MATERIAL HANDLING APPARATUS AND METHOD FOR SORTING ITEMS USING A DYNAMICALLY CONFIGURABLE SORTING ARRAY

Reference to Related Applications

[001] The present application claims the benefit of U.S. Provisional Patent Application Serial No. 62/331,020 filed on May 3, 2016, the entire disclosure of which is hereby incorporated herein by reference.

Field of the Invention

[002] The present invention relates to material handling systems and, more particularly, to systems and methods for aggregating items into groups based on an automated recognition, detection, and/or characterization process.

Background of the Invention

[003] The inventors herein have observed that aggregating items into respective groups (e.g, in the fulfillment of corresponding orders items to be shipped to customers or retail points of sale and/or in the processing of returns of such items) can be laborious, time consuming, inefficient, and prone to error. Such disadvantages are most keenly felt when the items must be retrieved from (or returned to) scattered locations within a warehouse or other large facility. A single order fulfillment center may receive hundreds, thousands or more orders a day, with each order requiring one, several, or many different items to be retrieved from inventory. The retrieved tems are typically transferred, manually either to a cell of a temporary item accumulation area known as a "put wall" or directly into a parcel or carton. After all the items for an order have been accumulated in this manner, the packaging process is completed.

Summary

[004] Described herein are automated sorting systems and methods by which items of disparate size and/or weight are automatically identified and transported to an array of dynamically reconfigurable sort destinations, based on the identification.

[004a] According to an aspect, the present disclosure refers to a method of sorting items to a dynamically reconfigurable sort array structure defining columns of sort destinations, comprising the steps of: advancing one of a plurality of delivery vehicles to a loading station; at the loading station, receiving, onto the delivery vehicle, an item to be delivered to a first sort destination; advancing the delivery vehicle along a path to the first sort destination, wherein the step of advancing comprises driving the delivery vehicle vertically upwardly along a track; determining that the sort destination cannot receive the item; advancing the delivery vehicle along a path to an alternate sort destination; at the alternate sort destination, discharging the item from the delivery vehicle into the alternate sort destination.

[005] In an example, a method of sorting items to a dynamically reconfigurable sort array structure defining columns of sort destinations, comprises the steps of receiving,

onto a delivery vehicle, an item to be delivered to a first sort destination advancing the delivery vehicle along a path to the first output bin; determining that the sort destination cannot receive the item; advancing the delivery vehicle along a path to an alternate sort destination; and at the alternate sort destination, discharging the item from the delivery vehicle into the alternate sort destination.

[006] In an example, the step of determining comprises operating at least one sensor of the delivery vehicle to detect that the first sort destination cannot receive additional items.

[007] In some examples, the method further includes operating the at least one sensor to determine that the alternate sort destination can receive the item and may further include transmitting to a controller, from the delivery vehicle, a notification that the first sort destination cannot receive the item.

[008] In an example, the method further includes receiving at the delivery vehicle, an instruction from the controller identifying a location of an alternate sort destination. and transmitting to a controller, from the delivery vehicle, a notification that the item has been delivered to the alternate sort destination.

[009] In examples, the method further includes receiving at the delivery vehicle, an instruction from the controller identifying a first output bin as a primary destination and a second output bin as a secondary destination. The determining may comprise operating at least one sensor of the delivery vehicle to detect that the first output bin is missing.

[010] In another example, a method of sorting items using a dynamically reconfigurable sorting array system, the system including a plurality of destination areas arranged into a series of columns extending generally vertically, a plurality of delivery vehicles, and an event annunciation system, wherein the method comprises transferring, onto a delivery vehicle, an item to be delivered to a first destination area of the plurality of destination areas; driving the delivery vehicle along a path to the first destination area; initiating discharge of the item to the first destination area; upon detection of a first event associated with operation of the sorting array system, operating the event annunciation system to provide a first visible alert; and/or upon detection of a second event, operating the alert indicating system to at least one of discontinue the first visible alert or provide a second visible alert visibly distinguishable from the first visible alert.

[011] In an example, a sensor of the material handling system is operated to detect the first event, wherein the first event detected by the sensor is delivery of a last item required to complete a grouping of items at the first destination area.

[012] In a further example, a material handling system for sorting a plurality of items into groups of one or more items, comprises a plurality of destination areas arranged into a series of columns extending generally vertically; a plurality of visible indicators, wherein at least one visible indicator of the plurality of visible indicators is adjacent to a corresponding destination area of the plurality of destination areas; a plurality of delivery vehicles each dimensioned and arranged to receive a respective item of a plurality of items and operable to transport a received item to any destination area of the plurality of destination areas, wherein each vehicle comprises a power source for driving the vehicle, and a transfer mechanism operative to transfer a received item to a selected destination area; and a controller including a processor to executing instructions, stored in memory, for activating a first visible indicator adjacent to the first destination area when a destination area has accumulated a complete group of items.

[013] The memory of the material handling system may further include instructions executable by the processor for deactivating the first visible indicator when the complete group of items has been removed from the first destination area and/or instructions executable by the processor for re-assigning the first destination area to enable accumulation of items for a second group.

[014] The memory of the material handling system may further include instructions executable by the processor for controlling the movement and operation of each delivery vehicle, and the system may further include a destination module operable to identify the selected destination area. In some examples, the destination module identifies the destination area based on a marking on the item.

[015] According to an example, the plurality of destination areas of the material handling system are arranged into a first series of columns extending generally vertically and a second series of columns extending vertically, the system further including a track for guiding the delivery vehicles to the destination areas, wherein the track is positioned between the first series of columns and the second series of columns so that a delivery vehicle can move vertically between the first

CLAIMS

What is claimed is:

1. A method of sorting items to a dynamically reconfigurable sort array structure defining columns of sort destinations, comprising the steps of:

advancing one of a plurality of delivery vehicles to a loading station;

at the loading station, receiving, onto the delivery vehicle, an item to be delivered to a first sort destination;

advancing the delivery vehicle along a path to the first sort destination, wherein the step of advancing comprises driving the delivery vehicle vertically upwardly along a track;

determining that the sort destination cannot receive the item;

advancing the delivery vehicle along a path to an alternate sort destination;

at the alternate sort destination, discharging the item from the delivery vehicle into the alternate sort destination.

2. The method of claim 1, wherein the determining comprises operating at least one sensor of the delivery vehicle to detect that the first sort destination cannot receive additional items.

3. The method of claim 2, further including operating the at least one sensor to determine that the alternate sort destination can receive the item.

4. The method of any of claims 1-3, further including transmitting to a controller, from the delivery vehicle, a notification that the first sort destination cannot receive the item.

5. The method of claim 4 further including receiving at the delivery vehicle, an instruction from the controller identifying a location of an alternate sort destination.

6. The method of any of claims 1-5, further including transmitting to a controller, from the delivery vehicle, a notification that the item has been delivered to the alternate sort destination.

7. The method of any of claims 1-6, further including receiving at the delivery vehicle, an instruction from the controller identifying a first output bin as a primary destination and a second output bin as a secondary destination.

8. The method of any of claims 1-7, wherein the determining comprises operating at least one sensor of the delivery vehicle to detect that the first output bin is missing.

9. The method of any of claims 1-8, wherein the method of driving a delivery vehicle upwardly comprises the step of driving a plurality of drive wheels.

10. The method of any of claims 1-9, wherein the method of driving a delivery vehicle comprises the step of driving a semi-autonomous vehicle having an onboard drive system including an onboard power supply.

11. The method of any of claims 1-10 wherein the step of discharging the element comprises driving a conveyor belt in a first direction to displace the item toward the rearward end of the delivery vehicle or driving the conveyor belt in a second direction to displace the item toward the forward end of the delivery vehicle.