MULTIPLE STATION INVENTORY CONTROL SYSTEM

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ABSTRACT

An inventory control system may include one or more paddles, a position of which is changed by adding or removing items to be inventoried, a plurality of encoder strips, each connected for motion with a paddle, and a plurality of detectors at least some of which are each responsive to the motion of an encoder strip to determine the addition or removal of the items. The encoding strip may be in the form of a loop mounted for rotation or a linear member such as self coiling strip. An alternate embodiment may include an illumination target mounted for motion with each paddle and a light source and detector for determining motion of the target.
MULTIPLE STATION INVENTORY CONTROL SYSTEM

CROSS REFERENCE TO RELATED APPLICATIONS


BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] The invention relates to inventory control systems and in particular to systems which monitor and report on the number of items stored at a particular location.

[0004] 2. Description of the Prior Art

[0005] Many inventory management systems such as those in grocery stores and general merchandising stores commonly display products for sale on a shelf. In an effort to organize products in a more cost-effective and time-efficient manner, and display them in an esthetically pleasing way, stores began placing dividers and pusher paddles on shelves. Dividers may vary in length and height to facilitate better organization of products on a shelf. They allow a pusher paddle to be placed in between to move products forward as products are retrieved from the front of the shelf.

[0006] Inventory data, that is, data reflecting the number of items, such as a can, at a particular location on a shelf is conventionally collected manually although various proposals have been made to automate the collection of such data.

[0007] Conventional product display systems, such as the Shelf-facing System, available from FFr Inc. of Cleveland, Ohio include a spring-powered pusher paddle movable on a track against the resistance of a flat spring coiled within. In a grocery store application, a series of cans may be lined up in front of the paddle to fill the shelf. As one can is removed, the spring causes the remaining cans to be pushed forward to maintain the appearance of a full shelf.

[0008] What is needed is an improved technique for automating the collecting of inventory data.

SUMMARY OF THE DISCLOSURE

[0009] An inventory control system is disclosed in one aspect having one or more paddles, a position of which is changed by adding or removing items to be inventoried, one or more encoder strips, each connected for motion with a paddle and one or detectors at least one of which is each responsive to the motion of an encoder strip to determine the addition or removal of the items.

[0010] An inventory control system is disclosed in one aspect having one or more paddles, a position of which is changed by adding or removing items to be inventoried, each paddle including an illumination target, one or more sources of illumination, each illuminating one or more targets and one or more detectors, each responsive to light reflected from the one or more targets for detecting motion of each paddle to determine how many items to be inventoried were removed from inventory related to each such paddle.

[0011] An inventory control system is disclosed in a further aspect having a housing including a plurality of detectors, each detector including a source of illumination and one or more photo detectors configured to detect motion of the contrasting bars of an encoder strip which may be associated therewith to determine how many items were removed and/or removed from inventory associated therewith, each detector further including a post on which may be mounted a self coiling portion of an encoder strip, a linear member of which may be extended or retracted in response to the motion of a pusher associated with a subset of the items, whereby changes in the configuration of the items to be inventoried may easily be accommodated by changing the number and position of the pushers, attaching a portion of the linear member of an encoder strip to each pusher and mounting a self coiling portion of that encoder strip on a convenient post.

[0012] A method for inventory control is disclosed by providing a plurality of detectors mounted on a housing, providing a plurality of encoding strips, one of which may be associated with each of the detectors and connected for motion with a pusher associated with items to be inventoried and detecting motion of the encoder strips to determine items removed from inventory.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] FIG. 1A illustrates an exemplary drawings.

[0014] FIG. 1B illustrates an exemplary shelf with products placed thereon.

[0015] FIG. 1C illustrates an exemplary shelf with products organized by dividers.

[0016] FIG. 1D illustrates an exemplary shelf with products organized by dividers with some products missing from the front of the shelf.

[0017] FIG. 1E illustrates an exemplary shelf with products organized by dividers with a push plate pushing the products from the back of the shelf toward the front of the shelf as products are retrieved from the front.

[0018] FIG. 1F illustrates an exemplary shelf, wherein a monitoring device determines the number of products remaining on the shelf and communicates the information through a computer system.

[0019] FIG. 1G illustrates an exemplary shelf, wherein a monitoring device determines the number of products remaining on the shelf and communicates the information through a computer system and also displays the information in an electronic display located in front of the products.

[0020] FIG. 2A illustrates an exemplary pushing mechanism having a push plate.

[0021] FIG. 2B illustrates an exemplary computer mouse.

[0022] FIG. 2C illustrates an exemplary computer mouse attached to the pushing mechanism behind the push plate.

[0023] FIG. 2D illustrates an exemplary computer mouse according to FIG. 2C, wherein a movement of the mouse corresponds to the movement of the push plate.

[0024] FIG. 2E illustrates an exemplary computer mouse according to FIG. 2C, wherein the mouse moves further backward to correspond to the movement of the push plate.
FIG. 2F illustrates an exemplary computer mouse according to FIG. 2C that has moved backwards to the end of the pushing mechanism to correspond to the movement of the push plate.

FIG. 2G illustrates an exemplary computer mouse according to FIG. 2C with products on the system. The mouse has moved relative to the push plate.

FIG. 2H illustrates an exemplary computer mouse according to FIG. 2C with products on the system that has moved forward the same distance as the depth of a product as a product has been removed from the front. The mouse has moved relative to the push plate.

FIG. 2I illustrates an exemplary computer mouse according to FIG. 2C with products on the system that has moved forward as all of the products have been removed from the front of the shelf. The mouse has moved relative to the push plate.

FIG. 3A illustrates an exemplary hub that is used to receive connections from a plurality of the computer mice attached to the pushing mechanism and communicate the information to a computer system.

FIG. 3B illustrates an exemplary computer.

FIG. 3C illustrates an embodiment of the invention where a plurality of computer mice attached to the pushing mechanism transfer information concerning inventory products through a hub to a computer.

FIG. 4A illustrates an exemplary electronic tape measure.

FIG. 4B illustrates another embodiment of the invention using an exemplary electronic tape measure (or components from it) instead of a computer mouse.

FIG. 4C illustrates an exemplary electronic laser measuring device.

FIG. 4D illustrates another embodiment of the invention using an electronic laser measuring device (or components from it) instead of a computer mouse.

FIG. 4E illustrates an example of how the multiple electronic measuring tape or electronic laser measuring device is used to detect the number of inventory products on a shelf and communicate the information through a hub to a computer system.

FIG. 5A illustrates an exemplary photo cell.

FIG. 5B illustrates an exemplary light emitting diode (LED).

FIG. 5C illustrates an encoder with holes evenly placed.

FIG. 5D illustrates an encoder with holes evenly placed moving between a photo cell and a LED.

FIG. 5E illustrates another embodiment of the invention where an encoder moves between a LED and a photo cell to determine the presence or removal of the inventory products remaining on a display area.

FIG. 5F illustrates another embodiment of the invention where an encoder moves between a LED and a photo cell to determine the presence or removal of the inventory products remaining on each display area and communicate the information through a hub to a computer system.

FIG. 5G illustrates another embodiment of the invention where an encoder moves between a LED and a photo cell to determine the presence or removal of the inventory products remaining on each display area and communicate the information through a hub to a computer system which is displayed near the corresponding display area.

FIG. 5H illustrates another embodiment of the invention as illustrated in FIG. 5F, except that the invention operates wireless.

FIG. 5I is a top view of a multistation inventory control system illustrating various sensor techniques for determining the number of items on a shelf.

FIG. 7 is a front view of a portion of an encoder strip that may be used in inventory stations in a multistation inventory control system.

FIG. 8 is a top view of an inventory station using the encoder strip of FIG. 7.

FIG. 9 is a top view of an alternate embodiment of the inventory station of FIG. 8.

FIG. 10 is a front view of a rotating target used with another embodiment of the inventory station of FIG. 8.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT(S)

An improved inventory monitoring system is disclosed that allows users to keep their existing organization and display mechanism of products, yet monitors and communicates the most updated inventory of the products almost at the same time a change is made to the inventory. At the very moment a customer picks up a product and removes it from a product display space, the present inventory monitoring system would determine the number of the products remaining on the display space and transmits that information to a computer to be viewed by any user who has access to the computer, e.g., the manager of the store, an employee of the store, or the supplier of the products. The manager or any other employee of the store can react to the information by immediately replenishing the display space with a new set of the products. The supplier of the products may alert the store to order more supplies of the products.

An improved inventory monitoring system is disclosed that can be used to prevent theft. Knowing the most updated count of products displayed on the display space alert the store of a potential shoplifting. Because most shoplifters steal more than one item at a time, the significant decrease of the number of products in a short period of time will alert the store whether a potential shoplifting has taken place. Before the perpetrator leaves the store, the store security, acting based upon the most updated information, can locate and capture the perpetrator.

Such information can also be displayed near the display space to alert the employees of the number of the
products remaining on the display space along with any other relevant information about the products, such as the price, the name and the sale status, the bar code number, etc. The employees walking by the display space then can react immediately and replenish the display space with a new set of the products on the display space before the products completely run out.

[0054] An improved inventory monitoring system is disclosed that uses an electronic detection system within a product display space to detect a movement of the inventory products. The product display space comprises a pusher paddle which indicates the position of the product placed farthest from the front of the product display space. By knowing the depth of the product and detecting the movement of the inventory products displayed on the display space, the improved inventory monitoring system calculates the number of products remaining on the display space.

FIGS. 1A-2A illustrates an exemplary inventory display using a shelf 1 upon which products 2 are placed. Using dividers 3, the products 2 can be displayed more efficiently and consumers can locate products more easily. At the same time, they are esthetically pleasing to consumers. To further increase the efficiency of product display, stores typically place a plurality of the same products 2 together in a row, and thus the products 2 in a row will share the same depth. To further increase the efficiency of product display, stores use a pusher paddle 7 to move the remaining products toward the front of the display space 4. The pusher paddle 7 may be spring-powered. The spring in the spring-powered pusher paddle 7 may be flat and coiled within the pusher paddle 7. The pusher paddle 7 determines the position of the product placed farthest from the front of the display space 4.

[0055] After having determined the depth of the products 2, a user can use any of the following embodiments to detect the movement of the pusher paddle 7 and ultimately determine the most updated count of the products 2 remaining on the display space 4.

[0056] Referring now also to FIGS. 2B through 2F, one embodiment uses a computer mouse 8 to track the movement of the pusher paddle 7. The computer mouse 8 is configured to detect the movement of the pusher paddle 7 and travel the identical distance that the pusher paddle 7 travels.

[0057] The computer mouse 8 will sense any movement of the pusher paddle 7 and communicate the movement to a computer 10 which is in communication with the computer mouse 8.

[0058] As shown for example in FIG. 1G, cord 5 may be connected to the pusher paddle 7 to relay information to the electronic components to provide information on the movement of pusher paddle 7 and therefore the addition or removal of products.

[0059] Electronic wiring and displays 6 can also be used to display product information like product name, product description, prices and inventory levels, etc.

[0060] For example, in FIG. 2G, the pusher paddle 7 is placed behind three products 2 and the computer mouse 8 is placed behind the pusher paddle 7. As illustrated in FIG. 2H, after a customer has removed the product 2 placed closest to the front of the display space 4, the pusher paddle 7 travels toward the front of the display space 4 the distance identical to the depth of the product 2. Behind the pusher paddle 7 is the computer mouse 8 which has traveled the same distance as the pusher paddle 7. FIG. 2F further illustrates the further movements of the product 2, the pusher paddle 7, and the computer mouse 8, leaving only one product 2 on the display space 4. FIG. 2J further illustrates the further movement of the product 2, the pusher paddle 7, and the computer mouse 8, leaving the display space 4 empty.

[0061] As Referring now also to FIGS. 3A through 3C, the computer mouse 8 is in connection with a computer 10 to communicate the measurement of the distance that the pusher paddle 7 has traveled. Such communication will translate into a number of the products 2 remaining on the display space 4 using the pre-determined depth of the products 2. Such communication can take place through a hub 9. Also, such communication can be done wirelessly. The computer 10 then communicates the resulting number of the products 2 remaining on the display space 4 to any other computer in connection with the computer 10. The communication between the computer 10 and another computer can be wireless. Further, the computer 10 may communicate the resulting information to an electronic display 6 near the display space 4, along with other relevant information about the products, such as the price, the name, the sale status, the bar code number, etc. The communication between the computer 10 and the electronic display can be wireless.

[0062] FIGS. 4A through 4E illustrate another embodiment of using an electronic tape measure 12. The electronic tape measure 12 is configured to determine the distance that the pusher paddle 7 travels. The electronic tape measure 12 may, for example, be an electronic laser measuring device 13 such as a laser range finder. The electronic tape measure 12 is in connection with a computer 10 so that any movement of the pusher paddle 7, once determined, will be communicated to the computer 10 for users to view. The communication between the electronic tape measure 12 and the computer 10 can be wireless. The computer 10 may also be in connection with an electronic display placed near the display space so that the most updated count of the products 2 remaining on the display space 4 can be displayed, along with other relevant information about the products, such as the price, the name, the sale status, the bar code number, etc. The communication between the computer 10 and the electronic display can be wireless. The computer 10 may also be in connection with another computer so that the most updated count of the products 2 can be communicated to a remote user. The communication between the computer 10 and another computer can be wireless.

[0063] FIGS. 5A through 51 illustrates another embodiment using at least one light emitting diode (LED) 101 and at least one photocell 102 to detect the movement of an encoder 103 which is configured to correspond to the movement of the pusher paddle 107. The encoder 103 is further configured to pass between the LED 101 and the photocell 102 so that a beam of light emitted from the LED 101 can be received through the encoder 103 by the photocell 102. The encoder 103 may be made of a strip of various materials, such as plastic, rubber, metal, etc. having a plurality of holes equally spaced along the length of the
encoder 103. The encoder 103 may be made into various sizes and assume various shapes, such as rectangle, square, circle, or disk.

[0064] The encoder 103 may be slideably configured along the length of the display space to cover at least the combined depths of all the products displayed on the display space. The encoder 103 may have one end of the encoder 103 substantially in connection with the pusher paddle 107 so that the encoder 103 can move as the pusher paddle 107 moves along the length of the display space.

[0065] In one embodiment, the encoder 103 may have one end of the encoder 103 substantially in connection with one end of the spring within the pusher paddle 107 and have the other end of the encoder 103 substantially in connection with the other end of the spring within the pusher paddle 107 so that the encoder 103 can move as the pusher paddle 107 moves along the length of the display space.

[0066] The encoder 103 that is substantially in connection with the pusher paddle 107 may loop around the display space. As the pusher paddle 107 moves towards the back end of the display space, the encoder 103 moves towards the back end of the display space 104. As the pusher paddle 107 moves towards the front of the display space, the encoder 103 moves towards the front of the display space.

[0067] As illustrated in FIG. 5E, the LED 101 emits a beam of light toward the encoder 103. The holes in the encoder 103 break the beam of light from the LED 101, so that the photocell 102 sees pulses of light, instead of a continuous beam of light. With one photocell 102, the system can detect whether the pusher paddle 107 has traveled. With two photocells 102, the system can detect to which direction the pusher paddle 107 has traveled.

[0068] The rate of the pulsing is directly related to the speed of the encoder 103 which is directly related to the speed of the pusher paddle 107. Similarly, the rate of the pulsing is directly related to the distance that the encoder 103 has traveled which is directly related to the distance that the pusher paddle 107 has traveled. The pulses of light that have been received by the photocell 102 will be converted to the exact distance that the pusher paddle 107 has traveled, which will then be converted to the number of products remaining on the display space 104. Specifically, the distance that the pusher paddle 107 has traveled will be calculated by counting the pulses of lights being received and blocked through the encoder 103. The number of light pulses being received and blocked correlates to the number of the holes evenly spaced in the encoder 103 that the light has traveled through. Thus, using the number of light pulses being received and blocked can be translated to the distance that the encoder 103 has traveled, which is the distance that the pusher paddle 107 has traveled.

[0069] In another embodiment, two photocells 102 are used so that the system can detect both addition and deletion of a product to the display space. As illustrated in FIG. 5E, the LED 101 emits a beam of light toward the encoder 103. The holes in the encoder 103 break the beam of light from the LED 101 so that the photocells detect that the light has been blocked, instead of receiving a continuous beam of light. There are two photocells encased in one container. The photocells may be arranged vertically or horizontally. In vertical fashion, one photocell is on top of the other photocell. In horizontal the two are substantially side by side. Either arrangement is operable for the present inventory control system.

[0070] As the encoder 103 moves in one direction the pulses of light are detected by one photocell before the other photocell. For example, if on an X-Y axis the encoder 103 moves from 0 to 100 (positive and to the right) and one photocell is at point (1,0) and the other photocell is at (2,0), a light pulse will be first detected by the photocell at (1,0) and then by the photocell at (2,0). If the encoder 103 is moving in the opposite direction, a light pulse will be first detected by the photocell at (2,0) and then by the photocell at (1,0).

[0071] When the pusher paddle 107 moves, the encoder 103 moves along with the pusher paddle 107, changing the light being traveled though the holes in the encoder 103. Because of their horizontal alignment along the encoder 103, one photo cell will detect the change in the light being traveled through the encoder 103 before the other photocell. If the first photocell has been receiving a beam of light through one of the holes in the encoder 103, it will now detect the light being blocked by the filled-in portion of the encoder 103. If the first photocell has not been receiving light, it will now detect a beam of light traveling through one of the holes on the encoder 103, and detect that the light is now being blocked before the other photocell detects such change. The distance that the pusher paddle 107 has traveled will be calculated by counting the number of light pulses being received and blocked through the encoder 103. The number of light pulses being received and blocked correlates to the number of the holes evenly spaced in the encoder 103. Thus, using the number of light pulses being received and blocked can be translated to the distance that the encoder 103 has traveled, which is the distance that the pusher paddle 107 has traveled. The system can detect the change of direction which translates to either addition or removal of products from the display space.

[0072] The photocell 102 is in connection with a computer 110 so that any movement of the pusher paddle 107 is determined and communicated to the computer 110 for users to view and stored in a database to be used at a later time. The computer may also be in connection with an electronic display 112 placed near the display space so that the most updated count of the products remaining on the display space can be displayed, along with other relevant information about the products, such as the price, the name, the sale status, the bar code number, etc. The computer 110 may also be in connection with another computer so that the most updated count of the products can be communicated to a remote user.

[0073] Referring now to FIG. 6, multistation inventory control system 11 includes one or more multistation units 13 and 14. Multistation unit 13 may include a plurality of inventory control stations, such as inventory stations 16, 18, 20 and 22, and multistation monitor housing 66 which includes at least one monitor station for each inventory station, such as monitor stations 63, 64, 74 and 80. Each inventory station provides a location at which data from a particular column of products, such as can goods 24 in inventory station 16, may be derived by a related monitor station such as monitor station 63. Multistation unit 13 may combine a series of separate stations for communication,
such as a series of conventional pushers modified to provide information related the position of pusher paddle 7 as shown above with regard to FIGS. 1-5, or may be configured as a separate unit with one or more stations interlocked with monitor housing 66.

[0074] The nature of inventory systems is that the goods may not, and often are not, the same size at all locations even on the same shelf. Multistation unit 13, as shown in the figure, has four separate stations although a smaller or larger number of stations may be advantageous in particular applications. If inventory goods substantially larger the diameter of can goods 24 were to be stored on multistation unit 13 in addition to can goods 24, such larger can goods could be stored in station 10, while stations 18 and 20 were not used. Multistation monitor 24 may include a large number of monitor stations which provides the capability of working with a large number of inventory stations so that maximum shelf space may be utilized, but multistation monitor is sufficiently flexible so that the removal or non-installation of one or more of the stations does not alter the collection of data. Multistation monitor 24 therefore permits the sizes of the goods stored to be changed by persons stocking the shelves without requiring reprogramming or adjustment of the data collection system.

[0075] Each of the inventory stations 16, 18, 20 and 22 includes paddle 26 which pushes the goods stored to the front of the shelf as goods are purchased. Paddle 26 typically rides along track 28, on which can goods 24 may be positioned. Paddle 26 and track 28 may collectively be called pushers. Conventional pushers include a flat spring, coiled in paddle 26 and fixed at one end to the forward shelf edge 29 of track 28. Although the pushers may be provided separately from multistation monitor 24, it may be preferable to join each track 28 to multistation monitor 24 to improve the stability of both the inventory stations, that is the pushers and associated gear, and monitor 24. As discussed above, not all stations need be populated with pushers.

[0076] A typical multistation unit 13 may typically use the same type of monitor station mechanism for each inventory station. For ease of disclosure, four different types of monitor station mechanisms will be described on a single multistation unit.

[0077] Station 16 utilizes a continuous loop encoder 30 which rotates freely about forward and rearward rotation wheels 32 and 34 which are mounted for rotation at forward shelf edge 29 of track 28 and on multistation monitor 13 at monitor station 63, respectively. Wheels 32 and 34 may be positioned within or below track 28 and/or monitor 13 if convenient. Continuous loop encoder 30 is fixed to paddle 26 by anchor point 36 so that loop 30 rotates counterclockwise as paddle 26 moves forward and back indicating a decrease or increase in the number of can goods in inventory on station 16.

[0078] Referring now to FIG. 7, encoder loop 30 may conveniently be a transparent plastic strip, a portion of which is shown in the figure as encoder strip 40, on which a series of vertical bars 42 are formed and spaced apart by contrasting bars 44. The contrasting bars may be transparent and non-transparent, white and black, reflective or non-reflective or have any other contrasting relationship which permits the detection of motion of encoder 30 by photo detectors. The number of vertical bars, per unit of measure along loop 30, is preferably high enough so that rotation of loop 30 caused by the addition or removal of the smallest product to be monitored causes more than one vertical bar to pass through position detector 38 mounted to monitor 24.

[0079] Referring now to FIG. 8, position detector 38 may conveniently include a pair of photo detectors 46 and 48, such as those used in a conventional computer mouse, positioned side by side on one side of encoder strip 40. A source of light, which may be visible or infrared light such as an LED 47, is positioned on the other side of loop 30. Bars 42 and 44 are preferably transparent to the radiation from the LED 47. If the bars are not contrasting bars based on transmission of light through encoder strip 40, but are contrasting based on reflection, LED 47 may be positioned on the same side of encoder strip 30.

[0080] Although shown in the top view as extending through encoder strip 40, bars 42 and 44 may be formed on one vertical surface only. For example, black lines printed on one side of a transparent strip. As encoder strip 40 is caused to move forward or back as a result of rotation of paddle 26, one of the photo detectors will sense the transition between transparent and non-transparent bars before the other photo detector. As a result, electronic circuitry, such as detector circuit 50, may be used to generate pulses as a result of the movement of encoder strip 30 and also detect whether the motion is related to the addition or removal of inventory.

[0081] Referring again to FIG. 6 and also to FIG. 9, inventory station 18 utilizes a coiled encoder strip 52 which may be attached at one end to paddle 26 at anchor 36 and the other end is formed in coil 54 for rotation about pin 56. Movement of paddle 26 is detected by position detector 39, which may conveniently be a modified form of detector 38 that causes encoder strip 52 to change direction by 90°. This may be accomplished by positioning either or both LED 47 and/or detectors 46 and 48 in or behind a turning post or guide such as inside guide 60. Optionally, outside guide 62 may be provided, for example, between strip 52 and photo detectors 46 and 48.

[0082] Alternately, LED 47 may be positioned adjacent outside guide 62 while photo detectors 46 and 48 are positioned adjacent inside guide 60. Further, outside guide strip 52 may be guided by other turning guides and the LED and photo detectors mounted adjacent a straight section of strip 52 before or after the change in direction. Turning guides 60 and 62 must be configured to permit illumination from LED 47 to pass through (or optionally be reflected by) encoder strip 52 to reach photo detectors 46 and 48.

[0083] Still further, position detector 38 may be used without turning guides so strip 52 unwinds from coil 54 and travels in a straight line to anchor 36. This configuration requires that the width of monitor housing 66 accommodate both position detector 38 and coil 54. It is usually preferable to reduce the width of monitor housing 66 to maximize the room for inventory on the shelf, along track 28.

[0084] Encoder strip 52 may conveniently be a self coiling strip, that is, in an unrestrained state a major portion of encoder strip 52 forms itself into coil 54 which may be easily mounted or demounted from pin 56. Such strips, currently made without non-transparent bars, are made of a high quality, coiled roll of plastic film and are available, for
example, from Spring-Roll LLC in Winder, Ga. Contrasting stripes or bars may be printed directly on the Spring-Roll coiled roll or added to the coiled roll by another layer of plastic. When unrolled, at least a substantial portion encoder strip 52 will return to its original compact coiled shape, shown as coil 54.

[0085]  Forward end 58 of encoder strip 52 is configured to be anchored to paddle 26 at anchor 36 as shown for example in station 18 of FIG. 1. In a preferred embodiment, forward end 58 may include a simple thru hole, such as hole 59, which may be fastened over a protrusion on paddle 26.

[0086]  Coil 54 has a central opening permitting it to be easily slipped onto pin 56 so that coil 54 freely rotates about pin 56 when forward end 58 is not anchored. If preferred, coil 54 may be fixed to pin 56 so that it cannot slip out of place. Turning guides 60 and 62 permit coiled encoder strip 52 to be easily mounted on pin 56 and threaded through the guides for attachment to anchor 36. Monitor station 64 includes a pair of turning guides 60 and 62 and pin 56.

[0087]  Alternately, pairs of inventory and monitor stations may be configured to detect the position, or changes in position of paddle 26 along track 28 by changes in resistance or capacitance. For example, a thick film resistor may be positioned along track 28, along the flat coiled spring in each pusher, or along the shelf on which the multistation monitor is mounted and changes in the position of paddle 26 may be detected as a result of changes in the relationship between the thick film resistor and a fixed or moving contact. Similarly, the capacitance of the coiled portion of the flat spring in the pusher, or the capacitance between a fixed capacitance plate and a moving capacitance plate, one of which have a varying plate area, may be used to detect the position or changes of position of the paddle 26 with respect to track 28.

[0088]  Multistation unit 13 may include monitor housing 66 being conveniently molded from a plastic and include a plurality, such as six, monitor stations molded theon. Electronic circuitry 50, a portion of which is shown in FIG. 3, may be formed on a printed circuit board made to fit inside monitor housing 66. The LEDs and photo detectors for each monitor station, such as monitor station 64, may be mounted on the printed circuit board so that when assembled, the LEDs and photo detectors for each station are properly positioned within the appropriate turning guides 60 and 62.

[0089]  In this way, multistation unit 13 will have a plurality of monitor stations, such as stations 63, 64, 74 and 80 not all of which are activated. Each monitor station may be activated by aligning an inventory station, such as station 18, including track 28 and paddle 26, in front of that monitor station, slipping coil 54 of encoder strip 52 over post 56 and attaching forward end 58 to anchor 36. As a result, once multistation unit 13 is positioned on an inventory shelf it may be configured, and easily reconfigured, for a different number of monitor stations up to the maximum number of stations available on monitor housing 66, depending upon the sizes of the goods to be stocked or for other reasons.

[0090]  Similarly, encoder strip 52, if damaged or to be reconfigured or updated, may easily be removed by unhooking strip 52 from paddle 26, allowing strip 52 to coil as much as it will coil and removing coil 54 from pin 56 and turning guides 60 and 62. Thereafter station 64 may be re-activated by simply installing another encoder strip 52 as described above. It is important to note that installation of multistation unit 13, together with one or more of the stations 16, 18, 20 and 22, is no more complex than the installation of conventional pushers. The only additional steps required for the activation of particular monitoring stations is the insertion of self coiling encoder strip 52, and connection of leading end 58 to the appropriate pusher and connection of the appropriate communication systems. These tasks do not require substantial special training or experience so that they can easily be handled by the staff normally used to stock and restock inventory shelves.

[0091]  Referring now to FIGS. 6 and 10, inventory station 20 includes light source 72, mounted at monitor station 74 of multistation unit 13, which is aimed at target 76 at the rear of paddle 26. Monitor station 74 includes position detector 78 which receives the light reflected from target 76 and determines the current distance to paddle 26. Target 76 may include fan shaped reflector 77 mounted for rotation on paddle 26 by gear and pulley system 80, also mounted on paddle 26 and in contact with track 28. Motion of paddle 26 causes the light reflected by fan 77 to position detector 78 to be interrupted. The output of position detector 78 will then be a set of pulses which can be processed by electronic circuitry 50.

[0092]  If more than one monitor station uses a target 76 for motion detection, the light reflected from any such target may be distinguishable from the light reflected from other pushers by differently shaped or sized reflecting blades of rotating target 77. For example, the relatively wide pulses from a wide bladed version of fan 77 may be distinguished from the relatively narrow pulses of a narrow bladed version of fan 77. The distinguishable widths of pulses should be greater than the differences in pulse width resulting from the normal motion of paddle 26. When using multiple stations with rotation it may be desirable to use a single light source, such as source 72, to illuminate targets on more than one station and or a single position detector to detect the reflected light from more than one station.

[0093]  Referring now again to FIG. 6, inventory station 22 includes conventional laser light distance measuring unit or laser range finder 82, at monitor station 80 of multistation unit 13. Laser range finder technology is well known and is available, for example, from SONIN, Inc., Charlotte N.C. It can be used to detect movements of 1/8 inch, about 1 cm, or less. The complexity and resultant costs of such laser range finders may be reduced for use with multistation monitors. For example, monitor station 74 may be considered a simplified version of a light based range finder suitable for use in inventory control management.

[0094]  Laser range finder 82 is aimed at target 84 at the rear of paddle 26. Monitor station 82 may include circuitry to provide pulses to electrical circuitry 50 for compatibility with other types of monitor stations or provide a digital or analog output reflecting the absolute distance to target 84 for use by electronic circuitry 50.

[0095]  Multistation unit 13 includes a pair of communication connectors 68 which may be connected via cables 70 to other multistation units, such as unit 14, a portion of which is shown. A Daisy chain of units may be connected in this way. Power may be provided from a central source to each daisy chain via cables 70 or individually to each unit.
One end of the daisy chain is connected directly, or wirelessly, to a computer or computer network which includes software for converting the outputs of all the monitor stations into useful data related to inventory. For example, the software may count the pulses, and determine the sense, of the signals provided by the daisy chain of multistation units. Alternately, a hardware pulse counter may be provided between the daisy chain of units and the software to do this task, or circuitry 50 provided in each multistation unit could perform this task.

[0096] In certain applications, such as grocery or other stores with multiple isles, one or more daisy chained groups of multistation units, such as those along different shelves of an isle may be separately connected wirelessly to a main network to minimize installation costs and complexities. The main network may provide all processing needed for inventory control purposes using the signals from all monitor stations or transmit the raw or partially processed data to a central computer, perhaps via the Internet, for further processing, display or control.

[0097] The signals for all monitor stations within each multistation unit may conveniently be assigned to a designated channel or port so that the inventory data from each monitor station may be distinguished. In a daisy chained configuration, the most upstream unit, that is the multistation monitor closest to the computer collecting the data, may provide a sufficient number of separate channels or ports to carry data from all downstream units. Conventional circuitry, based for example on RS 232 standards, may be used to provide up to 256 separate channels. Conventional circuitry based on other standards, such as RS 485, may be used to provide a greater number of channels. Packet addressing may also be used to distinguish data from different monitor stations by adding a unique coding as an address header for each group of data sent.

[0098] The frequency of occurrence of the data is relatively low, even when shelves are being stocked so that a variety of conventional techniques may be used to forward, and distinguish, the relative position changes of each of a large number of pushers. One further piece of information for each pusher is required and may be changed whenever the inventory is relocated on the shelves. Whenever the motion to be detected from a particular pusher for a single can or other type of goods is changed, this knowledge must be made available to the system so that the particular number of pulses representing one can will properly be identified. In some applications, such as chains of stores where the arrangements of the goods on the shelves are centrally controlled, the type of goods on each shelf may be dictated centrally so that the person stocking the shelf follows a printed list provided by computer. The number of pulses representing a particular type of goods may be entered in a large database.

[0099] In other applications, such as those where the inventory arrangement is not controlled centrally, or changes rapidly, circuitry 50 may include an operating mode in which the circuitry or central computer learns the number of pulses related to a single item. This may be accomplished simply by causing the monitor unit to enter a learning mode and adding or removing a single item. Similarly an alarm or notification mode may be automatically entered whenever an item is added or removed outside of predefined parameters. That is, once the number of pulses representing a single item is accurately known by the system, an alarm may be raised when more than a predetermined number of items is removed from a shelf. This mode may be particularly useful in identifying shoplifters who often sweep the shelves by grabbing as many items at a time as possible. Similarly, the person stocking the shelves may be notified, perhaps at the end of the day when returned items are restocked, that an item of a different size than expected was added to a shelf.

[0100] Although many different embodiments have been described herein, many additional variations may made without departing from the spirit or scope of the inventions described herein which are identified in the appended claims.

I claim as my invention:

1. An inventory control system comprising:
   one or more paddles, a position of which is changed by adding or removing items to be inventoried;
   one or more encoder strips, each connected for motion with a paddle; and
   one or more detectors at least one of which is responsive to the motion of an encoder strip to determine the addition or removal of the items,

2. The invention of claim 1 wherein the one or more encoder strips each further comprise:
   an elongate member having a plurality of contrasting bars detectable by the detector associated therewith.

3. The invention of claim 2 wherein each detector further comprises:
   an illumination source; and
   a pair of photo detectors configured to detect motion and the direction of motion of the contrasting bars of the encoder strip associated therewith to determine how many items were added or how many items were removed.

4. The invention of claim 3 in which the pair of photo detectors are configured to detect the direction of motion of the encoder strip associated therewith for determining how many items were added and how many items were removed from inventory associated with the encoder strip.

5. The invention of claim 2 wherein at least one of the encoder strips forms a continuous loop mounted for rotation in response to motion of the paddle associated therewith.

6. The invention of claim 2 wherein at least one of the encoder strips forms a linear member mounted for linear motion in response to motion of the paddle associated therewith.

7. The invention of claim 6 wherein each of the encoder strips which form a linear member includes a self-coiling portion from which the linear member may automatically be extended or retracted by motion of the paddle associated therewith.

8. The invention of claim 7 further comprising:
   a post associated with each detector for mounting the self-coiling portion of an encoder strip for rotation.

9. The invention of claim 8 further comprising:
   one or more turning guides associated with each post to cause the linear portion of the encoding strip to change.
direction after being extended or retracted from the self-coiling portion mounted the post associated therewith.

10. The invention of claim 9 wherein at least some of the turning guides further comprise:

a housing for an illumination source or for a pair of photo detectors configured to detect motion of the contrasting bars of the encoder strip associated therewith to determine how many items were added or how many items were removed associated with the encoder strip.

11. The invention of claim 10 in which the pair of photo detectors are configured to detect the direction of motion of the encoder strip associated therewith for determining how many items were added and how many items were removed from inventory associated with the encoder strip.

12. The invention of claim 2 further comprising:

one or more housings,

each including a plurality of monitoring stations,

each monitoring station including a number of the plurality of detectors,

each detector including a source of illumination and one or more photo detectors configured to detect motion of the contrasting bars of an encoder strip associated therewith to determine how many items were removed from inventory associated therewith, and

each detector further including a post on which may be mounted a self-coiling portion of an encoder strip, a linear member of which is extended or retracted in response to the motion of one of the paddles;

whereby changes in the configuration of the items to be inventoried may easily be accommodated by changing the number and position of the paddles, attaching a portion of the linear member of an encoder strip to each paddle and mounting the self-coiling portion of that encoder strip on a convenient post.

13. The invention of claim 12 in which the pair of photo detectors are configured to detect the direction of motion of the encoder strip associated therewith for determining how many items were added and how many items were removed from inventory associated with the encoder strip.

14. An inventory control system comprising:

one or more paddles, a position of which is changed by adding or removing items to be inventoried, each paddle including an illumination target;

one or more sources of illumination, each illuminating one or more targets; and

one or more detectors, each responsive to light reflected from the one or more targets for detecting motion of each paddle to determine how many items to be inventoried were removed from inventory related to each such paddle.

15. An inventory control system, comprising:

a housing including a plurality of detectors, each detector including a source of illumination and one or more photo detectors configured to detect motion of the contrasting bars of an encoder strip which may be associated therewith to determine how many items were removed from inventory associated therewith, each detector further including a post on which may be mounted a self-coiling portion of an encoder strip, a linear member of which may be extended or retracted in response to the motion of a pusher associated with a subset of the items,

whereby changes in the configuration of the items to be inventoried may easily be accommodated by changing the number and position of the pushers, attaching a portion of the linear member of an encoder strip to each pusher and mounting a self-coiling portion of that encoder strip on a convenient post.

16. The invention of claim 15 wherein each detector further comprises:

one or more turning guides associated with each post to cause the linear portion of the encoding strip to change direction after being extended or retracted from the self-coiling portion mounted on the post associated therewith.

17. A method for inventory control, comprising:

providing a plurality of detectors mounted on a housing;

providing a plurality of encoding strips, one of which may be associated with each of the detectors and connected for motion with each pusher associated with items to be inventoried; and

detecting motion of the encoder strips to determine items removed from inventory.

18. The invention of claim 17 wherein detecting motion further comprises:

detecting motion of contrasting bars on the encoder strip.

19. The invention of claim 17 wherein providing the encoding strips further comprises:

providing encoding strips with self-coiling portions configured for removably mounting in association with each detector.

20. The invention of claim 19 wherein providing the encoding strips further comprises:

providing turning guides through which the encoding strips may be threaded to change direction of a linear portion of each encoding strip to reduce a dimension of the housing.

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