

## **AUTOMATED BIKIOSK**

### **Field of the Invention**

**[0001]** The present invention generally relates to automated dispensing technologies, and more particularly to an automated biokiosk that can be operated to store and dispense products in freezing temperatures and that can be controlled remotely.

### **Background of the Invention**

**[0002]** Many circumstances require a secured freezer dispensing system that can automatically dispense any items stored therein at any desirable time. For example, many biological and medical reagents and products have to be stored at  $-20^{\circ}\text{C}$  or colder before use. In addition, a researcher or medical practitioner may need some reagents or products at an inconvenient time.

**[0003]** A typical storage freezer used for on-site distribution mini-centers as seen in many biomedical research buildings is no more than a low temperature freezer with a lock. Usually, one or more authorized persons will have the access to the freezer. When a user or customer needs any reagents or products, he/she will request the authorized person to check whether the needed reagents or products are available; if available, the authorized person will manually unlock the freezer, open the front door of the freezer, fetch the requested reagents or products, close the front door, lock the freezer, and log in the transaction. This standalone storage freezer apparently has some disadvantages. One is that at least one authorized person must be assigned for giving out the reagents/products and keeping track of all transactions manually. This will lead to human errors, and inconvenience where the authorized person is not available when a reagent or product is needed from the freezer. Another one is that the manual process of retrieving a reagent or product will cause moisture condensation on the front door and in the chamber of the freezer, resulting in frozen ice in the freezer and deterioration of the stored reagents and products.

**[0004]** US 6,393,339 discloses a computerized stock control system that includes a refrigerated carousal dispensing station. While it mentions that the dispensing station may have a freezer cabinet, the carousal dispensing station is no more than a conventional vending machine. In use, a suspended product is removed from the carousel by a “kicker arm” that kicks the product from the slot of the carousel. This carousel encounters a problem of “mis-kicking” a product. The design of the carousel only allows restocking outside of the dispensing station when the whole carousel is taken down from the motor shaft and out of the station. In addition, the design is very restrictive of types and sizes of product packaging allowed and products have to be re-packaged to be sold via these units. Furthermore, it has no concern about minimizing the air interchange between the cabinet and the external environment. In practice, minimizing the fluctuation of the temperatures in a freezer is crucial for maintaining the quality of the reagents and products stored therein.

**[0005]** US 2005/0060063 A1 discloses an automated item dispensing system that includes a dispenser enclosed by walls and main dispenser door. Within the dispenser is a multi-layer carousel, where each carousel is aligned with a respective access hatch which permits access to a single cell. The access hatch is a small door allowing items being stocked into the cell and taken out from the cell. While this design may reduce the loss of cold air or entry of warm humid air into the dispenser chamber in comparison with conventional vending machine, the opening/closing of the access hatches still affects the internal environment greatly. In addition, the stocking has to be done for each cell with an open access hatch; it will cause moisture condensation and temperature fluctuation within the cabinet, resulting in detrimental effects to the stored reagents and products.

### **Summary of the Invention**

**[0006]** Therefore, there is an imperative need of an automated dispensing system that can store any items in a controlled environment and dispense the stored items in such a way that the controlled environment is minimally affected, maintaining the quality of the stored items.

**[0007]** In one aspect of the present invention, there is provided an automated dispensing system that comprises a front frame, two side walls, a rear wall with a plurality

of shaft channels, a top wall, a bottom wall, wherein the front frame, the two side walls, the rear wall, the top wall, and the bottom wall form a chamber, and a plurality of automated coil tray dispensers disposed within the chamber; wherein each of the plurality of automated coil tray dispensers comprises a motor, a motor shaft, and a dispensing coil; wherein the motor shaft is disposed within the shaft channel of the rear wall so that the motor is disposed outside of the chamber; and wherein, when the motor shaft is turned by the motor, it will in turn drive the dispensing coil, resulting in the dispense of a product from the dispensing coil. In one embodiment, the automated dispensing system further comprises one or more doors that are disposed onto the front frame to provide access to the chamber. In another embodiment, in the automated dispensing system, the plurality of automated coil tray dispensers form rows and columns.

**[0008]** In another embodiment, in each of the plurality of automated coil tray dispensers, one end of the motor shaft has a symmetric pair of protrusions, and one end of the dispensing coil has a slot; thereby the dispensing coil is detachably engaged with the motor shaft so that the dispensing coil can be detached from the motor shaft and replenished outside of the chamber. In yet another embodiment, each of the plurality of automated coil tray dispensers further comprises a dispensing tray within which the dispensing coil is disposed.

**[0009]** In another aspect, the automated dispensing system further comprises a plurality of rows of racks disposed within the chamber and fixed at both ends to the side walls; wherein the plurality of the coil tray dispensers are supported by the plurality of rows of racks. In one embodiment, in each of the plurality of automated coil tray dispensers, both ends of the motor shaft have a bushing. In another embodiment, underneath of the bushing, one or two O-rings are disposed below the bushing.

**[0010]** In yet another aspect, the automated dispensing system further comprises an auto-retractable collection tray having a compartment for collecting products dispersed by the automated coil tray dispenser. In one embodiment, the auto-retractable collection tray comprises a tray with a front panel enabling a user to open the collecting tray, and a shallow recess collecting the items; and a door closer assembly connecting the front frame and a metal frame disposed below the bottom wall. In another embodiment, the door closer assembly consists of two linkage levers that connect the door closer; wherein these two linkage levers provide the stroke for opening the collection tray.

**[0011]** In yet another aspect, the automated dispensing system further comprises one or more compartments above the top wall, wherein the top compartments are used to house the freezer unit such as air blower, fans, power supply unit, and compressor.

**[0012]** In yet another aspect, the automated dispensing system further comprises a computer-controlled DC motor dispensing system which uses a matrix coupling control.

**[0013]** In yet another aspect, the automated dispensing system further comprises a PC, a GUI, a Database, and a backup power supply; wherein the GUI provides an interface by which a user can access the dispensing system. In one embodiment, the PC is embedded with necessary computer programs enabling the user to access the dispensing system via internet or SMS.

**[0014]** One advantage of the present invention is that the dispensing system allows remote connection from anywhere which has the pre-determined access rights.

**[0015]** Another advantage of the present invention is that the dispensing system is automated to provide 24 hours solution for the patrons allowing them to purchase their desired biomedical products anytime. The transaction is automatically logged and keep tracked in database. The administrator can then retrieve the database from either remote or on site.

**[0016]** Yet another advantage of the present invention is that the automated dispensing system is a computer-controlled storage freezer operates at -20 degrees Celsius and below that could perform large storage of biomedical products typically enzymes.

**[0017]** Yet another advantage of the present invention is that the automated dispensing system allows the user or customer to select the desired biomedical products and quantity through its software graphic user interface (GUI) and the automated dispensing system will dispense or dispatch the desired biomedical product.

**[0018]** Yet another advantage of the present invention is that a software database inside the computer will keep track all transactions occurred, records and updates the necessary information in the the automated dispensing system.

**[0019]** The objectives and advantages of the invention will become apparent from the following detailed description of preferred embodiments thereof in connection with the accompanying drawings.

### Brief Description of the Drawings

[0020] Preferred embodiments according to the present invention will now be described with reference to the Figures, in which like reference numerals denote like elements.

[0021] FIG 1 is a front perspective view of the automated dispensing system in accordance with one embodiment of the present invention.

[0022] FIG 2 is a back perspective view of the automated dispensing system as shown in FIG 1 without the back cover and the top cover.

[0023] FIG 3A is a front-back cross-sectional view of the automated dispensing system as shown in FIG 1.

[0024] FIG 3B is a side-side cross-sectional view of the automated dispensing system as shown in FIG 1.

[0025] FIG 4 shows an illustrative view of the coil tray dispenser rows installed in the housing of the automated dispensing system in accordance with one embodiment of the present invention.

[0026] FIG 5 shows an exemplary row of the coil tray dispenser in accordance with one embodiment of the present invention.

[0027] FIG 6 is an exploded view of the coil tray dispenser in accordance with one embodiment of the present invention.

[0028] FIG 7 shows a perspective view of the auto-retractable collection tray in accordance with one embodiment of the present invention.

[0029] FIG 8 is block functional diagram of the computer-controlled matrix-coupled DC motor dispensing system for controlling the coil tray dispensers in accordance with one embodiment of the present invention.

[0030] FIG 9 is an exemplary circuit of the computer-controlled matrix coupled DC motor dispensing system in accordance with one embodiment of the present invention.

[0031] FIG 10 is a block diagram of the automated dispensing system architecture for communication and control in accordance with one embodiment of the present invention.

### **Detailed Description of the Invention**

**[0032]** The present invention may be understood more readily by reference to the following detailed description of certain embodiments of the invention.

**[0033]** Throughout this application, where publications are referenced, the disclosures of these publications are hereby incorporated by reference, in their entireties, into this application in order to more fully describe the state of art to which this invention pertains.

**[0034]** In the following detailed description, specific details are set forth in order to provide a thorough understanding of the invention. However, it will be understood by those skilled in the relevant art that the present invention may be practiced without these specific details. In other instances, well-known methods, procedures, components, and materials have not been described in detail so as not to obscure the present invention.

**[0035]** The present invention provides an automated dispensing system that has unique designs so that the system can store and dispense frozen products in an automated manner. More importantly, the automated dispensing system has minimized internal/external air interchange during the dispensing process; the stored products will be minimally affected, guaranteeing the quality of the stored products.

**[0036]** In accordance with one embodiment of the present invention, there is provided a Biokiosk 1 as shown in FIG 1 and FIG 2 that comprises a front frame 2, two side walls 3, 4, a rear wall 5, a top wall 6, and a bottom wall 7, wherein the front frame 2 is disposed with two doors, and front doors and all the walls form a housing. It is to be noted that while the chamber as shown in FIG 1 and FIG 2 is in the shape of a cubicle, the shape of the chamber is not critical for the present invention. Any other shape may be designed to have the same functions. In addition, the front frame could be installed with one door either covering a portion of the front frame or the whole front frame when the front frame has a portion opening or an opening spanning the whole front frame respectively.

**[0037]** All the walls may be made from any suitable insulating materials that have the mechanic strength so as to sustain the freezing temperature within the housing. In one embodiment, the walls are made of three-layered sandwich structured panels. For example, the outside layers may be made of any suitable metals and the middle layer of insulating materials.

**[0038]** Now referring to FIGS 1- 4, the Biokiosk further comprises a plurality of automated coil tray dispensers **10** disposed within the chamber. In one embodiment, the plurality of automated coil tray dispensers **10** form conventional rows and columns. It is to be appreciated that the practice of the present invention is not limited to any specified number of rows and columns. In addition, the arrangement of the plurality of the dispensers may be designed in any way suitable for one's purpose.

**[0039]** Now referring to FIG 6, there is provided an exploded view of a single automated coil tray dispenser **10** in accordance with one embodiment of the present invention. The single coil tray dispenser **10** comprises a motor **11**, a motor shaft **12**, and a dispensing coil **13**. One end of the motor shaft **12** is connected with the motor **11** so that when the motor starts to run, it will turn the motor shaft **12** in a predetermined speed and direction for a certain distance. The other end of the motor shaft has a symmetric pair of protrusions **14** detachably fitting into the slot **15** located at one end of the dispensing coil **13**. The detachable engagement between the motor shaft **12** and the dispensing coil **13** may also be achieved by any other means known to those skilled in the art. The detachable engagement provides the advantage of replenishing products outside the chamber so as to minimize the external/internal air exchange. When the motor shaft **12** is turned by the motor **11**, it will in turn drive the dispensing coil by a predetermined distance (turning 360°), resulting in the dispense of one product from the dispensing coil. In this way, when different pitches of the dispensing coils accommodate different sizes of products, the same motor operation can dispense different sized products without modification of the motor operation.

**[0040]** Still referring to FIG 6, the coil tray dispenser **10** may further comprise a dispensing tray **17** within which the dispensing coil may be disposed. The dispensing tray may serve multiple functions. For example, the dispensing tray may prevent the stored products from sliding out of the dispensing coil. In addition, the dispensing tray may serve a separator between two coil tray dispensers. More importantly, the detachable dispensing coil/tray units enable a user to do refill outside of the Biokiosk; it will minimize the air interchanges between the chamber and the external environment.

**[0041]** Now referring to FIG 5, there is provided an exemplary row of the coil tray dispenser in accordance with one embodiment of the present invention. The dispensing trays are supported by a rack **18** that is disposed within the chamber and fixed at both ends

to the side walls. The rack can be made of any suitable material and made into any suitable shape and configuration as long as it can support the row of the coil tray dispensers.

**[0042]** Now referring back to FIGS 1-4, the plurality of rows of the coil tray dispensers are supported by a plurality of rows of racks disposed within the chamber. The number of the coil tray dispensers that can be disposed on a rack is flexible. A user may determine the number of the coil tray dispensers in a rack by considering the size of the dispensing coils, the distances between two coil tray dispensers and the dimensions of the housing. Apparently, the principles of the present invention do not limit to any particular sizes or pitches of coil dispensers that can be implemented.

**[0043]** When a vending machine operates in an ambient temperature environment, the disposition places of the motors are not important. However, when the motors are operated in a frozen environment, their performances will be impaired. In addition, the motors that can operate at frozen environments are expensive. In order to have better performance and cost-saving in employing inexpensive components, the present invention in one embodiment provides that the motors are disposed outside of the housing so that the motors can operate at an ambient temperature environment. As shown in FIG 4, a plurality of motor shaft tunnels are provided in the rear wall. The motor shaft **12** of each coil tray dispenser penetrates one motor shaft tunnel so that the motor will be located outside of the chamber and the dispensing coil/tray inside of the chamber. Referring back to FIG 6, both ends of the motor shaft have a bushing **19**. Without proper insulation, the motor shaft tunnel will become a source for the loss of coolness of the housing and the condensation and moisture formed on the rear wall. The condensation and moisture are detrimental to the motor assemblies and cable wiring, resulting in short circuiting. In one embodiment, the insulation placed upon the shaft is a bushing. The bushing can be placed in any one end of the motor shaft or both ends of the motor shaft. For better insulation, one or two O-ring **16** may be disposed below the bushing, where there are grooves on the motor shaft to guide the O-rings. In addition, a sensor system may be disposed at the junction between the motor and the motor shaft so that it can synchronize the movement of the motor and the motor shaft.

**[0044]** Referring now to FIG 7, the Biokiosk further comprises an auto-retractable collection tray. The auto-retractable collection tray **20** has a compartment for collecting items dispersed by the automated coil tray dispenser. The collection tray **20** comprises a

tray **21** with a front panel enabling a user to open the collecting tray, and a shallow recess collecting the items; and a door closer assembly **22** connecting the front frame and a metal frame disposed below the bottom wall. The metal frame may be an integral part of the side walls, the rear wall and the front frame. There are rubber seals disposed onto the inner side of the front panel of the tray so that the rubber seals help to provide cushion effect to the door, to prevent condensation at the collection tray opening, and to stop moisture to flow out to the outer wall of the Biokiosk. The door closer provides an auto-closing mechanism. The auto-closing mechanism consists of two linkage levers that connect the door closer. These two linkage levers will provide the stroke for opening the collection tray. The speed of retracting the collection tray can be adjusted by turning a screw on the door closer.

**[0045]** Referring back to FIGS 1-3B, the Biokiosk further comprises one or more compartments above the top wall. The top compartments may be used to house the freezer unit such as air blower, fans, power supply unit, and compressor.

**[0046]** Now there is provided a brief description of the operations of the coil tray dispensers. The merchandise is kept ready in horizontally in the dispensing coils that are rotatable in motor-driven fashion about their longitudinal axis. The dispensing coils are rotated when the appropriate merchandise would have been selected in the operating control system discussed in detail hereinafter. By rotation of the appropriate dispensing coil, the forwardmost merchandise package of the selected merchandise is moved forwardly by a certain amount toward the front opening, whereafter it falls into the auto-retractable collection tray, from which it can then be taken out by a user

**[0047]** Referring back to FIG 1, the two front doors are hinged into the front frame. On one front door is disposed with a control and display panel. The control and display panel shows the information including the keys for selecting any coil tray dispenser and status of the availability of each stock.

**[0048]** Referring now to FIG 8, the automated dispensing system further comprises a computer-controlled DC motor dispensing system which uses a matrix coupling control. The matrix coupling control will help to reduce input/output (I/O) pins for motor control and sensor feedback. In addition, cable connection is reduced many times and is much simpler and neater. The number of motors and sensors pairings can be as scalable to any size, i.e. the system can be re-configured into any number of combinations of columns and rows as long as they could fit into the freezing chamber. FIG 9 is an exemplary circuit of

the computer-controlled matrix coupled DC motor dispensing system in accordance with one embodiment of the present invention.

**[0049]** The matrix-coupled control system is controlled through PC by using a PCI digital IO control card. In a nutshell, the control flow could be described by using the system architecture shown in FIG 10. The system architecture comprises the dispensing system 1, a PC 31, a GUI 32, an SMS modem 33, a Mobile device 34, an Internet access 35, an Onboard LAN 36, a Database 37, and a backup power supply 38. Both patrons and administrator have access to the dispensing system by the PC via the GUI, where the PC is equipped with capacities of connecting with SMS and internet.

**[0050]** The PC and control compartment may house a computer with keyboard and mouse, and network and SMS capability, a UPS backup power supply, a receipt printer, a barcode scanner, an input card and an output card, a PCI digital IO controller card installed in the computer, and a GSM modem attached to PC.

**[0051]** The Bio-Kiosk came with network or Internet capabilities; therefore it could be able to be access through network or Internet with pre-assigned access rights. Status of the Automated BioKiosk can also be known anytime, anywhere with remote access. The possible tasks that would be able to be performed through Internet access include inventory check, inventory low alert, customer orders, files and database transfer, and emails.

**[0052]** The Bio-Kiosk is also capable of alerting the administrator or anyone pre-assigned through the wireless telecommunication short messaging system (SMS) by using the GSM modem that is attached through the PC. The Bio-Kiosk will alert the administrator in the following events: power trip/ breakdown, low inventory, no stock, and email orders.

**[0053]** The PCI digital IO control card in the PC could trigger output signals to the output card to turn on or off the DC motors, and on the other hand, it can also detect the triggering of input signals of the sensors through the input card. Finally, the use of IO ports and cost are reduced greatly by using the new system.

**[0054]** While the present invention has been described with reference to particular embodiments, it will be understood that the embodiments are illustrative and that the invention scope is not so limited. Alternative embodiments of the present invention will become apparent to those having ordinary skill in the art to which the present invention pertains. Such alternate embodiments are considered to be encompassed within the spirit

and scope of the present invention. Accordingly, the scope of the present invention is described by the appended claims and is supported by the foregoing description.

## CLAIMS

What is claimed is:

1. An automated dispensing system, comprising:
  - a front frame;
  - two side walls;
  - a rear wall with a plurality of shaft channels;
  - a top wall;
  - a bottom wall; wherein the front frame, the two side walls, the rear wall, the top wall, and the bottom wall form a chamber; and
  - a plurality of automated coil tray dispensers disposed within the chamber; wherein each of the plurality of automated coil tray dispensers comprises a motor, a motor shaft, and a dispensing coil; wherein the motor shaft is disposed within the shaft channel of the rear wall so that the motor is disposed outside of the chamber; and wherein, when the motor shaft is turned by the motor, it will in turn drive the dispensing coil, resulting in the dispense of a product from the dispensing coil.
2. The automated dispensing system of claim 1, further comprises one or more doors that are disposed onto the front frame to provide access to the chamber.
3. The automated dispensing system of claim 1, wherein the plurality of automated coil tray dispensers form rows and columns.
4. The automated dispensing system of claim 1, wherein in each of the plurality of automated coil tray dispensers, one end of the motor shaft has a symmetric pair of protrusions, and one end of the dispensing coil has a slot; thereby the dispensing coil is detachably engaged with the motor shaft so that the dispensing coil can be detached from the motor shaft and replenished outside of the chamber.

5. The automated dispensing system of claim 1, wherein each of the plurality of automated coil tray dispensers further comprises a dispensing tray within which the dispensing coil is disposed.
6. The automated dispensing system of claim 1, further comprises a plurality of rows of racks disposed within the chamber and fixed at both ends to the side walls; wherein the plurality of the coil tray dispensers are supported by the plurality of rows of racks.
7. The automated dispensing system of claim 1, wherein in each of the plurality of automated coil tray dispensers, both ends of the motor shaft have a bushing.
8. The automated dispensing system of claim 7, wherein underneath of the bushing, one or two O-rings are disposed below the bushing.
9. The automated dispensing system of claim 1, further comprises an auto-retractable collection tray having a compartment for collecting products dispersed by the automated coil tray dispenser.
10. The automated dispensing system of claim 9, wherein the auto-retractable collection tray comprises a tray with a front panel enabling a user to open the collecting tray, and a shallow recess collecting the items; and a door closer assembly connecting the front frame and a metal frame disposed below the bottom wall.
11. The automated dispensing system of claim 10, wherein the door closer assembly consists of two linkage levers that connect the door closer; wherein these two linkage levers provide the stroke for opening the collection tray.
12. The automated dispensing system of claim 1, further comprises one or more compartments above the top wall, wherein the top compartments are used to house the freezer unit such as air blower, fans, power supply unit, and compressor.

13. The automated dispensing system of claim 1, further comprises a computer-controlled DC motor dispensing system which uses a matrix coupling control.
14. The automated dispensing system of claims 1, further comprises a PC, a GUI, a Database, and a backup power supply; wherein the GUI provides an interface by which a user can access the dispensing system.
15. The automated dispensing system of claim 14, wherein the PC is embedded with necessary computer programs enabling the user to access the dispensing system via internet or SMS.