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RFID Tray Return System

Field of Invention

This invention makes use of Radio Frequency Identification (RFID) technology, and automation technology to improve the process of returning used food trays and utensils in any food establishments. It attempts to encourage patrons of food establishments to return used food trays on their own accord by offering incentive either in the form of money or vouchers that is dispensed automatically by the system.

Background

In food establishments like food courts, hawker centers, and fast food outlets, patrons normally dine in a self-serve manner. That is, they will queue to purchase and collect their own food or drinks on a food tray, after which they will proceed to a common area where the dining tables and chairs are located, to consume their food. After consumption of their food, patrons can choose to voluntarily return their used utensils and trays to a common collection point, or they can just leave the used utensils and trays on the table for the table cleaner to clear it for them. This conventional system has thus far been unable to effectively motivate and encourage patrons to voluntarily return their used utensils and trays, as most patrons still have the mentality that they are not rewarded for their voluntarism.

An alternative way invented by Temasek Polytechnic, would be to force patrons to return their used-trays. The food courts, hawker centers, and fast-food outlets, will only be equipped with special tables without a table-top. To use such tables for dining, a tray is essential to serve as a table-top. Before purchasing food/drinks, patrons must insert a \$1 coin into a device that is attached to each tray. This will unlock the tray from its locking mechanism, and patrons can then go ahead and order and place their food/drinks on this tray, and dine at the special tables provided, using the tray as a table-top. To redeem the \$1 coin, patrons must clear their utensils and insert the tray back to the locking mechanism, in order to retrieve back their previously deposited \$1 coin. This method is still not being adopted by the commercial world, as it is rather cold to confiscate the table-tops, and to force patrons to pay a deposit of \$1. This will very much cause displeasure to patrons, resulting in them not wanting to revisit these food establishments anymore.

In response to Singapore Government's productivity drive, and tray returning campaign, Daifuku Mechatronics has developed a tray return system in an attempt to encourage patrons return their used utensils and trays on their own accord, so as to create a better eating environment in major food establishments, and at the same time improve productivity of the table cleaners.

Summary

We believe that it is essential to offer some forms of reward in order to motivate or encourage patrons return trays voluntarily. Basing on this concept, Daifuku Mechatronics has invented a tray-return-machine that accepts a used food-tray, authenticates that it is a valid return, and dispenses a coin (can be 10 cents, 20 cents, 50 cents or 1 dollar) or voucher to reward the patron for returning the tray.

As there is a need to keep track of which trays are already returned and which are not, Daifuku Mechatronics has invented a way to uniquely identify each tray by embedding and/or attaching a RFID tag into / onto every single tray. Each RFID tag has a unique EPC (Electronic Product Code) to uniquely identify each tray in the system. The tray-return-machine is equipped with a



RFID reader and antenna to identify and authenticate the return status of each returned tray, to determine if the reward can be dispensed.

Brief Description of Drawings

For better understand of the RFID Tray Return System, three drawings are provided. The following briefly describes the content of the drawings.

FIG. 1 shows the process flow of the RFID Tray Return System.

FIG. 2 shows the various parts of a Food Tray and where the RFID Tag will be attached.

FIG. 3 shows the various components and features of the RFID Tray Return Machine.

Detailed Description

This invention is made up of three major components, namely the RFID tray, the RFID tray-return-machine and the improved process to encouraging patrons return trays voluntarily by offering tangible rewards to them.

(1) Improved Process Flow

The new process flow attempts to motivate patrons of food establishments voluntarily return used utensils and trays by offering tangible rewards like a coin (can be 10 cents, 20 cents, 50 cents or dollar) or a voucher.

FIG.1 shows the generic process flow chart. Below shows a detailed description of the improved process flow:

Process Flow (A)

- (1) Each stall will collect trays from a Tray Issuance Area, whereby these trays will be "Activated".
- (2) When a customer comes to a stall to purchase food/drinks, the stall will issue them with an "Activated" tray.
- (3) The customer go ahead to consume the food/drinks.
- (4) Upon finishing the food/drinks, the customer will proceed to the tray-return-machine.
- (5) The customer will clear the tray of all utensils in a bin provided at the side of the tray-return-machine.
- (6) The customer will deposit the cleared tray on the tray-return-machine.
- (7) Upon detection of an "Activated" tray, the tray-return machine deactivates the tray immediately, and dispense a reward (coin or voucher) to the customer.
- (8) If a "Deactivated" tray is detected by the tray-return machine upon deposit, the machine sounds off and alarm, and does not dispense the reward. This prevents abuse from customer/staff who attempts to get multiple rewards by returning the same tray over and over again.
- (9) Trays are cleaned by workers, and sent to Tray Issuance Area. This process is repeated again from step (1) onwards.

The process flow can be slightly modified to better accommodate the operations of the food establishments. Below describes one more variation to our process flow.

Process Flow (B)

- (1) Workers issue cleaned trays to each stall, These cleaned trays will always be in the "Deactivated" state.

- (2) The trays will only be "Activated" upon activation by the POS terminal of the stall upon valid customer purchase of the food from the stall.
- (3) - (8) same as that of steps (3) - (8) in Process Flow (A)
- (9) Trays are cleaned by workers, and redistributed to each stall. This process is repeated again from step (1) onwards.

(2) RFID Trays

To prevent abuse from customer/staff who attempts to return the tray over and over again to claim more rewards, there is a need to keep track of which trays are already returned and which are not, Daifuku Mechatronics has invented a way to uniquely identify each tray by embedding and/or attaching a RFID tag into / onto every single tray. Each RFID tag has a unique EPC to uniquely identify each tray in the system. The tray-return-machine is equipped with a RFID reader and antenna to identify and authenticate the return status of each returned tray, to determine if the reward can be dispensed.

Three ways are invented to attach RFID tags, that are water-proof and heat-resistant to the food-trays:

- (1) The RFID label tag is pasted directly onto one of the handles of the tray, using very strong adhesive.
- (2) An indentation is made at one of the handles of the tray, and the RFID label tag is pasted directly inside the indentation, using very strong adhesive. The RFID label tag exactly fits into the indentation's dimensions, and it is flushed with the surface of the tray handle. This prevents patrons from peeling the tag with their fingernails.
- (3) The RFID label tag is molded inside one of the handles of the tray, and is not visible and accessible from the outside.

(3) RFID Tray Return Machine

Daifuku Mechatronics has invented and developed a RFID Tray Return Machine to facilitate dispensing of tangible rewards upon returning of a valid RFID tray. FIG. 2 shows the different components of the RFID Tray Return Machine.

The Tray Return Machine comprises of a RFID antenna and a RFID reader that is capable of scanning a deposited RFID Tray to determine its unique EPC. The EPC is subsequently used to retrieve the Activation Status of this tray from the Database. The Activation Status shows whether a tray is "Activated" or "Deactivated". If the status shows that the deposited tray is "Activated", the system immediately sets it to "Deactivated", and dispense the reward through the coin-dispenser or voucher-printer. Conversely, if the status shows that the deposited tray is "Deactivated", the system halts, sounds off an alarm on the tower light and touch-screen PC, and will not dispense any reward.

At the tail of the Tray Return Machine is a detachable push-cart that will stack returned trays nicely. The push-cart has wheels for easy maneuver, and has an ergonomic design the always stack trays at the same level preventing the need for workers to bend down to offload the trays. The detachable push-cart stores up to 60 trays, and can be detached to be sent for washing. Upon detachment of the push-cart, the system will halt, and alarm sounded off at the tower light and touch-screen PC, to prevent returned trays drop on the floor. Also, when the push-cart is full, the system will halt, and sound off alarm on tower light and touch-screen PC.

The Tray Return Machine is equipped with a touch-screen PC for displaying instructions to the patrons. The PC also depict pictures showing the patrons how to correctly deposit the trays and where to collect the reward. The PC also serves as a media to display errors and warnings to the

patrons or staff. The touch-screen PC is also being utilized to display marketing information, advertisements and promotions.

The Tray Return Machine is equipped with a Tower Light that displays 3 colors to signify the different state of the machine. Green color signifies normal operation with no errors. Yellow color signifies normal operation with some warnings like low coin-level at coin-dispense, or low paper-level at printer. Red color means an error condition has occurred, and that the system has halted. The tower light is also capable of creating sounds to capture the attention of the staff in event patrons encounter problems while depositing trays in the machine. Below shows the possible error and warnings that our system is capable of displaying using tower-light or using touch-screen display:

- (1) Coin Low Level Warning
- (2) Paper Low Level Warning
- (3) Push-Cart Full Error
- (4) Push-Cart Detached Error
- (5) Tray Already Returned Alert
- (6) No RFID Tag Detected Error
- (7) Multiple RFID Tags Detected Error
- (8) Control Box Opened Alert
- (9) Tray Jam Alert
- (10) Conveyor Stopper Error Alert

An important component of the Tray Return Machine will be its ability to dispense tangible rewards. A coin dispenser or voucher printer is equipped onto the Tray Return Machine to dispense the tangible reward upon verifying that the deposited return tray is an "Activated" tray.

The body of the Tray Return Machine is made of stainless steel to prevent rust from getting onto the tray during deposit. A non-motorized conveyor is utilized to transport the returned tray from the deposit area to the RFID antenna for scanning, and subsequently to be stacked onto the push-cart. The conveyor is inclined at an angle so that trays slide on the rollers with the use of free-fall gravity. Non-motorized conveyor is utilized to improve safety amongst patrons when they are utilizing the machine.

Claims

- (1) The improved process of using tangible rewards, inclusive of coins and vouchers, to encourage patrons of food establishments to return used utensils and food-trays voluntarily.
- (2) The use of RFID (Radio Frequency Identification) tags to uniquely identify each food tray for the purpose of keeping track its activation status, so as to prevent patrons or staff from trying to get multiple rewards using the same tray.
- (3) The use of RFID (Radio Frequency Identification) readers and antennas on any tray return machines or mechanisms, to scan tags embedded inside or attached on food trays, for the purpose of checking their activation status before allowing any tangible reward be dispensed.
- (4) The use of any coin dispenser or any voucher printer or both to dispense any reward for patrons when they voluntarily return used trays and utensils to any tray return mechanism.
- (5) The use of any detachable push-cart to stack up returned trays as part of any tray return mechanism.
- (6) The use of tower light to create sound and visual alerts in any tray return mechanism.
- (7) The use any E-STOP (Emergency Stop) button to halt any tray return mechanism.
- (8) The use of any touch-screen PC, any monitors, any computers, or any displays, in any tray return mechanism, for the purpose of displaying instructions to patrons, displaying marketing/advertising information, or displaying of messages pertaining to error situations encountered by any tray return mechanism.
- (9) The use of any displays and tower light to alert users of the following errors happened in any tray return mechanism:
 - (a) Coin Low Level Warning
 - (b) Paper Low Level Warning
 - (c) Push-Cart Full Error
 - (d) Push-Cart Detached Error
 - (e) Tray Already Returned Alert
 - (f) No RFID Tag Detected Error
 - (g) Multiple RFID Tags Detected Error
 - (h) Control Box Opened Alert
 - (i) Tray Jam Alert
 - (j) Conveyor Stopper Error Alert
- (10) The use of any non-motorized conveyor as part of any tray return mechanism.
- (11) The methods of attaching RFID tags to the trays as mentioned below:
 - (a) The RFID label tag is pasted directly onto one of the handles of the tray, using very strong adhesive.
 - (b) An indentation is made at one of the handles of the tray, and the RFID label tag is pasted directly inside the indentation, using very strong adhesive. The RFID label tag exactly fits into the indentation's dimensions, and it is flushed with the surface of the tray handle. This prevents patrons from peeling the tag with their fingernails.
 - (c) The RFID label tag is molded inside one of the handles of the tray, and is not visible and accessible from the outside.
- (12) The use of any heat-resistant and water-resistant RFID tags on food-trays.