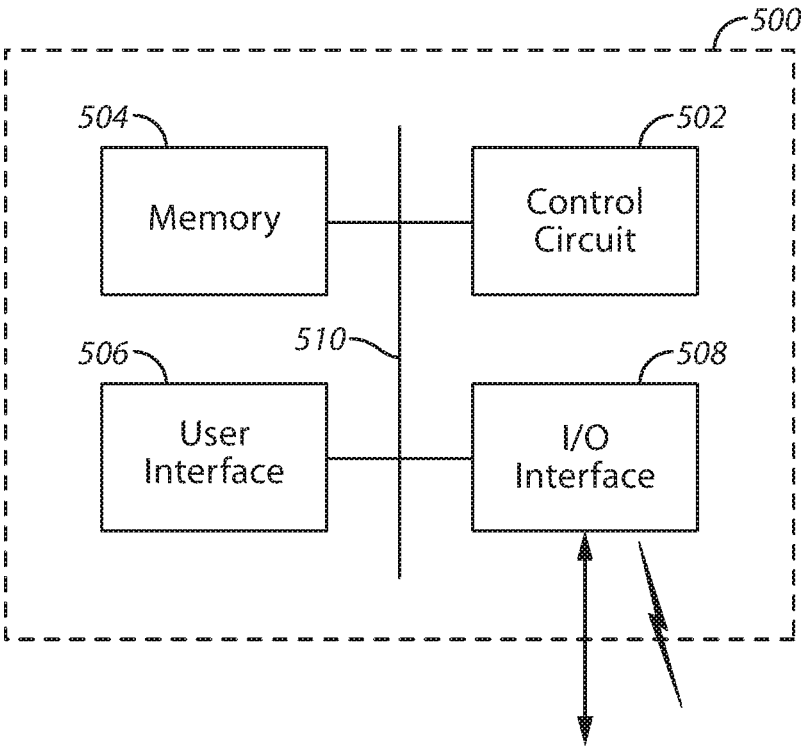
500
504
Memory
502
Control Circuit
510
506
User Interface
508
I/O Interface

*FIG. 5*

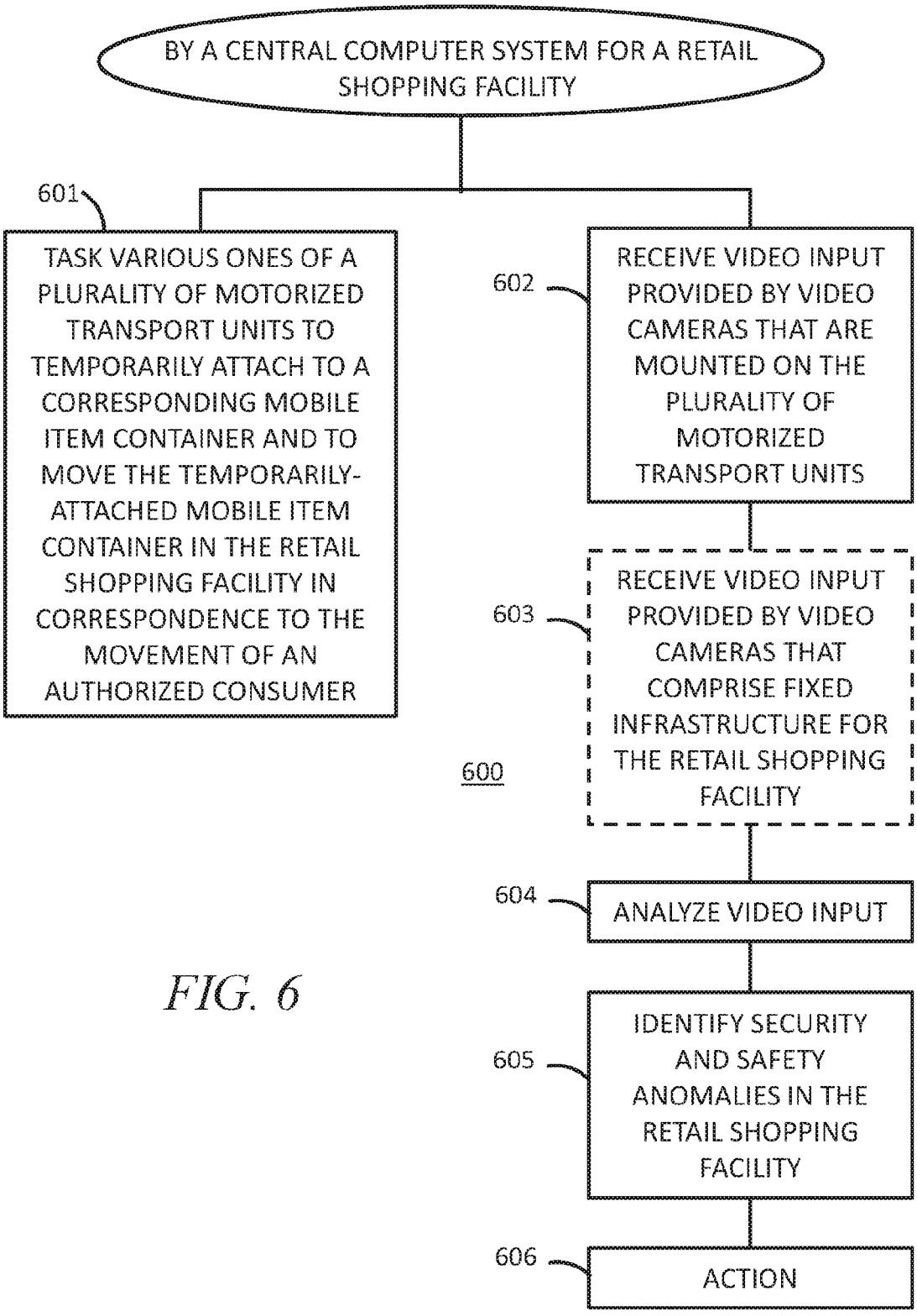
BY A CENTRAL COMPUTER SYSTEM FOR A RETAIL SHOPPING FACILITY
601
TASK VARIOUS ONES OF A PLURALITY OF MOTORIZED TRANSPORT UNITS TO TEMPORARILY ATTACH TO A CORRESPONDING MOBILE ITEM CONTAINER AND TO MOVE THE TEMPORARILY-ATTACHED MOBILE ITEM CONTAINER IN THE RETAIL SHOPPING FACILITY IN CORRESPONDENCE TO THE MOVEMENT OF AN AUTHORIZED CONSUMER
602
RECEIVE VIDEO INPUT PROVIDED BY VIDEO CAMERAS THAT ARE MOUNTED ON THE PLURALITY OF MOTORIZED TRANSPORT UNITS
603
RECEIVE VIDEO INPUT PROVIDED BY VIDEO CAMERAS THAT COMPRISE FIXED INFRASTRUCTURE FOR THE RETAIL SHOPPING FACILITY
600
604
ANALYZE VIDEO INPUT
605
IDENTIFY SECURITY AND SAFETY ANOMALIES IN THE RETAIL SHOPPING FACILITY
606
ACTION

*FIG. 6*

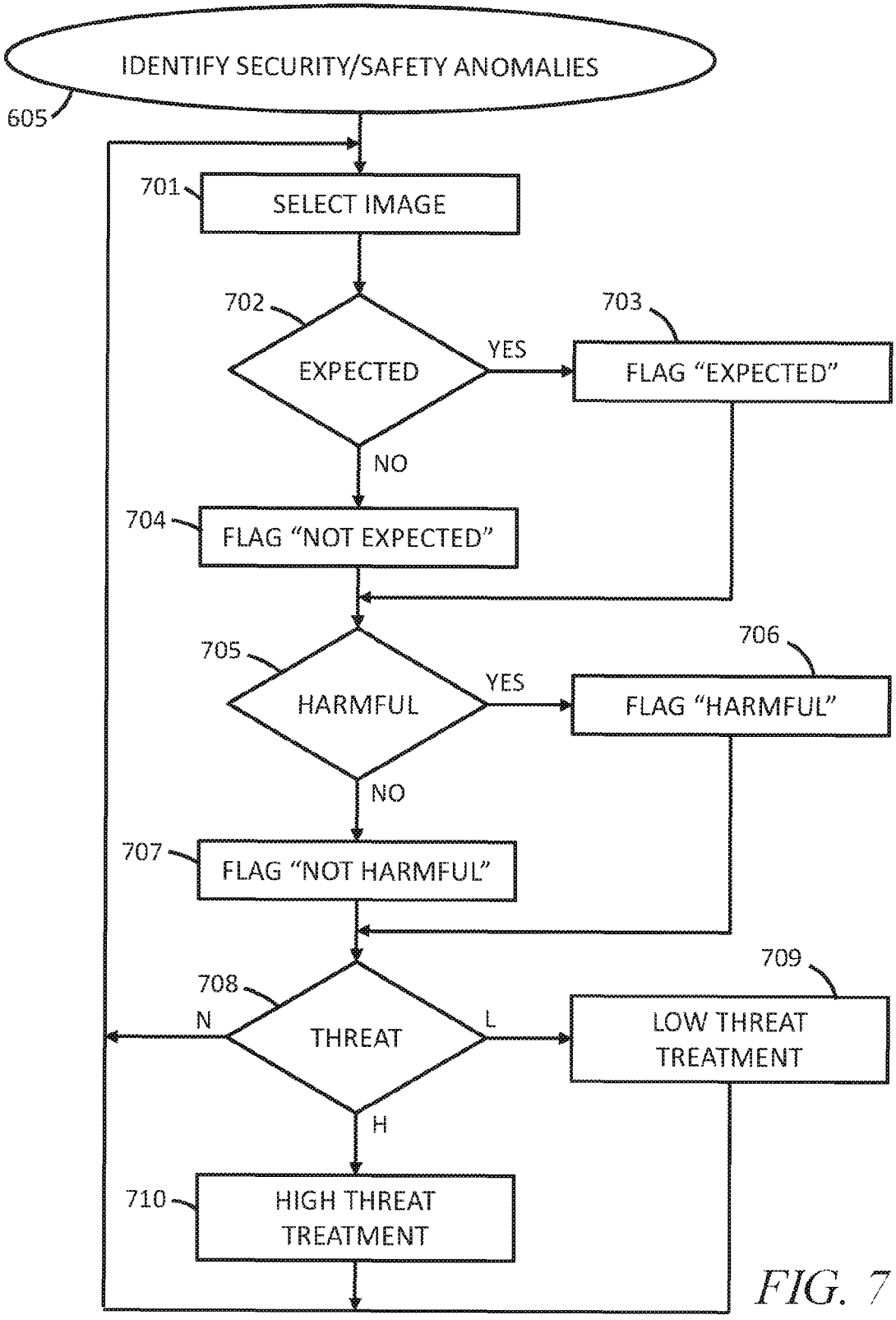
IDENTIFY SECURITY/SAFETY ANOMALIES
605
701
SELECT IMAGE
702
EXPECTED
YES
703
FLAG "EXPECTED"
NO
704
FLAG "NOT EXPECTED"
705
HARMFUL
YES
706
FLAG "HARMFUL"
NO
707
FLAG "NOT HARMFUL"
708
THREAT
N
L
709
LOW THREAT TREATMENT
H
710
HIGH THREAT TREATMENT

*FIG. 7*

# SHOPPING FACILITY ASSISTANCE SYSTEMS, DEVICES, AND METHODS TO IDENTIFY SECURITY AND SAFETY ANOMALIES

## RELATED APPLICATIONS

This application claims the benefit of each of the following U.S. Provisional applications, each of which is incorporated herein by reference in its entirety: U.S. Provisional Application No. 62/129,726, filed Mar. 6, 2015; U.S. Provisional Application No. 62/129,727, filed Mar. 6, 2015; U.S. Provisional Application No. 62/138,877, filed Mar. 26, 2015; U.S. Provisional Application No. 62/138,885, filed Mar. 26, 2015; U.S. Provisional Application No. 62/152,421, filed Apr. 24, 2015; U.S. Provisional Application No. 62/152,465, filed Apr. 24, 2015; U.S. Provisional Application No. 62/152,440, filed Apr. 24, 2015; U.S. Provisional Application No. 62/152,630, filed Apr. 24, 2015; U.S. Provisional Application No. 62/152,711, filed Apr. 24, 2015; U.S. Provisional Application No. 62/152,610, filed Apr. 24, 2015; U.S. Provisional Application No. 62/152,667, filed Apr. 24, 2015; U.S. Provisional Application No. 62/157,388, filed May 5, 2015; U.S. Provisional Application No. 62/165,579, filed May 22, 2015; U.S. Provisional Application No. 62/165,416, filed May 22, 2015; U.S. Provisional Application No. 62/165,586, filed May 22, 2015; U.S. Provisional Application No. 62/171,822, filed Jun. 5, 2015; U.S. Provisional Application No. 62/175,182, filed Jun. 12, 2015; U.S. Provisional Application No. 62/182,339, filed Jun. 19, 2015; U.S. Provisional Application No. 62/185,478, filed Jun. 26, 2015; U.S. Provisional Application No. 62/194,131, filed Jul. 17, 2015; U.S. Provisional Application No. 62/194,119, filed Jul. 17, 2015; U.S. Provisional Application No. 62/194,121, filed Jul. 17, 2015; U.S. Provisional Application No. 62/194,127, filed Jul. 17, 2015; U.S. Provisional Application No. 62/202,744, filed Aug. 7, 2015; U.S. Provisional Application No. 62/202,747, filed Aug. 7, 2015; U.S. Provisional Application No. 62/205,548, filed Aug. 14, 2015; U.S. Provisional Application No. 62/205,569, filed Aug. 14, 2015; U.S. Provisional Application No. 62/205,555, filed Aug. 14, 2015; U.S. Provisional Application No. 62/205,539, filed Aug. 14, 2015; U.S. Provisional Application No. 62/207,858, filed Aug. 20, 2015; U.S. Provisional Application No. 62/214,826, filed Sep. 4, 2015; U.S. Provisional Application No. 62/214,824, filed Sep. 4, 2015; U.S. Provisional Application No. 62/292,084, filed Feb. 5, 2016; U.S. Provisional Application No. 62/302,547, filed Mar. 2, 2016; U.S. Provisional Application No. 62/302,567, filed Mar. 2, 2016; U.S. Provisional Application No. 62/302,713, filed Mar. 2, 2016; and U.S. Provisional Application No. 62/303,021, filed Mar. 3, 2016.

## TECHNICAL FIELD

These teachings relate generally to shopping environments and more particularly to devices, systems, and methods for assisting customers and/or workers in those shopping environments.

## BACKGROUND

In a modern retail store environment, there is a need to improve the customer experience and/or convenience for the customer. A modern retail shopping facility can constitute a large physical structure filled with various product displays, service areas, associate staging and work areas, and so forth.



At any given moment any number of anomalies can occur in such a facility. (As used herein, the word anomaly will be understood to refer to something that constitutes a deviation from that which is ordinarily expected or normal.) It can be helpful to identify anomalies sooner rather than later, and timeliness can be particularly important when the anomaly presents at least a potential threat to security and or safety as regards any of the retail shopping facility, customers in the retail shopping facility, and/or associates of the retail shopping facility. Unfortunately, the very size and complexity of a modern retail shopping facility, in combination with the very physically dynamic nature of such an application setting, makes it very difficult to identify anomalies let alone assess what level of concern or response might reasonably be raised by any given anomaly.

## BRIEF DESCRIPTION OF THE DRAWINGS

The above needs are at least partially met through provision of embodiments of systems, devices, and methods designed to provide assistance to customers and/or workers in a shopping facility, such as described in the following detailed description, particularly when studied in conjunction with the drawings, wherein:

FIG. **1** comprises a block diagram of a shopping assistance system as configured in accordance with various embodiments of these teachings;

FIGS. **2**A and **2**B are illustrations of a motorized transport unit of the system of FIG. **1** in a retracted orientation and an extended orientation in accordance with some embodiments;

FIGS. **3**A and **3**B are illustrations of the motorized transport unit of FIGS. **2**A and **2**B detachably coupling to a movable item container, such as a shopping cart, in accordance with some embodiments;

FIG. **4** comprises a block diagram of a motorized transport unit as configured in accordance with various embodiments of these teachings;

FIG. **5** comprises a block diagram of a computer device as configured in accordance with various embodiments of these teachings;

FIG. **6** comprises a flow diagram as configured in accordance with various embodiments of these teachings; and

FIG. **7** comprises a flow diagram as configured in accordance with various embodiments of these teachings.

Elements in the figures are illustrated for simplicity and clarity and have not necessarily been drawn to scale. For example, the dimensions and/or relative positioning of some of the elements in the figures may be exaggerated relative to other elements to help to improve understanding of various embodiments of the present teachings. Also, common but well-understood elements that are useful or necessary in a commercially feasible embodiment are often not depicted in order to facilitate a less obstructed view of these various embodiments of the present teachings. Certain actions and/or steps may be described or depicted in a particular order of occurrence while those skilled in the art will understand that such specificity with respect to sequence is not actually required. The terms and expressions used herein have the ordinary technical meaning as is accorded to such terms and expressions by persons skilled in the technical field as set forth above except where different specific meanings have otherwise been set forth herein.

## DETAILED DESCRIPTION

The following description is not to be taken in a limiting sense, but is made merely for the purpose of describing the

general principles of exemplary embodiments. Reference throughout this specification to "one embodiment," "an embodiment," or similar language means that a particular feature, structure, or characteristic described in connection with the embodiment is included in at least one embodiment of the present invention. Thus, appearances of the phrases "in one embodiment," "in an embodiment," and similar language throughout this specification may, but do not necessarily, all refer to the same embodiment.

Generally speaking, pursuant to various embodiments, systems, devices and methods are provided for assistance of persons at a shopping facility. Generally, assistance may be provided to customers or shoppers at the facility and/or to workers at the facility. The facility may be any type of shopping facility at a location in which products for display and/or for sale are variously distributed throughout the shopping facility space. The shopping facility may be a retail sales facility, or any other type of facility in which products are displayed and/or sold. The shopping facility may include one or more of sales floor areas, checkout locations (i.e., point of sale (POS) locations), customer service areas other than checkout locations (such as service areas to handle returns), parking locations, entrance and exit areas, stock room areas, stock receiving areas, hallway areas, common areas shared by merchants, and so on. Generally, a shopping facility includes areas that may be dynamic in terms of the physical structures occupying the space or area and objects, items, machinery and/or persons moving in the area. For example, the sales floor area may include product storage units, shelves, racks, modules, bins, etc., and other walls, dividers, partitions, etc. that may be configured in different layouts or physical arrangements. In other example, persons or other movable objects may be freely and independently traveling through the shopping facility space. And in another example, the persons or movable objects move according to known travel patterns and timing. The facility may be any size of format facility, and may include products from one or more merchants. For example, a facility may be a single store operated by one merchant or may be a collection of stores covering multiple merchants such as a mall.

Generally, the system makes use of automated, robotic mobile devices, e.g., motorized transport units, that are capable of self-powered movement through a space of the shopping facility and providing any number of functions. Movement and operation of such devices may be controlled by a central computer system or may be autonomously controlled by the motorized transport units themselves. Various embodiments provide one or more user interfaces to allow various users to interact with the system including the automated mobile devices and/or to directly interact with the automated mobile devices. In some embodiments, the automated mobile devices and the corresponding system serve to enhance a customer shopping experience in the shopping facility, e.g., by assisting shoppers and/or workers at the facility.

In some embodiments, a shopping facility personal assistance system comprises: a plurality of motorized transport units located in and configured to move through a shopping facility space; a plurality of user interface units, each corresponding to a respective motorized transport unit during use of the respective motorized transport unit; and a central computer system having a network interface such that the central computer system wirelessly communicates with one or both of the plurality of motorized transport units and the plurality of user interface units, wherein the central computer system is configured to control movement of the plurality of motorized transport units through the shopping facility space based at least on inputs from the plurality of user interface units.

System Overview

Referring now to the drawings, FIG. **1** illustrates embodiments of a shopping facility assistance system **100** that can serve to carry out at least some of the teachings set forth herein. It will be understood that the details of this example are intended to serve in an illustrative capacity and are not necessarily intended to suggest any limitations as regards the present teachings. It is noted that generally, FIGS. **1-5** describe the general functionality of several embodiments of a system, and FIGS. **6** and **7** expand on some functionalities of some embodiments of the system and/or embodiments independent of such systems.

In the example of FIG. **1**, a shopping assistance system **100** is implemented in whole or in part at a shopping facility **101**. Generally, the system **100** includes one or more motorized transport units (MTUs) **102**; one or more item containers **104**; a central computer system **106** having at least one control circuit **108**, at least one memory **110** and at least one network interface **112**; at least one user interface unit **114**; a location determination system **116**; at least one video camera **118**; at least one motorized transport unit (MTU) dispenser **120**; at least one motorized transport unit (MTU) docking station **122**; at least one wireless network **124**; at least one database **126**; at least one user interface computer device **128**; an item display module **130**; and a locker or an item storage unit **132**. It is understood that more or fewer of such components may be included in different embodiments of the system **100**.

These motorized transport units **102** are located in the shopping facility **101** and are configured to move throughout the shopping facility space. Further details regarding such motorized transport units **102** appear further below. Generally speaking, these motorized transport units **102** are configured to either comprise, or to selectively couple to, a corresponding movable item container **104**. A simple example of an item container **104** would be a shopping cart as one typically finds at many retail facilities, or a rocket cart, a flatbed cart or any other mobile basket or platform that may be used to gather items for potential purchase.

In some embodiments, these motorized transport units **102** wirelessly communicate with, and are wholly or largely controlled by, the central computer system **106**. In particular, in some embodiments, the central computer system **106** is configured to control movement of the motorized transport units **102** through the shopping facility space based on a variety of inputs. For example, the central computer system **106** communicates with each motorized transport unit **102** via the wireless network **124** which may be one or more wireless networks of one or more wireless network types (such as, a wireless local area network, a wireless personal area network, a wireless mesh network, a wireless star network, a wireless wide area network, a cellular network, and so on), capable of providing wireless coverage of the desired range of the motorized transport units **102** according to any known wireless protocols, including but not limited to a cellular, Wi-Fi, Zigbee or Bluetooth network.

By one approach the central computer system **106** is a computer based device and includes at least one control circuit **108**, at least one memory **110** and at least one wired and/or wireless network interface **112**. Such a control circuit **108** can comprise a fixed-purpose hard-wired platform or can comprise a partially or wholly programmable platform, such as a microcontroller, an application specification integrated circuit, a field programmable gate array, and so on.

These architectural options are well known and understood in the art and require no further description here. This control circuit **108** is configured (for example, by using corresponding programming stored in the memory **110** as will be well understood by those skilled in the art) to carry out one or more of the steps, actions, and/or functions described herein.

In this illustrative example the control circuit **108** operably couples to one or more memories **110**. The memory **110** may be integral to the control circuit **108** or can be physically discrete (in whole or in part) from the control circuit **108** as desired. This memory **110** can also be local with respect to the control circuit **108** (where, for example, both share a common circuit board, chassis, power supply, and/or housing) or can be partially or wholly remote with respect to the control circuit **108** (where, for example, the memory **110** is physically located in another facility, metropolitan area, or even country as compared to the control circuit **108**).

This memory **110** can serve, for example, to non-transitorily store the computer instructions that, when executed by the control circuit **108**, cause the control circuit **108** to behave as described herein. (As used herein, this reference to "non-transitorily" will be understood to refer to a non-ephemeral state for the stored contents (and hence excludes when the stored contents merely constitute signals or waves) rather than volatility of the storage media itself and hence includes both non-volatile memory (such as read-only memory (ROM) as well as volatile memory (such as an erasable programmable read-only memory (EPROM).)

Additionally, at least one database **126** may be accessible by the central computer system **106**. Such databases may be integrated into the central computer system **106** or separate from it. Such databases may be at the location of the shopping facility **101** or remote from the shopping facility **101**. Regardless of location, the databases comprise memory to store and organize certain data for use by the central control system **106**. In some embodiments, the at least one database **126** may store data pertaining to one or more of: shopping facility mapping data, customer data, customer shopping data and patterns, inventory data, product pricing data, and so on.

In this illustrative example, the central computer system **106** also wirelessly communicates with a plurality of user interface units **114**. These teachings will accommodate a variety of user interface units including, but not limited to, mobile and/or handheld electronic devices such as so-called smart phones and portable computers such as tablet/pad-styled computers. Generally speaking, these user interface units **114** should be able to wirelessly communicate with the central computer system **106** via a wireless network, such as the wireless network **124** of the shopping facility **101** (such as a Wi-Fi wireless network). These user interface units **114** generally provide a user interface for interaction with the system. In some embodiments, a given motorized transport unit **102** is paired with, associated with, assigned to or otherwise made to correspond with a given user interface unit **114**. In some embodiments, these user interface units **114** should also be able to receive verbally-expressed input from a user and forward that content to the central computer system **106** or a motorized transport unit **102** and/or convert that verbally-expressed input into a form useful to the central computer system **106** or a motorized transport unit **102**.

By one approach at least some of the user interface units **114** belong to corresponding customers who have come to the shopping facility **101** to shop. By another approach, in lieu of the foregoing or in combination therewith, at least some of the user interface units **114** belong to the shopping facility **101** and are loaned to individual customers to employ as described herein. In some embodiments, one or more user interface units **114** are attachable to a given movable item container **104** or are integrated with the movable item container **104**. Similarly, in some embodiments, one or more user interface units **114** may be those of shopping facility workers, belong to the shopping facility **101** and are loaned to the workers, or a combination thereof.

In some embodiments, the user interface units **114** may be general purpose computer devices that include computer programming code to allow it to interact with the system **106**. For example, such programming may be in the form of an application installed on the user interface unit **114** or in the form of a browser that displays a user interface provided by the central computer system **106** or other remote computer or server (such as a web server). In some embodiments, one or more user interface units **114** may be special purpose devices that are programmed to primarily function as a user interface for the system **100**. Depending on the functionality and use case, user interface units **114** may be operated by customers of the shopping facility or may be operated by workers at the shopping facility, such as facility employees (associates or colleagues), vendors, suppliers, contractors, etc.

By one approach, the system **100** optionally includes one or more video cameras **118**. Captured video imagery from such a video camera **118** can be provided to the central computer system **106**. That information can then serve, for example, to help the central computer system **106** determine a present location of one or more of the motorized transport units **102** and/or determine issues or concerns regarding automated movement of those motorized transport units **102** in the shopping facility space. As one simple example in these regards, such video information can permit the central computer system **106**, at least in part, to detect an object in a path of movement of a particular one of the motorized transport units **102**.

By one approach these video cameras **118** comprise existing surveillance equipment employed at the shopping facility **101** to serve, for example, various security purposes. By another approach these video cameras **118** are dedicated to providing video content to the central computer system **106** to facilitate the latter's control of the motorized transport units **102**. If desired, the video cameras **118** can have a selectively movable field of view and/or zoom capability that the central computer system **106** controls as appropriate to help ensure receipt of useful information at any given moment.

In some embodiments, a location detection system **116** is provided at the shopping facility **101**. The location detection system **116** provides input to the central computer system **106** useful to help determine the location of one or more of the motorized transport units **102**. In some embodiments, the location detection system **116** includes a series of light sources (e.g., LEDs (light-emitting diodes)) that are mounted in the ceiling at known positions throughout the space and that each encode data in the emitted light that identifies the source of the light (and thus, the location of the light). As a given motorized transport unit **102** moves through the space, light sensors (or light receivers) at the motorized transport unit **102**, on the movable item container **104** and/or at the user interface unit **114** receive the light and can decode the data. This data is sent back to the central computer system **106** which can determine the position of the motorized transport unit **102** by the data of the light it receives, since it can relate the light data to a mapping of the

light sources to locations at the facility **101**. Generally, such lighting systems are known and commercially available, e.g., the ByteLight system from ByteLight of Boston, Mass. In embodiments using a ByteLight system, a typical display screen of the typical smart phone device can be used as a light sensor or light receiver to receive and process data encoded into the light from the ByteLight light sources.

In other embodiments, the location detection system **116** includes a series of low energy radio beacons (e.g., Bluetooth low energy beacons) at known positions throughout the space and that each encode data in the emitted radio signal that identifies the beacon (and thus, the location of the beacon). As a given motorized transport unit **102** moves through the space, low energy receivers at the motorized transport unit **102**, on the movable item container **104** and/or at the user interface unit **114** receive the radio signal and can decode the data. This data is sent back to the central computer system **106** which can determine the position of the motorized transport unit **102** by the location encoded in the radio signal it receives, since it can relate the location data to a mapping of the low energy radio beacons to locations at the facility **101**. Generally, such low energy radio systems are known and commercially available. In embodiments using a Bluetooth low energy radio system, a typical Bluetooth radio of a typical smart phone device can be used as a receiver to receive and process data encoded into the Bluetooth low energy radio signals from the Bluetooth low energy beacons.

In still other embodiments, the location detection system **116** includes a series of audio beacons at known positions throughout the space and that each encode data in the emitted audio signal that identifies the beacon (and thus, the location of the beacon). As a given motorized transport unit **102** moves through the space, microphones at the motorized transport unit **102**, on the movable item container **104** and/or at the user interface unit **114** receive the audio signal and can decode the data. This data is sent back to the central computer system **106** which can determine the position of the motorized transport unit **102** by the location encoded in the audio signal it receives, since it can relate the location data to a mapping of the audio beacons to locations at the facility **101**. Generally, such audio beacon systems are known and commercially available. In embodiments using an audio beacon system, a typical microphone of a typical smart phone device can be used as a receiver to receive and process data encoded into the audio signals from the audio beacon.

Also optionally, the central computer system **106** can operably couple to one or more user interface computers **128** (comprising, for example, a display and a user input interface such as a keyboard, touch screen, and/or cursor-movement device). Such a user interface computer **128** can permit, for example, a worker (e.g., an associate, analyst, etc.) at the retail or shopping facility **101** to monitor the operations of the central computer system **106** and/or to attend to any of a variety of administrative, configuration or evaluation tasks as may correspond to the programming and operation of the central computer system **106**. Such user interface computers **128** may be at or remote from the location of the facility **101** and may access one or more the databases **126**.

In some embodiments, the system **100** includes at least one motorized transport unit (MTU) storage unit or dispenser **120** at various locations in the shopping facility **101**. The dispenser **120** provides for storage of motorized transport units **102** that are ready to be assigned to customers and/or workers. In some embodiments, the dispenser **120** takes the form of a cylinder within which motorized transports units **102** are stacked and released through the bottom of the dispenser **120**. Further details of such embodiments are provided further below. In some embodiments, the dispenser **120** may be fixed in location or may be mobile and capable of transporting itself to a given location or utilizing a motorized transport unit **102** to transport the dispenser **120**, then dispense one or more motorized transport units **102**.

In some embodiments, the system **100** includes at least one motorized transport unit (MTU) docking station **122**. These docking stations **122** provide locations where motorized transport units **102** can travel and connect to. For example, the motorized transport units **102** may be stored and charged at the docking station **122** for later use, and/or may be serviced at the docking station **122**.

In accordance with some embodiments, a given motorized transport unit **102** detachably connects to a movable item container **104** and is configured to move the movable item container **104** through the shopping facility space under control of the central computer system **106** and/or the user interface unit **114**. For example, a motorized transport unit **102** can move to a position underneath a movable item container **104** (such as a shopping cart, a rocket cart, a flatbed cart, or any other mobile basket or platform), align itself with the movable item container **104** (e.g., using sensors) and then raise itself to engage an undersurface of the movable item container **104** and lift a portion of the movable item container **104**. Once the motorized transport unit is cooperating with the movable item container **104** (e.g., lifting a portion of the movable item container), the motorized transport unit **102** can continue to move throughout the facility space **101** taking the movable item container **104** with it. In some examples, the motorized transport unit **102** takes the form of the motorized transport unit **202** of FIGS. **2A-3B** as it engages and detachably connects to a given movable item container **104**. It is understood that in other embodiments, the motorized transport unit **102** may not lift a portion of the movable item container **104**, but that it removably latches to, connects to or otherwise attaches to a portion of the movable item container **104** such that the movable item container **104** can be moved by the motorized transport unit **102**. For example, the motorized transport unit **102** can connect to a given movable item container using a hook, a mating connector, a magnet, and so on.

In addition to detachably coupling to movable item containers **104** (such as shopping carts), in some embodiments, motorized transport units **102** can move to and engage or connect to an item display module **130** and/or an item storage unit or locker **132**. For example, an item display module **130** may take the form of a mobile display rack or shelving unit configured to house and display certain items for sale. It may be desired to position the display module **130** at various locations within the shopping facility **101** at various times. Thus, one or more motorized transport units **102** may move (as controlled by the central computer system **106**) underneath the item display module **130**, extend upward to lift the module **130** and then move it to the desired location. A storage locker **132** may be a storage device where items for purchase are collected and placed therein for a customer and/or worker to later retrieve. In some embodiments, one or more motorized transport units **102** may be used to move the storage locker to a desired location in the shopping facility **101**. Similar to how a motorized transport unit engages a movable item container **104** or item display module **130**, one or more motorized transport units **102** may move (as controlled by the central computer system **106**)

underneath the storage locker **132**, extend upward to lift the locker **132** and then move it to the desired location.

FIGS. **2**A and **2**B illustrate some embodiments of a motorized transport unit **202**, similar to the motorized transport unit **102** shown in the system of FIG. **1**. In this embodiment, the motorized transport unit **202** takes the form of a disc-shaped robotic device having motorized wheels (not shown), a lower body portion **204** and an upper body portion **206** that fits over at least part of the lower body portion **204**. It is noted that in other embodiments, the motorized transport unit may have other shapes and/or configurations, and is not limited to disc-shaped. For example, the motorized transport unit may be cubic, octagonal, triangular, or other shapes, and may be dependent on a movable item container with which the motorized transport unit is intended to cooperate. Also included are guide members **208**. In FIG. **2**A, the motorized transport unit **202** is shown in a retracted position in which the upper body portion **206** fits over the lower body portion **204** such that the motorized transport unit **202** is in its lowest profile orientation which is generally the preferred orientation for movement when it is unattached to a movable item container **104** for example. In FIG. **2**B, the motorized transport unit **202** is shown in an extended position in which the upper body portion **206** is moved upward relative to the lower body portion **204** such that the motorized transport unit **202** is in its highest profile orientation for movement when it is lifting and attaching to a movable item container **104** for example. The mechanism within the motorized transport unit **202** is designed to provide sufficient lifting force to lift the weight of the upper body portion **206** and other objects to be lifted by the motorized transport unit **202**, such as movable item containers **104** and items placed within the movable item container, item display modules **130** and items supported by the item display module, and storage lockers **132** and items placed within the storage locker. The guide members **208** are embodied as pegs or shafts that extend horizontally from the both the upper body portion **206** and the lower body portion **204**. In some embodiments, these guide members **208** assist docking the motorized transport unit **202** to a docking station **122** or a dispenser **120**. In some embodiments, the lower body portion **204** and the upper body portion are capable to moving independently of each other. For example, the upper body portion **206** may be raised and/or rotated relative to the lower body portion **204**. That is, one or both of the upper body portion **206** and the lower body portion **204** may move toward/away from the other or rotated relative to the other. In some embodiments, in order to raise the upper body portion **206** relative to the lower body portion **204**, the motorized transport unit **202** includes an internal lifting system (e.g., including one or more electric actuators or rotary drives or motors). Numerous examples of such motorized lifting and rotating systems are known in the art. Accordingly, further elaboration in these regards is not provided here for the sake of brevity.

FIGS. **3**A and **3**B illustrate some embodiments of the motorized transport unit **202** detachably engaging a movable item container embodied as a shopping cart **302**. In FIG. **3**A, the motorized transport unit **202** is in the orientation of FIG. **2**A such that it is retracted and able to move in position underneath a portion of the shopping cart **302**. Once the motorized transport unit **202** is in position (e.g., using sensors), as illustrated in FIG. **3**B, the motorized transport unit **202** is moved to the extended position of FIG. **2**B such that the front portion **304** of the shopping cart is lifted off of the ground by the motorized transport unit **202**, with the wheels **306** at the rear of the shopping cart **302** remaining on the ground. In this orientation, the motorized transport unit **202** is able to move the shopping cart **302** throughout the shopping facility. It is noted that in these embodiments, the motorized transport unit **202** does not bear the weight of the entire cart **302** since the rear wheels **306** rest on the floor. It is understood that in some embodiments, the motorized transport unit **202** may be configured to detachably engage other types of movable item containers, such as rocket carts, flatbed carts or other mobile baskets or platforms.

FIG. **4** presents a more detailed example of some embodiments of the motorized transport unit **102** of FIG. **1**. In this example, the motorized transport unit **102** has a housing **402** that contains (partially or fully) or at least supports and carries a number of components. These components include a control unit **404** comprising a control circuit **406** that, like the control circuit **108** of the central computer system **106**, controls the general operations of the motorized transport unit **102**. Accordingly, the control unit **404** also includes a memory **408** coupled to the control circuit **406** and that stores, for example, operating instructions and/or useful data.

The control circuit **406** operably couples to a motorized wheel system **410**. This motorized wheel system **410** functions as a locomotion system to permit the motorized transport unit **102** to move within the aforementioned retail or shopping facility **101** (thus, the motorized wheel system **410** may more generically be referred to as a locomotion system). Generally speaking, this motorized wheel system **410** will include at least one drive wheel (i.e., a wheel that rotates (around a horizontal axis) under power to thereby cause the motorized transport unit **102** to move through interaction with, for example, the floor of the shopping facility **101**). The motorized wheel system **410** can include any number of rotating wheels and/or other floor-contacting mechanisms as may be desired and/or appropriate to the application setting.

The motorized wheel system **410** also includes a steering mechanism of choice. One simple example in these regards comprises one or more of the aforementioned wheels that can swivel about a vertical axis to thereby cause the moving motorized transport unit **102** to turn as well.

Numerous examples of motorized wheel systems are known in the art. Accordingly, further elaboration in these regards is not provided here for the sake of brevity save to note that the aforementioned control circuit **406** is configured to control the various operating states of the motorized wheel system **410** to thereby control when and how the motorized wheel system **410** operates.

In this illustrative example, the control circuit **406** also operably couples to at least one wireless transceiver **412** that operates according to any known wireless protocol. This wireless transceiver **412** can comprise, for example, a Wi-Fi-compatible and/or Bluetooth-compatible transceiver that can communicate with the aforementioned central computer system **106** via the aforementioned wireless network **124** of the shopping facility **101**. So configured the control circuit **406** of the motorized transport unit **102** can provide information to the central computer system **106** and can receive information and/or instructions from the central computer system **106**. As one simple example in these regards, the control circuit **406** can receive instructions from the central computer system **106** regarding movement of the motorized transport unit **102**.

These teachings will accommodate using any of a wide variety of wireless technologies as desired and/or as may be appropriate in a given application setting. These teachings

will also accommodate employing two or more different wireless transceivers **412** if desired.

The control circuit **406** also couples to one or more on-board sensors **414**. These teachings will accommodate a wide variety of sensor technologies and form factors. By one approach at least one such sensor **414** can comprise a light sensor or light receiver. When the aforementioned location detection system **116** comprises a plurality of light emitters disposed at particular locations within the shopping facility **101**, such a light sensor can provide information that the control circuit **406** and/or the central computer system **106** employs to determine a present location and/or orientation of the motorized transport unit **102**.

As another example, such a sensor **414** can comprise a distance measurement unit configured to detect a distance between the motorized transport unit **102** and one or more objects or surfaces around the motorized transport unit **102** (such as an object that lies in a projected path of movement for the motorized transport unit **102** through the shopping facility **101**). These teachings will accommodate any of a variety of distance measurement units including optical units and sound/ultrasound units. In one example, a sensor **414** comprises a laser distance sensor device capable of determining a distance to objects in proximity to the sensor. In some embodiments, a sensor **414** comprises an optical based scanning device to sense and read optical patterns in proximity to the sensor, such as bar codes variously located on structures in the shopping facility **101**. In some embodiments, a sensor **414** comprises a radio frequency identification (RFID) tag reader capable of reading RFID tags in proximity to the sensor. Such sensors may be useful to determine proximity to nearby objects, avoid collisions, orient the motorized transport unit at a proper alignment orientation to engage a movable item container, and so on.

The foregoing examples are intended to be illustrative and are not intended to convey an exhaustive listing of all possible sensors. Instead, it will be understood that these teachings will accommodate sensing any of a wide variety of circumstances or phenomena to support the operating functionality of the motorized transport unit **102** in a given application setting.

By one optional approach an audio input **416** (such as a microphone) and/or an audio output **418** (such as a speaker) can also operably couple to the control circuit **406**. So configured the control circuit **406** can provide a variety of audible sounds to thereby communicate with a user of the motorized transport unit **102**, other persons in the vicinity of the motorized transport unit **102**, or even other motorized transport units **102** in the area. These audible sounds can include any of a variety of tones and other non-verbal sounds. These audible sounds can also include, in lieu of the foregoing or in combination therewith, pre-recorded or synthesized speech.

The audio input **416**, in turn, provides a mechanism whereby, for example, a user provides verbal input to the control circuit **406**. That verbal input can comprise, for example, instructions, inquiries, or information. So configured, a user can provide, for example, a question to the motorized transport unit **102** (such as, "Where are the towels?"). The control circuit **406** can cause that verbalized question to be transmitted to the central computer system **106** via the motorized transport unit's wireless transceiver **412**. The central computer system **106** can process that verbal input to recognize the speech content and to then determine an appropriate response. That response might comprise, for example, transmitting back to the motorized transport unit **102** specific instructions regarding how to move the motorized transport unit **102** (via the aforementioned motorized wheel system **410**) to the location in the shopping facility **101** where the towels are displayed.

In this example the motorized transport unit **102** includes a rechargeable power source **420** such as one or more batteries. The power provided by the rechargeable power source **420** can be made available to whichever components of the motorized transport unit **102** require electrical energy. By one approach the motorized transport unit **102** includes a plug or other electrically conductive interface that the control circuit **406** can utilize to automatically connect to an external source of electrical energy to thereby recharge the rechargeable power source **420**.

By one approach the motorized transport unit **102** comprises an integral part of a movable item container **104** such as a grocery cart. As used herein, this reference to "integral" will be understood to refer to a non-temporary combination and joinder that is sufficiently complete so as to consider the combined elements to be as one. Such a joinder can be facilitated in a number of ways including by securing the motorized transport unit housing **402** to the item container using bolts or other threaded fasteners as versus, for example, a clip.

These teachings will also accommodate selectively and temporarily attaching the motorized transport unit **102** to an item container **104**. In such a case the motorized transport unit **102** can include a movable item container coupling structure **422**. By one approach this movable item container coupling structure **422** operably couples to a control circuit **202** to thereby permit the latter to control, for example, the latched and unlatched states of the movable item container coupling structure **422**. So configured, by one approach the control circuit **406** can automatically and selectively move the motorized transport unit **102** (via the motorized wheel system **410**) towards a particular item container until the movable item container coupling structure **422** can engage the item container to thereby temporarily physically couple the motorized transport unit **102** to the item container. So latched, the motorized transport unit **102** can then cause the item container to move with the motorized transport unit **102**. In embodiments such as illustrated in FIGS. **2A-3B**, the movable item container coupling structure **422** includes a lifting system (e.g., including an electric drive or motor) to cause a portion of the body or housing **402** to engage and lift a portion of the item container off of the ground such that the motorized transport unit **102** can carry a portion of the item container. In other embodiments, the movable transport unit latches to a portion of the movable item container without lifting a portion thereof off of the ground.

In either case, by combining the motorized transport unit **102** with an item container, and by controlling movement of the motorized transport unit **102** via the aforementioned central computer system **106**, these teachings will facilitate a wide variety of useful ways to assist both customers and associates in a shopping facility setting. For example, the motorized transport unit **102** can be configured to follow a particular customer as they shop within the shopping facility **101**. The customer can then place items they intend to purchase into the item container that is associated with the motorized transport unit **102**.

In some embodiments, the motorized transport unit **102** includes an input/output (I/O) device **424** that is coupled to the control circuit **406**. The I/O device **424** allows an external device to couple to the control unit **404**. The function and purpose of connecting devices will depend on the application. In some examples, devices connecting to the I/O device **424** may add functionality to the control unit **404**,

allow the exporting of data from the control unit **404**, allow the diagnosing of the motorized transport unit **102**, and so on.

In some embodiments, the motorized transport unit **102** includes a user interface **426** including for example, user inputs and/or user outputs or displays depending on the intended interaction with the user. For example, user inputs could include any input device such as buttons, knobs, switches, touch sensitive surfaces or display screens, and so on. Example user outputs include lights, display screens, and so on. The user interface **426** may work together with or separate from any user interface implemented at a user interface unit **114** (such as a smart phone or tablet device).

The control unit **404** includes a memory **408** coupled to the control circuit **406** and that stores, for example, operating instructions and/or useful data. The control circuit **406** can comprise a fixed-purpose hard-wired platform or can comprise a partially or wholly programmable platform. These architectural options are well known and understood in the art and require no further description here. This control circuit **406** is configured (for example, by using corresponding programming stored in the memory **408** as will be well understood by those skilled in the art) to carry out one or more of the steps, actions, and/or functions described herein. The memory **408** may be integral to the control circuit **406** or can be physically discrete (in whole or in part) from the control circuit **406** as desired. This memory **408** can also be local with respect to the control circuit **406** (where, for example, both share a common circuit board, chassis, power supply, and/or housing) or can be partially or wholly remote with respect to the control circuit **406**. This memory **408** can serve, for example, to non-transitorily store the computer instructions that, when executed by the control circuit **406**, cause the control circuit **406** to behave as described herein. (As used herein, this reference to "non-transitorily" will be understood to refer to a non-ephemeral state for the stored contents (and hence excludes when the stored contents merely constitute signals or waves) rather than volatility of the storage media itself and hence includes both non-volatile memory (such as read-only memory (ROM) as well as volatile memory (such as an erasable programmable read-only memory (EPROM).)

It is noted that not all components illustrated in FIG. **4** are included in all embodiments of the motorized transport unit **102**. That is, some components may be optional depending on the implementation.

FIG. **5** illustrates a functional block diagram that may generally represent any number of various electronic components of the system **100** that are computer type devices. The computer device **500** includes a control circuit **502**, a memory **504**, a user interface **506** and an input/output (I/O) interface **508** providing any type of wired and/or wireless connectivity to the computer device **500**, all coupled to a communication bus **510** to allow data and signaling to pass therebetween. Generally, the control circuit **502** and the memory **504** may be referred to as a control unit. The control circuit **502**, the memory **504**, the user interface **506** and the I/O interface **508** may be any of the devices described herein or as understood in the art. The functionality of the computer device **500** will depend on the programming stored in the memory **504**. The computer device **500** may represent a high level diagram for one or more of the central computer system **106**, the motorized transport unit **102**, the user interface unit **114**, the location detection system **116**, the user interface computer **128**, the MTU docking station **122** and the MTU dispenser **120**, or any other device or component in the system that is implemented as a computer device.

Additional Features Overview

Referring generally to FIGS. **1-5**, the shopping assistance system **100** may implement one or more of several different features depending on the configuration of the system and its components. The following provides a brief description of several additional features that could be implemented by the system. One or more of these features could also be implemented in other systems separate from embodiments of the system. This is not meant to be an exhaustive description of all features and not meant to be an exhaustive description of the details any one of the features. Further details with regards to one or more features beyond this overview may be provided herein.

Tagalong Steering: This feature allows a given motorized transport unit **102** to lead or follow a user (e.g., a customer and/or a worker) throughout the shopping facility **101**. For example, the central computer system **106** uses the location detection system **116** to determine the location of the motorized transport unit **102**. For example, LED smart lights (e.g., the ByteLight system) of the location detection system **116** transmit a location number to smart devices which are with the customer (e.g., user interface units **114**), and/or on the item container **104**/motorized transport unit **102**. The central computer system **106** receives the LED location numbers received by the smart devices through the wireless network **124**. Using this information, in some embodiments, the central computer system **106** uses a grid placed upon a 2D CAD map and 3D point cloud model (e.g., from the databases **126**) to direct, track, and plot paths for the other devices. Using the grid, the motorized transport unit **102** can drive a movable item container **104** in a straight path rather than zigzagging around the facility. As the user moves from one grid to another, the motorized transport unit **102** drives the container **104** from one grid to the other. In some embodiments, as the user moves towards the motorized transport unit, it stays still until the customer moves beyond an adjoining grid.

Detecting Objects: In some embodiments, motorized transport units **102** detect objects through several sensors mounted on motorized transport unit **102**, through independent cameras (e.g., video cameras **118**), through sensors of a corresponding movable item container **104**, and through communications with the central computer system **106**. In some embodiments, with semi-autonomous capabilities, the motorized transport unit **102** will attempt to avoid obstacles, and if unable to avoid, it will notify the central computer system **106** of an exception condition. In some embodiments, using sensors **414** (such as distance measurement units, e.g., laser or other optical-based distance measurement sensors), the motorized transport unit **102** detects obstacles in its path, and will move to avoid, or stop until the obstacle is clear.

Visual Remote Steering: This feature enables movement and/or operation of a motorized transport unit **102** to be controlled by a user on-site, off-site, or anywhere in the world. This is due to the architecture of some embodiments where the central computer system **106** outputs the control signals to the motorized transport unit **102**. These controls signals could have originated at any device in communication with the central computer system **106**. For example, the movement signals sent to the motorized transport unit **102** may be movement instructions determined by the central computer system **106**; commands received at a user interface

unit **114** from a user; and commands received at the central computer system **106** from a remote user not located at the shopping facility space.

Determining Location: Similar to that described above, this feature enables the central computer system **106** to determine the location of devices in the shopping facility **101**. For example, the central computer system **106** maps received LED light transmissions, Bluetooth low energy radio signals or audio signals (or other received signals encoded with location data) to a 2D map of the shopping facility. Objects within the area of the shopping facility are also mapped and associated with those transmissions. Using this information, the central computer system **106** can determine the location of devices such as motorized transport units.

Digital Physical Map Integration: In some embodiments, the system **100** is capable of integrating 2D and 3D maps of the shopping facility with physical locations of objects and workers. Once the central computer system **106** maps all objects to specific locations using algorithms, measurements and LED geo-location, for example, grids are applied which sections off the maps into access ways and blocked sections. Motorized transport units **102** use these grids for navigation and recognition. In some cases, grids are applied to 2D horizontal maps along with 3D models. In some cases, grids start at a higher unit level and then can be broken down into smaller units of measure by the central computer system **106** when needed to provide more accuracy.

Calling a Motorized Transport Unit: This feature provides multiple methods to request and schedule a motorized transport unit **102** for assistance in the shopping facility. In some embodiments, users can request use of a motorized transport unit **102** through the user interface unit **114**. The central computer system **106** can check to see if there is an available motorized transport unit. Once assigned to a given user, other users will not be able to control the already assigned transport unit. Workers, such as store associates, may also reserve multiple motorized transport units in order to accomplish a coordinated large job.

Locker Delivery: In some embodiments, one or more motorized transport units **102** may be used to pick, pack, and deliver items to a particular storage locker **132**. The motorized transport units **102** can couple to and move the storage locker to a desired location. In some embodiments, once delivered, the requestor will be notified that the items are ready to be picked up, and will be provided the locker location and locker security code key.

Route Optimization: In some embodiments, the central computer system automatically generates a travel route for one or more motorized transport units through the shopping facility space. In some embodiments, this route is based on one or more of a user provided list of items entered by the user via a user interface unit **114**; user selected route preferences entered by the user via the user interface unit **114**; user profile data received from a user information database (e.g., from one of databases **126**); and product availability information from a retail inventory database (e.g., from one of databases **126**). In some cases, the route intends to minimize the time it takes to get through the facility, and in some cases, may route the shopper to the least busy checkout area. Frequently, there will be multiple possible optimum routes. The route chosen may take the user by things the user is more likely to purchase (in case they forgot something), and away from things they are not likely to buy (to avoid embarrassment). That is, routing a customer through sporting goods, women's lingerie, baby food, or feminine products, who has never purchased such products based on past customer behavior would be non-productive, and potentially embarrassing to the customer. In some cases, a route may be determined from multiple possible routes based on past shopping behavior, e.g., if the customer typically buys a cold Diet Coke product, children's shoes or power tools, this information would be used to add weight to the best alternative routes, and determine the route accordingly.

Store Facing Features: In some embodiments, these features enable functions to support workers in performing store functions. For example, the system can assist workers to know what products and items are on the shelves and which ones need attention. For example, using 3D scanning and point cloud measurements, the central computer system can determine where products are supposed to be, enabling workers to be alerted to facing or zoning of issues along with potential inventory issues.

Phone Home: This feature allows users in a shopping facility **101** to be able to contact remote users who are not at the shopping facility **101** and include them in the shopping experience. For example, the user interface unit **114** may allow the user to place a voice call, a video call, or send a text message. With video call capabilities, a remote person can virtually accompany an in-store shopper, visually sharing the shopping experience while seeing and talking with the shopper. One or more remote shoppers may join the experience.

Returns: In some embodiments, the central computer system **106** can task a motorized transport unit **102** to keep the returns area clear of returned merchandise. For example, the transport unit may be instructed to move a cart from the returns area to a different department or area. Such commands may be initiated from video analytics (the central computer system analyzing camera footage showing a cart full), from an associate command (digital or verbal), or on a schedule, as other priority tasks allow. The motorized transport unit **102** can first bring an empty cart to the returns area, prior to removing a full one.

Bring a Container: One or more motorized transport units can retrieve a movable item container **104** (such as a shopping cart) to use. For example, upon a customer or worker request, the motorized transport unit **102** can reposition one or more item containers **104** from one location to another. In some cases, the system instructs the motorized transport unit where to obtain an empty item container for use. For example, the system can recognize an empty and idle item container that has been abandoned or instruct that one be retrieved from a cart storage area. In some cases, the call to retrieve an item container may be initiated through a call button placed throughout the facility, or through the interface of a user interface unit **114**.

Respond to Voice Commands: In some cases, control of a given motorized transport unit is implemented through the acceptance of voice commands. For example, the user may speak voice commands to the motorized transport unit **102** itself and/or to the user interface unit **114**. In some embodiments, a voice print is used to authorize to use of a motorized transport unit **102** to allow voice commands from single user at a time.

Retrieve Abandoned Item Containers: This feature allows the central computer system to track movement of movable item containers in and around the area of the shopping facility **101**, including both the sale floor areas and the back-room areas. For example, using visual recognition through store cameras **118** or through user interface units **114**, the central computer system **106** can identify abandoned and out-of-place movable item containers. In some

cases, each movable item container has a transmitter or smart device which will send a unique identifier to facilitate tracking or other tasks and its position using LED geo-location identification. Using LED geo-location identification with the Determining Location feature through smart devices on each cart, the central computer system **106** can determine the length of time a movable item container **104** is stationary.

Stocker Assistance: This feature allows the central computer system to track movement of merchandise flow into and around the back-room areas. For example, using visual recognition and captured images, the central computer system **106** can determine if carts are loaded or not for moving merchandise between the back room areas and the sale floor areas. Tasks or alerts may be sent to workers to assign tasks.

Self-Docking: Motorized transport units **102** will run low or out of power when used. Before this happens, the motorized transport units **102** need to recharge to stay in service. According to this feature, motorized transport units **102** will self-dock and recharge (e.g., at a MTU docking station **122**) to stay at maximum efficiency, when not in use. When use is completed, the motorized transport unit **102** will return to a docking station **122**. In some cases, if the power is running low during use, a replacement motorized transport unit can be assigned to move into position and replace the motorized transport unit with low power. The transition from one unit to the next can be seamless to the user.

Item Container Retrieval: With this feature, the central computer system **106** can cause multiple motorized transport units **102** to retrieve abandoned item containers from exterior areas such as parking lots. For example, multiple motorized transport units are loaded into a movable dispenser, e.g., the motorized transport units are vertically stacked in the dispenser. The dispenser is moved to the exterior area and the transport units are dispensed. Based on video analytics, it is determined which item containers **104** are abandoned and for how long. A transport unit will attach to an abandoned cart and return it to a storage bay.

Motorized Transport Unit Dispenser: This feature provides the movable dispenser that contains and moves a group of motorized transport units to a given area (e.g., an exterior area such as a parking lot) to be dispensed for use. For example, motorized transport units can be moved to the parking lot to retrieve abandoned item containers **104**. In some cases, the interior of the dispenser includes helically wound guide rails that mate with the guide member **208** to allow the motorized transport units to be guided to a position to be dispensed.

Specialized Module Retrieval: This feature allows the system **100** to track movement of merchandise flow into and around the sales floor areas and the back-room areas including special modules that may be needed to move to the sales floor. For example, using video analytics, the system can determine if a modular unit it loaded or empty. Such modular units may house items that are of seasonal or temporary use on the sales floor. For example, when it is raining, it is useful to move a module unit displaying umbrellas from a back room area (or a lesser accessed area of the sales floor) to a desired area of the sales floor area.

Authentication: This feature uses a voice imprint with an attention code/word to authenticate a user to a given motorized transport unit. One motorized transport unit can be swapped for another using this authentication. For example, a token is used during the session with the user. The token is a unique identifier for the session which is dropped once the session is ended. A logical token may be a session id used by the application of the user interface unit **114** to establish the session id when user logs on and when deciding to do use the system **100**. In some embodiments, communications throughout the session are encrypted using SSL or other methods at transport level.

## Further Details of Some Embodiments

In accordance with some embodiments, further details are now provided for one or more of these and other features as pertains in particular to shopping facility assistance systems, devices, and methods to identify security and safety anomalies

By one approach, the aforementioned central computer system is configured to simultaneously task various ones of the plurality of aforementioned motorized transport units to temporarily attach to a corresponding mobile item container and to move the temporarily-attached mobile item container in the retail shopping facility in correspondence to the movement of an authorized consumer while also receiving and analyzing video input provided by video cameras that are included with at least some of the motorized transport units to identify security and safety anomalies in the retail shopping facility.

By one approach, the central computer system identifies security and safety anomalies in the retail shopping center by characterizing the content of images as being either expected or unexpected and as being either potentially harmful or not potentially harmful. So configured the central computer system is able to not only identify anomalies but assess a degree of threat posed by a given anomaly. For example, the central computer system can be configured to treat image content that is both expected and potentially harmful as posing a lesser threat to security and safety than image content that is both unexpected and potentially harmful.

These teachings are highly flexible in practice and will accommodate a variety of modifications and further embellishments. By one approach, for example, the central computer system can be configured to automatically contact non-retail shopping facility authorities in response to identifying certain security and safety anomalies in the retail shopping facility. As another example, the central computer system can be configured to use not only video as provided by the motorized transport units but also as provided by video cameras that comprise a part of the retail shopping facility infrastructure.

So configured, these teachings serve to automatically detect both customer-only security and safety anomalies as well as facility-only security and safety anomalies (and, of course, security and safety anomalies that can affect both the facility and customers alike). These teachings can greatly facilitate the timeliness and efficiency by which anomalies of various types are identified and appropriately responded to. These results, in turn, can increase the safety and security of all parties involved in an efficient and economical manner.

Referring now to FIG. **6**, an illustrative process **600** that accords with the foregoing will now be described. It will be understood that the specifics of this example are not to be taken as suggesting any particular limitations in these regards. It will also be presumed for the sake of this example that the aforementioned central computer system **106** carries out the described activities.

It is also further presumed that the central computer system **106** is capable of multitasking. As used herein, the term multitasking shall be understood to refer to the performing of multiple tasks/processes over a period of time by executing those tasks/processes concurrently. Accordingly,

new tasks can start and interrupt already started ones before previously-begun tasks reach completion rather than executing each task sequentially to conclusion before starting a new task. Using this approach a computer executes segments of multiple tasks in an interleaved manner while the tasks share at least some common processing resources such as a central processing unit and memory. Multitasking does not necessarily mean that multiple tasks are executing at exactly the same time though multitasking can encompass such an approach.

With the foregoing in mind, as represented generally by block **601** the central computer system **106** carries on as described above by tasking various ones of a plurality of motorized transport units **102** to temporarily attach to us corresponding mobile item container **104** and to move the temporarily-attached mobile item container **104** in the retail shopping facility **101** in correspondence to the movement of an authorized consumer to thereby assist that consumer as regards carrying items selected for purchase by the consumer and so forth.

While carrying out the foregoing tasks, the central computer system **106** also multitasks a variety of other activities that pertain to identifying security and safety anomalies in the retail shopping facility **101**. In particular, at block **602** the central computer system **106** receives video input provided by video cameras that are mounted on at least some of the plurality of motorized transport units **102** (when, for example, one of the aforementioned motorized transport unit-mounted sensors **414** comprises a video camera). That video input can be received via a wireless communication link as described above and can generally serve to provide information regarding the appearance of things and situations within the field of view of such video cameras.

As indicated at optional block **603**, the foregoing video content can be supplemented if desired by video content provided by video cameras **118** that comprise fixed infrastructure for the retail shopping facility **101**. Accordingly, in addition to whatever other purposes those video cameras **118** might serve, at least some of the video content provided by at least some of these video cameras **118** can be leveraged for the present purposes as well.

At blocks **604** the central computer system **106** analyzes that video input. This analysis can comprise, at least in part, object recognition (also sometimes referred to as object classification) by which the central computer system **106** recognizes various objects in the captured images. So configured the central computer system **106** can recognize various products in the video images as well as people and other items (including such things as purses, umbrellas, knives, guns, brooms, and so forth). Object recognition can also serve to help identify puddles of liquid, toppled-over shelves or racks, and so forth. The richness and accuracy of the object recognition process can vary as desired and the library of comparative images or other data that the central computer system **106** employs in these regards can be continually added to on either an ad hoc dynamic basis or from time to time through a batch uploading process as desired.

There are various object recognition techniques known in the art. As the present teachings are not overly sensitive to any particular choices in these regards, further elaboration in these regards is not presented here for the sake of brevity.

At block **605** the central computer system **106** then identifies security and safety anomalies in the retail shopping facility **101** based upon the analyzed video input. By one approach this process **600** remains sensitive to identifying security and safety anomalies that include both customer-only security and safety anomalies as well as facility-only security and safety anomalies. These teachings will also support detecting and identifying security and safety anomalies that can include both customers and the retail shopping facility as well as associates thereof. FIG. **7** provides further details in these regards.

At block **701** the central computer system **106** selects an image from the video input. By one approach the central computer system **106** can select each and every image/frame of the video input for analysis. By another approach the central computer system **106** may only select occasional frames, such as one frame per second or one frame per every five seconds as desired.

At decision block **702** the central computer system **106** determines whether any of the objects in the selected image are expected or unexpected. This decision point can be as simple or as nuanced as desired. For example, by one simple approach, a gallon of milk can be "expected" regardless of its orientation or relative position in a given field of view. Pursuant to a more nuanced context, a gallon of milk that is on the floor can be categorized as "unexpected" in view of that context while a gallon of milk in a shopping cart can be categorized as "expected." An object that is expected can result in the central computer system **106** setting a corresponding flag at block **703**. Unexpected objects, however, can result in the central computer system **106** setting a "not expected" flag at block **704**.

Generally speaking, an object can be unexpected for either of two reasons. In one case, the object is known and recognized by the central computer system **106** but its presence is nevertheless unexpected. A gun, for example, may be recognized as such by the central computer system **106** but may nevertheless be unexpected in context because the gun is not located in the sporting goods section of the retail shopping facility **101** but rather in the customer service department thereof. In the other case, the object is unknown and hence unrecognized by the central computer system **106**. By one approach the central computer system **106** can be configured to learn over time and by experience what such objects are and can also similarly learn whether and under what conditions such objects are properly characterized as being expected.

At decision block **705** the central computer system **106** determines whether the objects in the selected image are potentially harmful or not potentially harmful. By one approach the central computer system **106** can draw upon previously-made characterizations in these regards. For example, the conclusions of one or more subject matter experts in these regards can be accessed by the central computer system **106** by querying one or more local or remotely-located databases containing such content. By another approach, in lieu of the foregoing or in combination therewith, the central computer system **106** may achieve its own conclusions in these regards based upon general rules it may have regarding various objects and the surrounding context.

An object in an image that represents a potential harm can be so flagged by the central computer system **106** at block **706**. Similarly, video content containing nothing that represents a potential harm can be flagged as "not harmful" at block **707**. In many cases it can be beneficial to consider not only whether a particular object in fact represents certain harm but rather what potential for harm the object represents.

At decision block **708** the central computer system **106** processes the threat to security and safety by each object in the selected image. This threat assessment is based, at least

in part, upon the above-described flags that have been set for each object in an image (or at least some of the objects in the image). Generally speaking, these teachings contemplate a range of measured responses depending upon the level of threat being potentially posed (including potential immediacy of the threat, potential likelihood of the threat, and potential magnitude of harm associated with that threat). Accordingly, in this simple example, the central computer system **106** can determine that a given object represents no threat, a low level of threat, or a high level of threat. (These threat levels are at least relative to one another but may be objectively represented by a corresponding threat-level metric if so desired.)

At block **709** the central computer system **106** addresses a low-level threat with a corresponding low threat treatment. This low threat treatment might comprise, for example, alerting a security person who is monitoring a bank of video inputs to pay particular attention to a particular video input.

At block **710** the central computer system **106** addresses a high-level threat (or at least a higher-level threat than the low-level threat) with a corresponding high threat treatment. This high threat treatment might comprise, for example, automatically contacting non-retail shopping facility authorities (such as local police or a Sheriff's office) to alert those authorities of the particular circumstance of concern. By one approach the central computer system **106** can email or otherwise forward or stream individual images or video content representing the object or objects of concern to permit their immediate analysis and consideration by those authorities.

Referring again to FIG. **6**, upon identifying one or more security and safety anomalies as per the foregoing, the central computer system **106** then takes one or more corresponding actions at block **606**. As already suggested above, these actions can include a wide variety of measured responses depending upon the particular threat assessment.

These teachings are highly flexible in practice and are readily leveraged to achieve significant analytical results. Objectively, most observers would agree that a gun represents a more significant threat to personal safety than a knife, though certainly both represent a considerable threat. The present teachings permit the central computer system **106** to recognize a gun in the sporting goods section of the retail shopping facility **101** and conclude that while the gun represents a high potential threat, that gun is nevertheless expected in context; simply put, the gun belongs where the central computer system **106** is finding it. As a result, the central computer system **106** may determine that there is no particular risk associated with that image. Conversely, a person wielding a knife in a remote part of the grocery section of the retail shopping facility **101** is both unexpected and representative of a significant threat and therefore warrants a corresponding more significant security-based response and intervention.

Those skilled in the art will recognize that a wide variety of modifications, alterations, and combinations can be made with respect to the above described embodiments without departing from the scope of the invention, and that such modifications, alterations, and combinations are to be viewed as being within the ambit of the inventive concept.

What is claimed is:

**1**. An apparatus comprising:

a retail shopping facility;

a plurality of motorized transport units that are each configured to temporarily attach to a corresponding mobile item container and to move the temporarily-attached mobile item container in correspondence to the movement of an authorized consumer, the motorized transport units each including at least one video camera;

a central computer system configured to simultaneously task various ones of the plurality of motorized transport units to temporarily attach to a corresponding mobile item container and to move the temporarily-attached mobile item container in the retail shopping facility in correspondence to the movement of an authorized consumer while also receiving and analyzing video input provided by the video cameras to identify security and safety anomalies in the retail shopping facility.

**2**. The apparatus of claim **1** wherein the central computer system is configured to identify security and safety anomalies in the retail shopping facility by characterizing contents of images as being either expected or unexpected.

**3**. The apparatus of claim **2** wherein the central computer system is further configured to identify security and safety anomalies in the retail shopping facility by also characterizing contents of images as being either potentially harmful or not potentially harmful.

**4**. The apparatus of claim **3** wherein the central computer system is configured to treat image content that is both expected and potentially harmful as posing a lesser threat to security and safety than image content that is both unexpected and potentially harmful.

**5**. The apparatus of claim **2** wherein the central computer system is configured to learn over time by experience at least some image contents that are properly characterized as being expected.

**6**. The apparatus of claim **1** wherein the central computer system is configured to employ object recognition to identify the security and safety anomalies in the retail shopping facility using the video input provided by the video cameras.

**7**. The apparatus of claim **1** wherein the central computer system is further configured to also receive and analyze video input provided by video cameras that comprise fixed infrastructure for the retail shopping facility to identify the security and safety anomalies in the retail shopping facility.

**8**. The apparatus of claim **1** wherein the central computer system is further configured to automatically contact non-retail shopping facility authorities in response to identifying certain security and safety anomalies in the retail shopping facility.

**9**. The apparatus of claim **1** wherein the security and safety anomalies include both customer-only security and safety anomalies and facility-only security and safety anomalies.

**10**. A method comprising:

by a central computer system for a retail shopping facility:

tasking various ones of a plurality of motorized transport units to temporarily attach to a corresponding mobile item container and to move the temporarily-attached mobile item container in the retail shopping facility in correspondence to the movement of an authorized consumer while also receiving and analyzing video input provided by video cameras that are mounted on the plurality of motorized transport units to identify security and safety anomalies in the retail shopping facility.

**11**. The method of claim **10** wherein identifying security and safety anomalies in the retail shopping facility includes characterizing contents of images as being either expected or unexpected.

**12**. The method of claim **11** wherein identifying security and safety anomalies in the retail shopping facility also

includes characterizing contents of images as being either potentially harmful or not potentially harmful.

**13**. The method of claim **12** further comprising:

treating image content that is both expected and potentially harmful as posing a lesser threat to security and safety than image content that is both unexpected and potentially harmful.

**14**. The method of claim **11** further comprising:

learning over time by experience at least some image contents that are properly characterized as being expected.

**15**. The method of claim **10** wherein identifying security and safety anomalies in the retail shopping facility comprises employing object recognition to identify the security and safety anomalies in the retail shopping facility.

**16**. The method of claim **10** further comprising:

also receiving and analyzing video input provided by video cameras that comprise fixed infrastructure for the retail shopping facility to identify the security and safety anomalies in the retail shopping facility.

**17**. The method of claim **10** further comprising:

automatically contacting non-retail shopping facility authorities in response to identifying certain security and safety anomalies in the retail shopping facility.

**18**. The method of claim **10** wherein the security and safety anomalies include both customer-only security and safety anomalies and facility-only security and safety anomalies.

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