A customer or user sends a ride request to a central computer system, which wirelessly instructs one of the motorized transport units 850 to travel to a passenger carrier 810, mechanically couple to the carrier, and travel through a shopping space to the customer to provide transportation. The transport units may provide locomotion to the carriers, which may not themselves be motorised. The ride request may be a reservation made by the customer prior to their arrival. The location of the customer may be determined using a user device associated with the customer, and the instructions sent to the transport unit may include this information. One or more additional transport units 852 may be instructed to couple to and drive the carrier. The computer system may be configured to verify the identity of the customer boarding the carrier before transporting them. The transport unit may have an audio input device.
FIG. 5
FIG. 7

1. Receive a ride request
2. Select a MTU and a passenger carrier
3. Instruct a MTU to travel to a passenger carrier
4. Instruct the MTU to travel to the customer with the passenger carrier
Central Computer

Determine request check for MTU & carrier availability

Create task assignment via request

Recommend destination, route and schedule

Gives MTU new tasks based upon request

Associate / Colleague

Approves / declines request

May modify route and destination

Helps Customer

Customer

Request vehicle assistance/ Give Parking Spot Location

Declined request will be explained to customer

Gives Command for Destination/Request help

MTU

Retrieves Carrier For Customer

Follow the provided path and schedule

Follows Commands Via Voice recognition

Returns Customer to Parking spot once Shopping/ task is Complete

Carrier

Hooks up with MTU

Detaches from MTU in designated Carrier bay

FIG. 9
The following terms are registered trade marks and should be read as such wherever they occur in this document:

WiFi
Zigbee
Bluetooth
Diet Coke
SYSTEMS, DEVICES, AND METHODS FOR PROVIDING PASSENGER TRANSPORT

Cross-Reference To Related Application
[0001] This application claims the benefit of U.S. Provisional Application No. 62/202,744, filed August 7, 2015, and which is incorporated herein by reference.

Technical Field
[0002] 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
[0003] In a modern retail store environment, there is a need to improve the customer experience and/or convenience for the customer. Whether shopping in a large format (big box) store or smaller format (neighborhood) store, customers often require assistance that employees of the store are not always able to provide. For example, particularly during peak hours, there may not be enough employees available to assist customers such that customer questions go unanswered. Additionally, due to high employee turnover rates, available employees may not be fully trained or have access to information to adequately support customers. Other routine tasks also are difficult to keep up with, particularly during peak hours. For example, shopping carts are left abandoned, aisles become messy, inventory is not displayed in the proper locations or is not even placed on the sales floor, shelf prices may not be properly set, and theft is hard to discourage. All of these issues can result in low customer satisfaction or reduced convenience to the customer. With increasing competition from non-traditional shopping mechanisms, such as online shopping provided by e-commerce merchants and alternative store formats, it can be important for “brick and mortar” retailers to focus on improving the overall customer experience and/or convenience.

Brief Description of the Drawings
[0004] 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:

[0005] FIG. 1 comprises a block diagram of a shopping assistance system as configured in accordance with various embodiments of these teachings;

[0006] FIGS. 2A and 2B 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;

[0007] FIGS. 3A and 3B are illustrations of the motorized transport unit of FIGS. 2A and 2B detachably coupling to a movable item container, such as a shopping cart, in accordance with some embodiments;

[0008] FIG. 4 comprises a block diagram of a motorized transport unit as configured in accordance with various embodiments of these teachings;

[0009] FIG. 5 comprises a block diagram of a computer device as configured in accordance with various embodiments of these teachings;

[0010] FIG. 6 comprises a block diagram of a system for providing passenger transport in accordance with some embodiments.

[0011] FIG. 7 comprises a flow diagram of a method for providing passenger transport in accordance with some embodiments.

[0012] FIG. 8 comprises an illustration of a passenger carrier in accordance with some embodiments.

[0013] FIG. 9 comprises a flow diagram of a process for providing passenger transport in accordance with some embodiments.

[0014] 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**

[0015] 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.

[0016] 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, 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 shopping 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 other 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.

[0017] 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.

[0018] SYSTEM OVERVIEW

[0019] 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. 6-7 expand on some functionalities of some embodiments of the system and/or embodiments independent of such systems.

[0020] 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.

[0021] 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.

[0022] 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.

[0023] 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.

[0024] 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).

[0025] 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)).

[0026] 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.

[0027] 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.

[0028] 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.

[0029] 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.

[0030] 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.

[0031] 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.

[0032] 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, Massachusetts. 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.

[0033] 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.

[0034] 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.

[0035] 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.

[0039] 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.

[0040] FIGS. 2A and 2B 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. 2A, 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. 2B, 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.

[0041] FIGS. 3A and 3B illustrate some embodiments of the motorized transport unit 202 detachably engaging a movable item container embodied as a shopping cart 302. In FIG 3A, the motorized transport unit 202 is in the orientation of FIG. 2A 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. 3B, the motorized transport unit 202 is moved to the extended position of FIG. 2B 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.

[0042] 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.

[0043] 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.

[0044] 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.

[0045] 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.

[0046] 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.

[0047] 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.

[0048] 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.

[0049] 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.

[0050] 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.

[0051] 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.

[0052] 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.

[0053] 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.

[0054] 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.

[0055] 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.

[0056] 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.

[0057] 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.

[0058] 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).

[0059] 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)).

[0060] 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.

[0061] 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.

[0062] ADDITIONAL FEATURES OVERVIEW

[0063] 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.

[0064] 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.

[0065] 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.

[0066] 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.

[0067] 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.

[0068] 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.

[0069] 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.

[0070] 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.

[0075] 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 re-position 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.

[0076] 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.

[0077] 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 an 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.

[0083] 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.

[0084] FURTHER DETAILS OF SOME EMBODIMENTS

[0085] In accordance with some embodiments, further details are now provided for one or more of these and other features. A system and method for providing passenger transport is provided herein.

[0086] In some embodiments, a motorized transport unit (MTU) system may be a progressively intelligent system with the capabilities of integrating smart devices, internet, cell services, indoor and outdoor location, and many other features that enhances the safety and enjoyment of customers and associates in a shopping space. An MTU may be configured for intelligent steering by using a concert of sensors, voice recognition, geo-location, predetermined routes, boundaries, store map, intelligent tag, GPS, compass, smart device, and “bird’s eye view” video analytics to select the optimal path to travel to perform various tasks. Intelligent steering may also be utilized to enable MTUs to drive passenger carriers to transport customer(s) or associate(s) around the shopping floor or the parking lot of a shopping facility.

[0087] There are situations where customers or associates are unable to walk (or would prefer not to walk) from the parking lot or may have difficulty standing or walking throughout the store. The technologies used to maneuver MTUs around a shopping facility can also be used to maneuver a mobility assistance vehicle or golf cart-like passenger carrier around the shopping space. An MTU driven passenger carrier system allows for better
utilization of the parking lot and can enable customers with limited mobility to shop in a store. Having MTU driven passenger carriers also allow stores to be built in locations that cannot provide adequate parking spaces nearby. An MTU driven passenger carrier system also allows for handicap spaces to be placed further from the doors of the stores. An MTU can also be fitted with a carrier for multiple (e.g. up to more than 4) passengers. An MTU may stop and pick up multiple customers within the parking lot and bring them to the door of a store. Multiple MTUs may be assigned to a passenger carrier to ensure that the weight-bearing requirement of holding multiple people is met. In some embodiments, the MTU may attach to a passenger carrier with similar means used to attach to a shopping cart described herein. The intelligence of the MTU system can be attached or given to any vehicle/cart by having the MTU drive the vehicle. The customer will be able to walk or ride through the aisles with two open hands while MTU drives and steers the passenger carrier.

[0088] In some embodiments, a passenger carrier may be a modified handicap grocery cart, golf cart, or other similar device without manual controls and steering. Steering capabilities may be provided by MTUs that are automated using the same methods that control an MTU’s maneuvering in a shopping space for other tasks described herein. The intelligence of the MTU system to maneuver is added to each such device through the central computer system and network. Added capabilities may include remotely starting the vehicle, responsive breaking and accelerating, turn signals, beacon lights, and a backup alarms.

[0089] As with other uses of the MTU, a route or path may be established for passenger transporting MTUs. In the parking lot, the MTU system may record customers’ parking spots to optimize the routes for transporting passengers to and from their vehicles. For stores with very large lots, continuous shuttle routes may be served by MTUs. Additionally, for customers with disabilities, a cart can be summoned using a portable user device and a passenger carrier may be instructed to meet the customer once he/she is parked. The MTU may determine the customer location through the customer’s user device and/or through video image analysis.

[0090] FIG. 6 illustrates a block diagram of a passenger transport system 600 as configured in accordance with various embodiments of these teachings. The passenger transport system 600 includes a central computer system 620, and a number of motorized transport units 640 (MTUs 640) each configured to attach to and transport passenger carriers 650 for carrying customers 660 as passengers. The passenger transport system 600 may
include or be implemented at least partially with one or more components shown in FIGS. 1, 4, and 5 or may be more generically implemented outside of the embodiments of FIGS. 1, 4 and 5.

[0091] The central computer system 620 includes a control circuit 621 and a memory 622 and may be generally referred to as a processor-based device, a computing device, a server, and the like. In some embodiments, the central computer system 620 may be implemented with one or more of the central computer system 106 and/or the computer device 500 described above. For example, the functionalities of the central computer system 620 described herein may be implemented as one or more software and/or hardware modules in the central computer system 106.

[0092] The central computer system 620 has stored on its memory 622, a set of computer readable instructions that is executable by the control circuit 621 to cause the control circuit 621 to instruct an MTU 640 to attach itself to a passenger carrier 650 to provide transportation to one or more customers 660. The central computer system 620 may further be configured to instruct the MTU 640 as it travels through a shopping space with a passenger carrier 650 and one or more customers 660. In some embodiments, the central computer system 620 may be located inside of and serve a specific shopping space. In some embodiments, the central computer system 620 may be at least partially implemented on a remote or cloud-based server that provides instructions to MTUs in one or more shopping spaces.

[0093] The central computer system 620 may further be communicatively coupled to a set of sensors (not shown). The sensors may include one or more of optical sensors, image sensors, proximity sensors, the location detection system 116, the video camera system 118, and sensors on MTUs 120 described with reference to FIG. 1 above. Generally, the sensors are configured to provide the central computer system information for locating one or more of the MTUs 640, the passenger carriers 650, and customers 660. In some embodiments, the sensors 116 may include one or more sensors attached to one or more of the MTU 640, the passenger carrier 650, and a portable user device carried by a customer 660. In some embodiments, one or more of the MTUs 605, the passenger carrier 650, and the user interface device may include a sensor that detects geolocation beacon transmissions for determining location. The detected geolocation beacon transmission may be relayed back to the central computer system 620 to indicate a location of the MTU 640, the passenger carrier 650, and/or
a user device carried by a customer. In some embodiments, the sensors include a set of cameras for providing images of the shopping space to the central computer system 620. The central computer system 620 may analyze the images captured by the cameras and determine the location of one or more of the passenger carrier 650, the customer 660, and/or a passenger vehicle. The cameras may be stationary cameras mounted in the shopping space and/or mounted on or integrated with the MTUs and/or user interface devices.

[0094] In some embodiments, each motorized transport unit 640 may be the MTU 102 described in FIG. 1, the MTU shown in FIGS. 2A-3B, and/or the MTU 402 described in FIG. 4. Generally, an MTU 640 may be a motorized device configured to transport a passenger carrier through a shopping space according to instructions received from a central computer system 620. The MTUs may couple to a passenger carrier 650 through similar coupling means as shown in FIGS. 3A-B above. For example, the MTU 640 may extend upward and partially lift the passenger carrier 650 to carry the passenger carrier 650. In some embodiments, a different type of MTU may be used for transporting passenger carriers. In some embodiments, the MTU 640 may include attachment means such as a magnet, a hook, a latch, and the like for attaching to the passenger carrier 650. The attachment means may selectively engage and disengage the passenger carrier from the MTU 640. In some embodiments, the MTU 640 may include other input and output devices such as a speaker, an audio input device, a visual status indicators, and the like for communicating with passengers.

[0095] The passenger carrier 650 may generally be any movable passenger carrier configured to be coupled to an MTU 640. While two seat carts are illustrated in FIG. 6, in some embodiments, the system may include different types of passenger carriers such as carts with different passenger capacities, carts with child seats, carts with mobility assistance features, carts with different types of item containers, etc. The central computer system 620 may be configured to select a passenger carrier 650 based on the number of customers it needs to carry and/or the customer’s requested type of passenger carrier. Generally, the passenger carriers 650 may include wheels and one or more passengers seats. In some embodiments, a passenger carrier 650 comprises wheels that are not powered and no steering controls for the passengers. In some embodiments, a passenger carrier 650 includes only limited safety controls such as an emergency break and a button to call for help. In some embodiments, a passenger carrier 650 includes one or more input/output means communicatively coupled to the MTU 540. For example, the passenger carrier 650 may
include a user interface that displays information provided by the MTU 540 to the passenger
and may relay touch and/or voice inputs form the passenger to the MTU 540. In some
embodiments, the MTU includes turn or break signals lights and/or backup alarms that can be
controlled by the MTU 540. In some embodiments, the passenger carriers 650 do not directly
communicate with the central computer system 620 or a portable user device. In some
embodiments, the steering and the input/output devices of the passenger carriers 650 are
powered and/or controlled solely by inputs from the MTU 520 attached to it. In some
embodiments, the passenger carrier may be a powered vehicle, and the steering and controls
may be disabled when an MTU is attached to the vehicle.

In some embodiments, the central computer system 620 may further be in
communication with user interface devices (not shown). The user interface devices may
include user interface unit 114 and may include one or more of a portable user device (e.g.
smartphone, tablet computer, wearable device, head mounted device, etc.), a user interface
attached to the MTU 640, an in-store stationary user interface unit, and the like. The
customers 660 may make a ride request to the central computer system 620 via a user
interface device. For example, the customer 660 may use an mobile application (“app”)
running on his/her portable device to request a ride from his/her vehicle and the central
computer may instruct an MTU 640 to meet the customer 660 with a passenger carrier 650 in
the parking lot. The customer may further select points in the store to visit using the portable
user device and/or the MTU’s user interface. For example, a passenger may enter a shopping
list and/or select sections, areas, and/or items from the user device. The system may then
configure a route for the user based on the entered information. In some embodiments, user
interface devices may be implemented as stationary devices. For example, a customer may
approach a ride station and request a ride using a user interface device in the ride station.

FIG. 7 shows a flow diagram of a method for providing passenger transport in
a shopping space in accordance with various embodiments of these teachings. The steps
shown in FIG. 7 may be performed by one or more of the central computer system 620 in
FIG. 6, the central computer system 106 in FIG. 1, and the computer device 500 in FIG. 5, for
example. In some embodiments, the steps are performed by a processor-based device
executing a set of computer readable instructions stored on a memory device.

In step 710, the control circuit receives a ride request. A ride request may be
made via a user interface device such as user interface unit 114, which may be a customer’s
personal device or a store-owned mobile or stationary device configured to communicate with a central computer system. The user interface unit may include a software or hardware button for requesting a ride. In some embodiments, the request may further include a request for a specific type of passenger carrier and/or a number of passengers. For example, a customer may request for a passenger carrier with four seats, a passenger carrier with a child seat, a passenger carrier with mobility assistance features, etc. The user interface unit may display the different available passenger carrier options to the user. In some embodiments, a ride request may comprise a spoken command. For example, the customer may say to an MTU unit and/or a user interface device: “I need a ride.” In some embodiments, when a ride is requested, the system also determines a location of the requesting customer and/or device. For example, the requesting user interface device may record a GPS coordinate or pick up a location beacon signal (e.g. smart LED) and provide that information to the system along with the ride request. In some embodiments, the customer may specify a time and/or pickup location for the requested ride. For example, prior to arriving at the store, the customer may reserve a passenger carrier and have that passenger carrier meet them in the parking lot when they arrive. In some embodiments, the system may continue to receive location information from the requesting device to determine when the customer will arrive at the store and where the customer should be picked up. The recorded location information may also be used at the end of the shopping trip to return the customer to their starting point, which may correspond to where they parked their vehicle. In some embodiments, in step 715, the system stores an initial location for the customer, which may correspond to one or more of: a location of the customer when the customer makes the ride request, a location of the customer when the customer boards the passenger carrier, and a location where a customer vehicle is parked.

In step 715, the control circuit selects an MTU from a plurality of MTUs and a passenger carrier from a plurality of passenger carriers in the system. In some embodiments, the passenger carrier and MTU combination that can be provided to the customer in the shortest amount of time may be selected. The time it takes for a passenger carrier to be brought to a customer may be estimated based on one or more of the customer’s location, the location of the passenger carrier, the location of the MTU, length of the path of travel, congestion conditions of the path of travel, etc. In some embodiments, if the customer makes a ride request to an MTU already assigned to the customer, the system may use the assigned MTU to retrieve a passenger carrier and provide passenger transport. In some embodiments,
if the ride request includes a selection of a specific type of passenger carrier, the system may select a passenger carrier according to the selection. In some embodiments, the ride request in step 710 may include an indication of the number of passengers in the party. The system may then select a passenger carrier with sufficient carrying capacity to accommodate the entire party. In some embodiments, idle passenger carriers may be stored in a passenger carrier parking area such as a cart bay. The system may instruct the MTU to attach itself to the first accessible passenger carrier in the carrier parking area. In some embodiments, if a shopping space includes two or more passenger carrier parking areas, the system may further select a carrier parking area based on one or more of the MTU’s location, store traffic condition, the pickup location, etc. In some embodiments, the system may select a specific type of passenger carrier from the available carriers based on one or more of user request, user demographic information, stored user shopping habit, user location, etc.

[00100] In some embodiments, in step 715, the system may determine that the selected passenger carrier requires two or more MTUs to transport and select the required number of MTUs. For example, power from two MTUs may be needed to carry a multi-passenger carrier at its maximum capacity. In such case, the system may instruct two MTUs to travel to the same passenger carrier and attach to the passenger carrier at different locations (e.g. front right and front left). The system may then instruct the two MTUs to simultaneously provide locomotion to the passenger carrier.

[00101] In step 720, the system provides instructions to the MTU selected in step 715 to travel to the selected passenger carrier and attach to the passenger carrier. The instructions may include a current location of the passenger carrier and/or a passenger carrier parking area. In some embodiments, the instructions may include real-time route guidance. When the MTU arrives at the passenger carrier, the MTU attaches itself to the carrier. In some embodiments, the MTUs may attach to a passenger carrier with similar means and methods as those used for carrying a shopping cart. In some embodiments, the MTU may include attachment means such as a magnet, a hook, a latch, a wedge, etc. for coupling with the passenger carrier. Generally, the MTU and the passenger carrier may be coupled through any known coupling means. In some embodiments, the attachment motion may be guided by one or more sensors on the MTU. For example, the passenger carrier may include markers to help the MTU orient and align itself for proper attachment. In some embodiments, the carrier parking area may include guides for attaching and/or detaching MTUs and passenger carriers.
In step 725, the system instructs the MTU to bring the passenger carrier to the location of the requesting customer and/or requesting device. The location of the customer may be manually entered by the customer and/or be based on the location information of the requesting device. In some embodiments, the system may provide real-time route guidance to the MTU. In some embodiments, the system may keep track of the current location of the customer and update the instruction to the MTU accordingly such that the MTU is able to “catch up” with the customer if the customer continues to move after making the request in step 710. After the MTU arrives at the customer’s location, the MTU may become assigned to the customer and only receives commands associated with the customer during the shopping trip. In some embodiments, the MTU may be instructed to carry the passenger based on one or more of a customer voice command, a customer selected destination, a customer shopping list, store area restrictions, a customer profile, and store promotions.

In some embodiments, the MTU may request passenger authentication prior to providing transport to the boarded passenger to ensure that the passenger is the customer that requested the ride. For example, the system may provide a passcode to the requesting user device. The customer may be required to enter or scan in the passcode before the MTU would accept commands from the customer. In some embodiments, the system may prompt the customer to scan a code and/or a RFID tag on the MTU and/or passenger carrier with their user device to confirm that they are boarding the correct passenger carrier.

In some embodiments, after step 725, the MTU may enter into a passenger transport mode in which the MTU would only accept a set of commands associated with the mode. For example, the MTU may accept commands to travel to a section, an item, a point of interest within the shopping space (e.g. “go to checkout counter,” “take me to apples,” etc.) but may not permit direct directional or steering control (e.g. “go forward,” “turn right,” “speed up,” etc.) from the customer. In some embodiments, a customer may enter a list of items they wish to purchase and the system may automatically select a route for the customer based on their shopping list. Generally, the route may take the customer by every item on their shopping list. In some embodiments, the route may further take the customer to areas with items the customer may be interested in purchasing but are not on the shopping list. The system may select items the customer may be interested in purchasing based on one or more of the customer’s past purchase history, the customer’s demographic, the entered shopping list, store discounts, etc. If more than one passenger is transported by a carrier, the system
may combine one or more of the passengers’ shopping list, preference, purchase history, and demographics in determining a route for the group transported by the MTU. In some embodiments, the route may further take into account real-time congestion conditions in the shopping space. In some embodiments, the MTU may be instructed to travel according to a default route that takes the customer through frequented sections of the store. In some embodiments, an MTU may only provide transportation in the parking lot and only carry the passengers between the front door of the store and their vehicle. In some embodiments, the MTU may provide transportation between a public transportation station (e.g. a bus stop, a subway exit, etc.) and the store. In such embodiments, the MTU may automatically transport the passenger either to or from the store without further input from the passenger. In some embodiments, an MTU may be configured to respond to two or more ride requests. For example, the system may receive requests from multiple customers in the parking lot that wishes to be brought to the store. The system may instruct the MTU to pick up each passenger at their requested pickup location and bring them to the store in the same passenger carrier. In some embodiments, the same or a different MTU may continue to transport the customers inside the store.

[00105] In some embodiments, after step 725, the MTU may be instructed to bring the customer back to the location where the passenger was picked up. For example, if the customer was picked up near his/her vehicle, the system may record the location of the customer’s vehicle and return the customer back to the vehicle at the end of his/her shopping trip. In some embodiments, after the passenger is dropped off, the MTU may be instructed to return the passenger carrier back to a carrier parking area. The MTU may be further instructed to detach from the passenger carrier in the carrier storage area. After the MTU is detached from the passenger carrier, the system may assign other types of tasks described herein to the MTU. For example, the MTU may be instructed to escort a walking customer, clean a spill, scan shelves, carry a shopping cart, etc.

[00106] FIG. 8 is an illustration of a passenger carrier driven by MTUs according to some embodiments. The passenger carrier 810 includes a set of non-motorized wheels 812 and is coupled to MTUs 850 and 852 that together provide locomotion to the passenger carrier 810. The passenger carrier 810 is shown to be pulled by two MTUs 850 and 852. In some embodiments, the number of MTUs used to drive a passenger carrier may be based on the weight of the passenger carrier and passengers. For example, some passenger carriers
may be configured to be driven by only one MTU. In some embodiments, the MTUs may
couple to the passenger carrier 810 by partially lifting one end of the passenger carrier 810. In
some embodiments, the passenger carrier 810 may couple to the MTU by one or more of a
magnet, a hook, a latch, a wedge, and the like. In some embodiments, the passenger carrier
810 also comprises a coupling mechanism for coupling with the MTU(s) at the designated
location. In some embodiments, the MTUs may couple to the front, back, and/or side portions
of the passenger carrier 810. Generally, the passenger carrier may be driven by the MTUs
850 and 852 based on instructions received from a central server. In some embodiments, at
least one of the MTUs 850 and 852 may be communicatively coupled to the passenger carrier
810 to control one or more input/output devices on the passenger carrier. For example, the
MTU may be configured to control one or more of turn and break signals, backup alarms,
speakers, microphones, and/or displays on the passenger carrier. The communication link
between the MTU and the passenger carrier that allows for the control of the input/output
devices on the passenger carrier may be part of the mechanical coupling mechanism and/or
be a wireless communication link. While the passenger carrier 810 shown in FIG. 8 includes
two rows of seats and a protective roof, passenger carriers with other carrying capacities and
configurations may be used in the described system without departing from the spirit of the
present disclosure.

FIG. 9 is an illustration of a process for providing passenger transport with
MTUs. In some embodiments, the steps in FIG. 9 may be implemented by one or more
components of the systems shown in FIG. 1 and FIG. 6. In step 921, the customer requests a
vehicle and provides a pick up location, such as he/her parking spot. In step 901, the central
computer verifies the request and checks for MTU and passenger carrier availability. The
availability of MTUs and passenger carriers may be based on the requested carrier type
and/or the number of passengers needing a ride. In step 911, a store associate or a colleague
approves or declines the request. Step 911 may also be options. In some embodiments, the
central computer may be configured to automatically approve or decline the request based on
the customer’s stored profile and/or MTU and carrier availability. For example, some
customers may have preapproval to use mobility assistance services and the system may
automatically approve any request from the preapproved customers. If the request is declined,
in step 923, the declined request is explained to the customer.
If the ride request is approved, in step 903, the central computer creates a task assignment based on the request. In step 905, the central computer further determines recommended destination, route, and/or schedule for the customer. The recommended destination, route, and/or schedule may be based on one or more of a customer entered shopping list, a customer purchase history, a customer profile, a customer demographic, and store congestion condition, etc. In step 913, a store associate may optionally manually modify the route and destination.

In step 931, the MTU is instructed to retrieve a passenger carrier for the customer. In some embodiments, the passenger carriers are stored in a carrier bay and the MTU is instructed to travel to the carrier bay. In step 941, a passenger carrier is hooked up with the MTU. The MTU may then travel to the requesting customer. In step 933, the MTU follows the path and schedule provided by the central computer once the requesting customer has boarded. In some embodiments, during step 933, the central computer continues to provide real-time navigation instructions to the MTU.

In step 925, the customer gives commands and/or requests for help while being carried by the passenger carrier driven by the MTU. If the customer requested assistance in step 925, in step 915, an associate may be notified to provide help to the customer. If the customer makes a voice command, in step 935, the MTU performs voice recognition and responds to the voice commands. In some embodiments, in step 935, the MTU relays the voice command to the central computer and the central computer may determine how the MTU should respond to the command from the customer. For example, the user may request to be brought to an item, brought to a store feature (e.g. customer service counter, checkout counter, restroom, etc.), or end the shopping trip. The central computer system may determine a new route for the MTU based on the customer input. In some embodiments, the central computer system may determine that the requested action is not permissible in the transport mode of the MTU and would notify the customer via MTU. In some embodiments, a customer command may be entered either through voice command or through a user interface device such as a portable user device.

At the conclusion of a shopping trip, in step 937, the MTU may return the customer to the starting point, which may be his/her parking spot. The location of the parking spot may be the location provided and recorded in step 921. In step 943, the MTU may bring the passenger carrier back to a carrier bay and the carrier detaches from the MTU. After the
passenger carrier is detached, in step 907, the central computer may give the MTU new tasks based upon other requests. For example, the MTU may be instructed to escort another customer who is walking in the shopping space, to collect abandoned shopping carts, to clean up a spill, etc.

[00112] In some embodiments, apparatuses and methods are provided herein useful for providing passenger transport. In some embodiments, a system for providing passenger transport includes a plurality of passenger carriers, a plurality of motorized transport units each configured to mechanically couple at least one of the plurality of passenger carriers, and a central computer system communicatively coupled to the plurality of motorized transport units. The central computer system being configured to receive a ride request from a customer, instruct a motorized transport unit to travel to a passenger carrier and couple to the passenger carrier, and instruct the motorized transport unit coupled to the passenger carrier to travel to the customer to provide transportation to the customer.

[00113] In some embodiments, a method for providing passenger transport is provided. The method comprises receiving, at a central computer system, a ride request from a customer, selecting, by the central computer system, a motorized transport unit from a plurality of motorized transport units and a passenger carrier from a plurality of passenger carriers, instructing the motorized transport unit to travel to the passenger carrier and mechanically couple to the passenger carrier, and instructing the motorized transport unit coupled to the passenger carrier to travel to the customer.

[00114] In some embodiments, an apparatus for providing passenger transport is provided. The apparatus comprising a wireless transceiver configured to communicate wirelessly with a central computer system, a motorized wheel system, a coupling structure for mechanically coupling with passenger carriers, and a control circuit coupled to the wireless transceiver and the motorized wheel system, the control circuit being configured to cause the apparatus to: travel, using the motorized wheel system, to a passenger carrier, couple to a passenger carrier apparatus via the coupling structure, travel, using the motorized wheel system, to a passenger location for passenger pickup, and travel through a shopping space based on instructions received from the central computer system via the wireless transceiver.

[00115] 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.
CLAIMS

What is claimed is:

1. A system for providing passenger transport, comprising:
   a plurality of passenger carriers;
   a plurality of motorized transport units each configured to mechanically couple at
   least one of the plurality of passenger carriers;
   a central computer system communicatively coupled to the plurality of motorized
   transport units, the central computer system being configured to:
       receive a ride request from a customer;
       instruct a motorized transport unit to travel to a passenger carrier and couple to
       the passenger carrier; and
       instruct the motorized transport unit coupled to the passenger carrier to travel
       to the customer to provide transportation to the customer.

2. The system of claim 1, wherein the passenger carrier is not motorized and a
   motorized wheel system of the motorized transport unit provides locomotion when coupled to
   the passenger carrier.

3. The system of claim 1, wherein the ride request comprises a ride reservation made
   by the customer prior to the customer arriving at a shopping space associated with the central
   computer system.

4. The system of claim 1, wherein the central computer system determines a location
   of the customer based on location information of a user device associated with the customer
   and instructs the motorized transport unit to travel to the customer according to the
determined location of the customer.

5. The system of claim 1, wherein the central computer system is further configured to
   instruct one or more additional motorized transport units to travel to the passenger carrier and
   the one or more additional motorized transport units are configured to couple to and drive the
   passenger carrier together with the motorized transport unit.
6. The system of claim 1, wherein the central computers system is further configured to:
   store an initial location corresponding to one or more of: a location of the customer when the customer makes the ride request, a location of the customer when the customer boards the passenger carrier, and a location where a customer vehicle is parked; and
   instruct the motorized transport unit to transport the customer to the initial location at the end of a shopping trip.

7. The system of claim 1, wherein the central computer system is further configured to instruct the motorized transport unit to transport the customer through a shopping space based on one or more of: a customer voice command, a customer selected destination, a customer shopping list, store area restrictions, a customer profile, and store promotions.

8. The system of claim 7, wherein the central computer system is further configured to verify that a customer boarding the passenger carrier is the customer that made the ride request before instructing the motorized transport unit to transport the customer through the shopping space.

9. The system of claim 1, wherein the passenger carrier comprises at least a set of wheels and a seat for the customer.

10. The system of claim 1, wherein the motorized transport unit comprises an audio input device for receiving voice commands from the customer.

11. A method for providing passenger transport, comprising:
   receiving, at a central computer system, a ride request from a customer;
   selecting, by the central computer system, a motorized transport unit from a plurality of motorized transport units and a passenger carrier from a plurality of passenger carriers;
   instructing the motorized transport unit to travel to the passenger carrier and mechanically couple to the passenger carrier; and
   instructing the motorized transport unit coupled to the passenger carrier to travel to the customer.
12. The method of claim 11, wherein the passenger carrier is not motorized and a motorized wheel system of the motorized transport unit provides locomotion when coupled to the passenger carrier.

13. The method of claim 11, wherein the ride request comprises a ride reservation made by the customer prior to the customer arriving at a shopping space associated with the central computer system.

14. The method of claim 11, further comprising:
determining a location of the customer based on location information of a user device associated with the customer, wherein the central computer system instructs the motorized transport unit to travel to the customer according to the determined location of the customer.

15. The method of claim 11, further comprising:
instructing one or more additional motorized transport units to travel to the passenger carrier and the one or more additional motorized transport units are configured to couple to and drive the passenger carrier together with the motorized transport unit.

16. The method of claim 11, further comprising:
storing an initial location corresponding to one or more of: a location of the customer when the customer makes the ride request, a location of the customer when the customer boards the passenger carrier, and a location where a customer vehicle is parked; and instructing the motorized transport unit to transport the customer to the initial location at the end of a shopping trip.

17. The method of claim 11, further comprising:
instructing the motorized transport unit to transport the customer through a shopping space based on one or more of: customer voice command, customer selected destination, customer shopping list, store area restrictions, customer profile, and store promotions.

18. The method of claim 17, further comprising:
verifying that a customer boarding the passenger carrier is the customer that made the ride request before instructing the motorized transport unit to transport the customer through the shopping space.

19. The method of claim 11, wherein the passenger carrier comprises at least a set of wheels and a seat for the customer.

20. The method of claim 11, wherein the motorized transport unit comprises an audio input device for receiving voice commands from the customer.

21. An apparatus for passenger transport comprising:
   a wireless transceiver configured to communicate wirelessly with a central computer system;
   a motorized wheel system;
   a coupling structure for mechanically coupling with passenger carriers; and
   a control circuit coupled to the wireless transceiver and the motorized wheel system, the control circuit being configured to cause the apparatus to:
   travel, using the motorized wheel system, to a passenger carrier;
   couple to a passenger carrier apparatus via the coupling structure;
   travel, using the motorized wheel system, to a passenger location for passenger pickup; and
   travel through a shopping space based on instructions received from the central computer system via the wireless transceiver.
Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

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<th>Category</th>
<th>Relevant to claims</th>
<th>Identity of document and passage or figure of particular relevance</th>
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<tr>
<td>Y</td>
<td>1-3, 5-13 and 15-21</td>
<td>JP 2009284944 A (NAT INST OF ADV IND &amp; TECHNOL) See the figures and EPODOC abstract in particular.</td>
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<td>WO 2008/151345 A2 (PROFACTOR RESEARCH &amp; BLUEBOTICS) See the EPODOC abstract, figure 9 and page 8, lines 25-29 in particular.</td>
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<td>EP 1136052 A2 (FUJI JUKOGYO KABUSHIKI KAISHA) See figures 1 and 2 and paragraphs [0015]-[0016] in particular.</td>
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Categories:

- X  Document indicating lack of novelty or inventive step
- Y  Document indicating lack of inventive step if combined with one or more other documents of same category.
- &  Member of the same patent family
- A  Document indicating technological background and/or state of the art.
- P  Document published on or after the declared priority date but before the filing date of this invention.
- E  Patent document published on or after, but with priority date earlier than, the filing date of this application.

Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC:

Worldwide search of patent documents classified in the following areas of the IPC:

A61G; A63B; B62D; G05B; G05D

The following online and other databases have been used in the preparation of this search report:

WPI, EPODOC, TXTA
### International Classification:

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