



- (51) International Patent Classification:
A61J 7/02 (2006.01) A61J 7/04 (2006.01)
A61G 12/00 (2006.01)
- (21) International Application Number:
PCT/CA2015/050591
- (22) International Filing Date:
25 June 2015 (25.06.2015)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:
62/017,088 25 June 2014 (25.06.2014) US
- (71) Applicant: MEDIPENSE INC. [CA/CA]; 9145 rue Boivin, Montréal, Québec H8R 2E5 (CA).
- (72) Inventor: FAGEN, Terry; 2447 Soprano, Montréal, Québec J7T 3L2 (CA).
- (74) Agent: ROBIC, LLP; 1001, Square-Victoria Bloc E - 8th floor, Montréal, Québec H2Z 2B7 (CA).

- (81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.
- (84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

[Continued on next page]

(54) Title: SYSTEM AND METHOD FOR THE DISPENSING OF PILLS

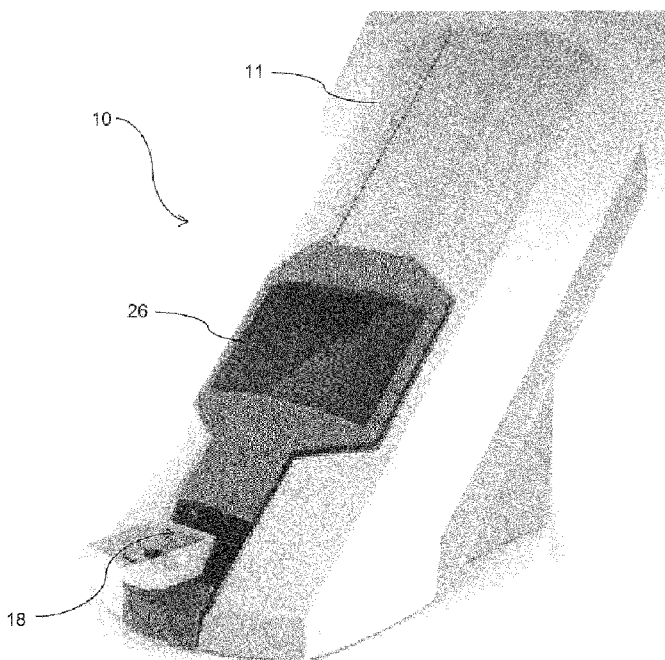


Figure 1

(57) Abstract: A pill dispensing system is provided. In an embodiment, the system comprises a pill release mechanism, a reader for reading an array-type pill package identifier; and a processing unit in communication with the pill release mechanism and the reader. The processing unit comprises a module to acquire the array-type pill package identifier; a module to obtain dispensing information using the acquired identifier; a module to match the package user ID with a system user ID associated with the system; and a module to, upon a match of the package user ID and the system user ID, operate the pill release mechanism to release pills. A method and a computer readable medium are also provided for operating a pill dispensing system.

WO 2015/196293 A1

Declarations under Rule 4.17:

— *of inventorship (Rule 4.17(iv))*

Published:

— *with international search report (Art. 21(3))*

SYSTEM AND METHOD FOR THE DISPENSING OF PILLS

FIELD OF THE DISCLOSURE

[0001] The present disclosure relates to a system and method for the dispensing of pills, and more specifically to a personal pill-dispensing system and method of use thereof
5 that ensures that patients or seniors take the correct medication on time.

BACKGROUND OF THE DISCLOSURE

[0002] There are many types of medication packages provided with a plurality of independent or individual small containers connected to one another at a common top surface thereof. Each individual container contains a predetermined set of medication
10 pills to be taken a specific day, and at a predetermined time by the patient. These type of packages are usually prepared in advance by a pharmacist or other health professional and it is the responsibility of the patient, or a care provider thereof (as a relative, spouse, visiting health professional, etc.), to take each set of pill(s) at the right time, the right day, and not to make any mistake on the specific individual container it is time to open.

15 [0003] On the other hand, in order to prevent the loss, the unintentional mix and/or the non-taking (omission or forgetting) of the medication at the proper time/day, there exist automatic medication dispensers. Among these dispensers, individual dispensers, located at the patient living place, are typically filled with one, two or three predetermined pills that would be distributed to the patient whenever required but are not adapted to
20 function with multiple individual container packages arranged into an array-type configuration with all containers extending on a same side of a common (top) surface. To access the pills of a specific individual container, the patient typically needs to tear off the container from the array of containers and then peel off, with difficulty, the top to release the pills, or to perforate the top with a sharp tool or the like.

25 [0004] The individual containers can all be simultaneously opened with a specific apparatus that would chop the entire top surface off using an elongated knife. Such an apparatus is only used by pharmacists that would have to recuperate all unused pills or simply for refill into another package, and would be useless to a patient.

[0005] Accordingly, there is a need for an improved dispenser for array-type pill packages.

SUMMARY OF THE DISCLOSURE

5 [0006] It is therefore a general object of the present disclosure to provide a personal pill-dispensing system that helps patients or seniors take the correct medication on time.

[0007] An advantage of embodiments of the present disclosure is that the pill-dispensing system helps ensure that patients, especially seniors living alone at home, take the correct medication on time and notifies caregivers if they miss a dose.

10 [0008] Another advantage of embodiments of the present disclosure is that the pill-dispensing system, by monitoring the medication input of the patient or senior, can reduce the risk of medication non-compliance, prolongs life and time spent at home for the patient, and reduce the cost to government and insurance.

15 [0009] According to an aspect, a pill dispensing system for dispensing pills to a user is provided, said pills being located in individual scheduled containers of an array-type pill package provided with an identifier. The pill dispensing system includes: a pill release mechanism; a reader for reading the array-type pill package identifier; and a processing unit in communication with the pill release mechanism and the reader. The processing unit includes: an identifier acquisition module configured to acquire the array-type pill package identifier from the reader; an identifier interpretation module configured to
20 obtain a package user ID, a layout format information and a pill distribution schedule using the acquired identifier; a matching module configured to match the package user ID with a system user ID associated with the system; and a dispensing module configured to, upon a match of the package user ID and the system user ID, operate the pill release mechanism to release pills from at least one of the scheduled containers of
25 the array-type pill package in accordance with the layout format information and the pill distribution schedule.

[0010] In an embodiment, the package user ID corresponds to a patient to whom the pills in the array-type pill package are prescribed.

[0011] In an embodiment, the system user ID corresponds to a patient associated with the pill dispensing system.

[0012] In an embodiment, the package user ID corresponds to a patient to whom the pills in the array-type pill package are prescribed, the system user ID corresponds to a patient associated with the pill dispensing system and the matching module is configured to match the patient associated with the system with the patient to whom the pills in the array-type pill package are prescribed.

[0013] In an embodiment, the dispensing module is configured to prevent operation of the pill release mechanism if the pills in the array-type pill package are not prescribed to the patient associated with the pill dispensing system.

[0014] In an embodiment, the scheduled containers are ordered in the array-type pill package and the pill release mechanism is configured to release pills from the at least one of the scheduled containers out of order.

[0015] In an embodiment, the layout format information includes a position of the scheduled containers in the array-type pill package in relation to their order.

[0016] In an embodiment, the dispensing module is configured to operate the release mechanism to skip at least one of the individual scheduled containers in the array-type pill package when releasing pills from another one of the individual scheduled containers in the array-type pill package.

[0017] In an embodiment, the pills dispensed from the at least one of the scheduled containers correspond to an early dose, wherein the identifier interpretation module is further configured to obtain an early dosage permission indicator from the acquired identifier, and wherein the processing unit further includes an early dose verification module configured to verify that the early dosage permission indicator indicates that the early dose is permitted.

[0018] In an embodiment, the pills dispensed from the at least one of the scheduled containers correspond to doses during an anticipated absence, the dispensing module being configured to operate the release mechanism to release pills from a plurality of scheduled containers corresponding to a period of anticipated absence of the user.

[0019] In an embodiment, the pill distribution schedule includes a day and a time during which the pills in the scheduled containers are to be dispensed to the user.

[0020] In an embodiment, the dispensing module is configured to automatically operate the pill release mechanism when a current day and time correspond to the day and time
5 during which the pills in the scheduled containers are to be dispensed to the user.

[0021] In an embodiment, the pill dispensing system further includes a camera configured to capture images of at least one of the releasing and dispensing of pills from the at least one of the scheduled containers.

[0022] In an embodiment, the processing unit further includes an image analysis module
10 configured to analyze the images captured by the camera and validate that the pills were correctly released or dispensed.

[0023] In an embodiment, the reader includes a Radio-Frequency Identification (RFID) reader configured to read the array-type pill package identifier from an RFID chip in the array-type pill package.

15 [0024] In an embodiment, the reader includes an optical sensor for reading the array-type pill package identifier.

[0025] In an embodiment, the optical sensor includes a barcode scanner or a Quick Response (QR) code scanner for reading a barcode or a QR code on the array-type pill package.

20 [0026] In an embodiment, the optical sensor includes a camera for capturing an image of text on the array-type pill package.

[0027] In an embodiment, the identifier interpretation module is configured to optically recognize characters in the image of text in order to obtain at least one of the package user ID, the layout format information and the pill distribution schedule.

25 [0028] In an embodiment, the identifier interpretation module is configured to optically recognize the characters in a plurality of different languages.

[0029] In an embodiment, the pill package identifier includes a link to a remote system, and the processing unit further includes a remote communications module configured to retrieve at least one of the package user ID, the layout format information and the pill distribution schedule from the remote system.

5 [0030] In an embodiment, the processing unit further includes a user interface module.

[0031] In an embodiment, the user interface module is configured to initiate at least one of a visual prompt and an audible prompt indicating to the user that it is time to take their medication.

10 [0032] In an embodiment, the user interface module is configured to initiate at least one of a visual prompt and an audible prompt indicating to the user that they missed a dose of medication.

[0033] In an embodiment, the user interface module is configured to display a visual indicator corresponding to the system user ID, the visual indicator allowing the user to recognize that the system user ID is associated to said user.

15 [0034] In an embodiment, the visual indicator includes at least one of a name of the user and a picture of a face of the user.

[0035] In an embodiment, the processing unit further includes a proximity sensing module configured to detect a user in proximity to the pill dispensing system and activate the user interface in response thereto.

20 [0036] In an embodiment, the dispensing module is configured to wait for a user dispense command signal before operating the pill release mechanism to release pills from the at least one of the scheduled containers.

[0037] In an embodiment, the dispensing module is configured to receive a user confirmation signal confirming that the dispensed pills were taken by the user.

25 [0038] In an embodiment, the user interface module is configured to generate at least one of the user dispense command signal and the user confirmation signal in response to a user interaction with the interface module.

[0039] In an embodiment, the pill dispensing system is operable between an open state wherein the pill dispensing system is configured to receive at least one array-type pill package, and a closed state wherein the pill dispensing system is configured to dispense pills from the at least one array-type pill package.

5 [0040] In an embodiment, the processing unit further includes a sensing module configured to detect whether the pill dispensing system is in the open state or the closed state, the identifier acquisition module being configured to wait for the pill dispensing system to be in the closed state before acquiring the pill package identifier from the reader.

10 [0041] In an embodiment, the user interface module is configured to initiate at least one of a visual prompt and an audible prompt indicating to the user that the pill dispensing system is in the open state.

[0042] In an embodiment, the processing unit further includes an input/output interface module configured to send an alert to a caregiver in response to the user not taking its
15 medication within a predefined amount of time.

[0043] In an embodiment, the pill dispensing system further includes a user portable component in wireless communication with the processing unit, the user portable component providing emergency notifications and indicating to the user that it is time to take their medication.

20 [0044] In an embodiment the processor further includes a user identification module configured to identify the user and validate that the package user ID and the system user ID are associated with the user.

[0045] In an embodiment, the system further includes an RFID reader operable by the user identification module, the user identification module being configured to read an
25 RFID tag through the RFID reader and validate that the RFID tag corresponds to the package user ID and the system user ID.

[0046] In an embodiment, the RFID tag is embedded in a hospital wristband issued to the user.

[0047] According to an aspect, a method is provided for dispensing pills from individual scheduled containers of an array-type pill package provided with an identifier. The method includes the steps of: a) providing a pill dispensing system including a pill release mechanism and a reader; b) loading the array-type pill package in the pill dispensing system; c) reading the array-type pill package identifier using the reader; d) obtaining a package user ID, a layout format information and a pill distribution schedule using the pill package identifier; e) matching the package user ID with a system user ID associated to the pill dispensing system; and f) upon a match of the package user ID and the system user ID, operating the pill release mechanism of the pill dispensing system to release pills from at least one of the scheduled containers of the array-type pill package in accordance with the layout format information and the pill distribution schedule.

[0048] In an embodiment, the array-type pill package identifier is generated by a pharmacist.

[0049] In an embodiment, the method further includes an initial step of detecting that the pill dispensing system is in an open state, and waiting for the pill dispensing system to be in a closed state before continuing from step a).

[0050] In an embodiment, step b) includes optically recognizing characters in the pill package identifier in order to obtain at least one of the package user ID, the layout format information and the pill distribution schedule.

[0051] In an embodiment, the method further includes the step of receiving a user input corresponding to a pill dispense command prior to proceeding with step d).

[0052] In an embodiment, the scheduled containers of the array-type pill package are ordered, and wherein in step d), the pill release mechanism is operated to release pills from the at least one of the scheduled containers out of order.

[0053] In an embodiment, the pills released from the at least one of the scheduled containers out of order corresponds to an early dosage, the method further including the step of verifying if the acquired identifier includes an early dosage permission prior to proceeding with step d).

[0054] In an embodiment, the method further includes the step of capturing an image of the pills released from the at least one of the scheduled containers to confirm that the pills were properly released.

[0055] In an embodiment, the method includes the steps of identifying a user using an
5 RFID tag embedded in a hospital wristband issued to said user, and validating that the user is associated with the package user ID and the system user ID.

[0056] According to an aspect, a computer readable medium is provided which includes instructions executable by a processor in a pill dispensing system for dispensing pills located in individual scheduled containers of an array-type pill package provided with an
10 identifier. The instructions cause the processor to perform the steps of: acquiring the array-type pill package identifier using a reader; obtaining a package user ID, a layout format information and a pill distribution schedule from the acquired identifier; matching the package user ID with a system user ID associated with the pill dispensing system; and upon a match of the package user ID and the system user ID, operating a pill
15 release mechanism to release pills from a at least one of the scheduled containers of the array-type pill package in accordance with the layout format information and the pill distribution schedule.

[0057] According to an aspect, there is provided a pill dispensing system for dispensing pills located into individual containers of an array-type pill package provided
20 with an identifier, said pill dispensing system including a pill release mechanism; a reader for reading the array-type pill package identifier; and a processor in communication with the pill release mechanism and the reader. The processor has an associated memory having stored therein processor executable instructions for configuring the processor to perform the steps of: acquiring the array-type pill package
25 identifier from the reader; obtaining a package user ID, a layout format information and a pill distribution schedule using the acquired identifier; matching the package user ID against a system user ID stored in the memory; upon a match of the package user ID and the system user ID, operating the pill release mechanism to open and release pills from a scheduled container of the array-type pill package in accordance with the layout
30 format information and the pill distribution schedule; wherein the released pills are provided in the open scheduled container for a user to take.

[0058] In an embodiment, the pill dispensing system further includes a user interface providing at least one of a visual prompt and an audible prompt to the user that is time to take their medication.

5 [0059] In an embodiment, the pill dispensing system further includes an input/output interface in communication with the processor, the processor executable instructions further including instructions for configuring the processor to perform the step of sending an alert to a caregiver through the input/output interface in response to the user not taking its medication within a predefined amount of time.

10 [0060] In an embodiment, the pill dispensing system further includes a user portable component in wireless communication with the pill dispensing system, the user portable component providing emergency notifications and indicating to the user that is time to take their medication.

15 [0061] Other objects and advantages of the present invention will become apparent from a careful reading of the detailed description provided herein, with appropriate reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0062] Further aspects and advantages of the present disclosure will become better understood with reference to the description in association with the following Figures, in which similar references used in different Figures denote similar components, wherein:

20 [0063] **Figure 1** is a perspective view of a pill dispensing system in accordance with an embodiment of the present disclosure;

[0064] **Figure 2** is a transparent perspective view of the pill dispensing system of Figure 1;

25 [0065] **Figures 3A and 3B** are schematic representations of the control system for the pill dispensing system of Figure 1; and

[0066] **Figures 4 to 22** show examples of the user/communication interface screens in accordance with the illustrative embodiment of the present disclosure.

DETAILED DESCRIPTION OF THE DISCLOSURE

[0067] With reference to the annexed drawings the illustrative embodiment of the present disclosure will be herein described for indicative purpose and by no means as of limitation.

5 [0068] Generally stated, the non-limitative illustrative embodiment of the present disclosure provides a pill-dispensing system that helps ensure that patients, especially seniors living alone at home, take the correct medication on time and notifies caregivers if they miss a dose. The pill-dispensing system does this with one or more prompts, for example visual, audible and/or vibrational prompts, to the patient or senior and
10 optionally, email, SMS and Cloud-based recording for caregivers. In an alternative embodiment, the pill-dispensing system includes an online monitoring service to reduce the risk of medication non-compliance, prolonging life and time spent at home for the patient or senior, and reducing the cost to government and insurance. Although the term patient will be used from here on end to lighten the text, it is to be understood that the
15 disclosure equally applies to seniors or anyone that is required to take specific medication at predefined times.

[0069] Referring to Figures 1 and 2, the pill-dispensing system 10 in accordance with an embodiment of the present disclosure comprises a pill release mechanism 12 for use with one or more array-type pill packages 13. In the illustrative embodiment, the pill
20 release mechanism 12 consist in an arc-shaped holding mechanism 14, a cutting mechanism 16 and a pill dispensing mechanism 18, examples of which are disclosed in co-pending US provisional Patent Applications entitled "Arc-Shaped Holding Mechanism For Array-Type Pill Packages", "Cylindrical-Shaped Dispenser For Array-Type Pill Packages", "Cutting Mechanism In A Dispenser For Array-Type Pill Packages" and
25 "Mechanism For Dispensing Pills From An Array-Type Pill Package Into An Original Container Thereof", which are herein incorporated by reference. The pill-dispensing system can be operated between an open state, in which the holding mechanism 18 can be loaded with a new array-type pill package, and a closed state, in which the array-type pill package is preferably locked in the holding mechanism, and the pill release
30 mechanism 12 and pill dispensing mechanism 18 can be operated to dispense pills.

[0070] The array-type pill packages 13 can be, for example, two dimensional arrays of individual scheduled containers, such as Dispill™ blister packs prefilled by a pharmacist, having printed thereon an identifier which clearly identifies and links the patient to the pills and the pill dispensing system 10. The identifier provides pill dispensing data which can include layout format information and other information such as the ID of the patient which can use the array-type pill package 13, pill distribution, dispensing time for each pill pouch, if an early dose is permitted and at what time an early dose can be dispensed. The identifier can comprise, for example, a quick response (QR) code, a barcode, -a frequency identifier (RFID), or other identifier, such as text data. The identifier can directly contain the pill dispensing data, or can include a reference from which the pill dispensing data can be retrieved, such as a file number for example.

[0071] It is to be understood that the information may be encoded in one or more identifiers, and that the identifier may contain a link to a remote system or server having the information stored therein.

[0072] Referring now to Figure 3, the pill dispensing system 10 further comprises a control system 20, which includes a processor or processing unit 22 with an associated memory 24 having stored therein processor executable instructions 40 for configuring the processor 22 to perform control, monitoring and alarm procedures and set configuration parameters 42. The processor can comprise a number of different modules containing instructions to perform various tasks which will be described hereafter, such as an identifier acquisition module, and identifier interpretation module, a matching module, a dispensing module, an early dose verification module, an image analysis module, a user interface module, a remote communications module, a sensing module and an input/output module. It will be readily understood that the reference to various modules is meant to describe the operation of the processor or processing unit at a conceptual level, and that in implementations the functionalities associated with each of these modules may be performed by one or more hardware and software components without departing from the scope of the invention. The system 10 may further include a user/communication interface 26, one or more Input/Output (I/O) interface 28, reader 30, a power source 32, sensors 34, mechanical systems controller 36 and optional portable component 38.

[0073] The user/communication interface 26 may include a touchscreen and, optionally, a microphone, speaker and camera, which may be used for video conferencing. Furthermore, the camera can be used to capture images of the pills as they are dispensed and released. The processing unit 22 can, for example, contain an image analysis module configured to analyze the pictures capture by the camera, and validate that the pills were correctly released or dispensed. The user interface 26 may also include a visual indicator such as a strobe light to indicate, for example, an alarm condition, indicate to the patient that an important message is displayed on the touchscreen, remind the patient that it is time to take their medication, or notify the user that they missed a dosage.

[0074] In some embodiments, the user/communication interface 26 is used to display various information, such as the current date and time and the time the next pills are going to be dispensed. An early dose virtual button might be provided if the next pills can be taken early according to the information provided by the QR code, barcode, RFID, file number or other identifier, or remote configuration. It can also be used to display reminders of the current day, which will automatically disappear at or a couple of minutes after the event. The various screens of the user/communication interface 26 will be further detailed below.

[0075] The configuration of the pill-dispensing system 10 can be modified from the user/communication interface 26 or remotely through the I/O interface 28 and saved in configuration parameters 42 stored locally in memory 24 in order for the pill dispensing system 10 to operate even in the absence of remote communications.

[0076] Various advanced aspects of the control, monitoring and alarm procedures 40 can be configured and used through the user/communication interface 26, or remotely though the I/O interface 28, using a security code or sequence. Some example of parameters that may be configured include:

[0077] **User ID:** used to uniquely identify a patient, and allows the unique association of a user to an array-type pill package 13 and a user to a pill dispensing system 10. A package user ID is included in the identifier provided with the array-type pill package 13. This allows for the array-type pill package 13 to be uniquely associated to a patient to whom the pills in

the package 13 were prescribed. A system user ID is provided in the pill dispensing system 10. This allows the pill dispensing system 10 to be uniquely associated with a user who will be using the system 10 to dispense pills. The pill dispensing system 10 will only distribute pills if the package user ID and the system user ID match. It should be understood that a system 10 can be associated with one or a plurality of users. In the latter case, the system can be provided with a plurality of system user IDs and can be loaded with a plurality of pill packages 13. The system can be configured to dispense pills from one of the pill packages 13 only if the package user ID of that package corresponds to a system user ID of a user currently operating the system.

[0078] **Early dose:** indicates if a pill might be taken early. This feature can be globally turned ON or OFF and needs to be enabled by the pharmacist through the identifier provided with the array-type pill package 13, which also contains information about how earlier the pill can be taken. This feature can be overridden remotely if required.

[0079] **Language:** the language of the user/communication interface 26, including the voice instruction feature, can be customized choosing one of the following languages, for example English, French, Spanish, etc.

[0080] **Voice instructions:** the user/communication interface 26 can generate voice instructions to the patient when pills are ready to be taken. These instructions are in the form of pre-recorded messages available in the different languages supported by the pill dispensing system 10.

[0081] **Reminders:** can be configured to repeat every day, week, month or at specific dates. If a monthly reminder is selected on a date which doesn't exist in the current month, the last day of the month will show the reminder. Reminders can be disabled without losing the current configuration; they can also be re-enabled at any time.

[0082] **Emergency call:** a phone number can be configured as an emergency number in case of a serious problem like a fall or sickness. This number can be any number from a caregiver to 911 or to the local alarm

monitoring company. The call may be transmitted using the I/O interface 28 through, for example, a conventional phone line, Voice over Internet Protocol (VoIP) or a 3G/4G transmitter. Short message service (SMS), Email, and other alert mechanisms may also be employed. The emergency called may be initiated either by pressing an emergency button displayed on the user/communication interface 26 or through activation of a Bluetooth 4.0 enabled portable component 38.

[0083] - **Video conferencing:** an optional video conferencing feature allows the patient to communicate with a remote caller using a PC or mobile device.

10 [0084] – **Alerts:** are sent to the caregiver and family members if required and configured to do so. Alerts are sent to a mobile phone using SMS and/or through email, selectable on a per-user basis. An alert is sent, for example, in the presence of the following events: pills are ready to be taken but have not been taken, power loss, low battery, pill reload required or emergency call sent.

[0085] In some embodiments, the I/O interface 28 includes one or more of a 3G, 4G, LTE or other cellular/mobile communication interface, WiFi transmitter, an Ethernet port, a universal serial bus (USB) port, a serial port, a public switched telephone network (PSTN) port for conventional phone line connectivity. The I/O interface 28 may also optionally include a Bluetooth 4.0 interface to a portable component 38 for the patient to wear or hold and communicate with the pill-dispensing system 10 via the processing unit 22 and/or a Z-Wave interface used to control home automation devices, lighting and alarm systems allowing notifications/alarms by flashing room lights or other means. The I/O interface 28 can be used to remotely upgrade the control system 20 as well as the mechanical systems controller 36.

[0086] The reader 30 may be in the form of an optical sensor such as a barcode reader, camera, other type of sensor depending on the means selected to identify the array-type pill packages 13 with the patient, such as an RFID reader for example. The reader can be operated by an identifier acquisition module in the processor to obtain a pill package identifier associated with the array-type pill packages 13. The identifier can be interpreted by an identifier interpretation module in the processor in order to extract

dispensing information contained therein. For example, if the pill package identifier comprises text, the interpretation module can be configured to optically recognize characters in an image of the text captured by the camera in order to obtainer the dispensing information. The optical character recognizing (OCR) can be performed in a number of languages, which can be preloaded in the system, or which can be downloaded to the system at a later time.

[0087] In some embodiments, the reader 30 can be operated by other modules in the processing unit 22 if necessary. For example, the processing unit 22 can comprise a user identification module configured to identify a user using the pill dispensing system, and validate that the user is associated with the package user ID and the system user ID. In this fashion, pills in the system will only be dispensed to a user who is associated with the system user ID, and thus only to a user who is prescribed the pills in the array-type pill package. In such an embodiment, the reader can be an RFID reader configured to read an RFID tag embedded within a hospital wristband issued to a patient. The user identification module can obtain the RFID tag from the reader, and validate that it corresponds to the package user ID and the system user ID before dispensing pills. It should be understood that in other embodiments, the user identification module can use other means in order to identify the user. For example, it could identify a user through the use of a password, or a biometric sensor.

[0088] The power source 32 may include an AC-DC converter, charger and battery pack in order to provide autonomy, for example two days, to the pill-dispensing system 10 in case of power outages.

[0089] In some embodiments, the sensors 34 detect if the pill dispensing system 10 is open or closed. A sensing module in the processing unit 22 can be configured to detect when the dispensing system 10 is open or closed, and cause the identifier acquisition module to wait for the pill dispensing system 10 to be closed before acquiring the pill package identifier from the reader. Sensors 34 are also present in the pill release mechanism 12 in order for the mechanical systems controller 36 to properly position the array-type pill packages 13 using in the arc-shaped holding mechanism 14 and operate the cutting mechanism 16. Optionally, the sensors may also include a proximity sensor, for example an ultrasonic sensor, to activate the user/communication interface 26 when it senses someone within range.

[0090] In some embodiments, the mechanical systems controller 36 includes the necessary circuitry to control the motors and actuators of the pill release mechanism 12 and related sensors 30. This control decoupling between the mechanical systems controller 36 and the processor 22 of the control system 20 prevents the processor 22 from doing real-time tasks, which could interfere with its high-level operating system running the control, monitoring and alarm procedures 40. The mechanical systems controller 36 communicates with the processor 22 using high level commands.

[0091] The optional portable component 38, which could also be in the form of a hand-held device, necklace or bracelet, may be Bluetooth 4.0 enabled for communication with the pill dispensing system 10 through the I/O interface 28 in order to facilitate emergency notifications, for example in the case of a fall, as well as lighting up or vibrating to indicate to the patient that an important message is displayed on the user/communication interface 26 or that it is time to take their medication.

Pill Dispensing

[0092] A pill dispensing process according to one non-limitative implementation is described herein below in more details.

[0093] Once the pill release mechanism 12 has been loaded with one or more array-type pill packages 13 by the caregiver or pharmacy delivery person, the pill dispensing system 10 locks it in. The pill dispensing system 10 can be locked and unlocked either manually, through the user/communication interface 26 and even remotely through the I/O interface 28 using a security code or sequence.

[0094] Once the sensors 34 detect that the pill dispensing system 10 is locked, the reader 30 reads the identifier printed on, or provided with, the array-type pill packages 13. The identifier provides layout format information and other information such as the user ID of the patient who is prescribed to use the array-type pill package 13, pill distribution and order, dispensing time for each container, if an early dose is permitted and at what time an early dose can be dispensed, and the layout format of the pills in the package 13. The pill dispensing system 10 will only distribute pills if the configured user ID matches the user ID from the array-type pill package 13.

[0095] The control, monitoring and alarm procedures 40 executed by the processor 22 through a dispensing module then operates the pill release mechanism 12 through the mechanical systems controller 36 in accordance with the layout format information and the schedule information provided by the identifier. The dispensing schedule can be correlated with the layout format information in order to operate the pill release mechanism 12 to release pills from a particular individual scheduled container of the array-type pill package. For example, the scheduled containers can be ordered in rows corresponding to days of a week, and columns corresponding to a time of day to take the medication. According to the day and time when the pills are being dispensed, the pill release mechanism 12 can be operated to dispense pills from a scheduled container in a particular row and column.

[0096] As can be appreciated, the described configuration is advantageous because it allows pills to be dispensed early or out of order. In the case of an early dose, the pill release mechanism 12 can be operated to release pills from a scheduled container ahead of schedule. The processor can be provided with an early dose verification module to verify that an early dosage permission indicator obtained from the pill package identifier indicates that the early dose is permitted, and/or if a setting in the pill dispensing system 10 allows for early doses.

[0097] Pills may need to be dispensed out of order for several reasons. For example, if a patient anticipates that they will not be able to access the pill dispenser 10 for an extended period of time, for example if they are on vacation, the pill release mechanism 12 can be operated to dispense pills from one or several scheduled containers corresponding to a period of the patient's anticipated absence. In such cases, the pill release mechanism 12 can be operated to skip one or several of the ordered scheduled containers so as to jump ahead and release pills in scheduled containers corresponding to the period of anticipated absence. Once the pills for the absence period have been dispensed, the pill release mechanism 12 can be operated to jump back and dispense pills in their proper order until the patient leave for their absence. Once the patient returns, the pill release mechanism 12 can be operated to continue dispensing pills in order, according to normal operation.

[0098] The When dispensed, the pills are provided in their container (thus minimizing contamination and error), with the top cover removed, through the pill dispensing

mechanism 18 and the user/communication interface 26 will use a visual and audible prompts to attract the attention of the patient. If present, the portable component 38 is also used to indicate to the patient that it is time to take their medication. Voice instructions may also be played if enabled.

5 [0099] These notifications will remain active for a certain amount of time, which may be configured. When the timeout is reached, a message on the touchscreen of the user/communication interface 26 will appear to notify that a dose has been missed. This message will stay visible until the delivery drawer is removed. If the pill has not been taken within a certain amount of time, also configurable, the pill dispensing system 10
10 can send an alert to the caregiver and/or family members.

User Interface

[0100] Figures 4-22 show examples of the user/communication interface 26 screens in accordance with one illustrative embodiment of the present disclosure. It is to be understood that the various screens, menus and options provided may vary without
15 departing from the spirit of the present disclosure.

[0101] Referring to Figure 4, there is shown the Home screen, which welcomes the patient and in invites him/her to touch the touchscreen to access its various features. The home screen can, for example, be provided with a visual indicator corresponding to the system user ID which allows the user to recognize that the system user ID, and thus
20 the pill dispensing system, is associated to them. For example, the visual indicator could include the user's name, or a picture of the user's face.

[0102] After touching the Home screen, the patient status screen is displayed, shown in Figure 5, which displays relevant data of the patient. From this screen the patient can initiate a Video Chat (i.e. teleconference) or an Emergency Call to a preprogrammed
25 person. The patient can select Return to go back the home screen, or the screen will automatically return home after a certain period of inactivity, for example 30 seconds. If the patient presses the Menu button, a security code or sequence is required to proceed to the Main Menu.

[0103] The Video Chat interface screen, shown in Figure 6, provides the visual interface
30 as well as a Recording indicator that indicates that the session is being recorded. An

End button allows the patient to close the session and return to the Patient Status screen.

[0104] The Main Menu, shown in Figure 7, offers various options:

5 [0105] - Load/Unload Meds: allowing the unlocking/locking of the pill-dispensing system 10 in order to load/unload

[0106] - Calendar: allowing the addition, modifying and deleting of events, appointments, etc.

10 [0107] - Configuration: allowing the modification of the current settings, enable/disable features, voice instructions, early dose enabled/disabled, alerts, reminders, etc., which are saved in the configuration parameters 42.

[0108] - Patient Profile: allowing the modification of the patient's profile, e.g.name, address, telephone number, email, language, enable/disable voice instructions, early dose enable/disable, etc.

15 [0109] - System Status: displaying how many containers have been dispensed or remain in the array-type pill packages 13, estimated refill date, version of firmware, software and any other pertinent info such as power source 32 status, etc.

[0110] - Contacts: listing of all contacts, e.g. pharmacy, doctor, with their name, address, telephone number, Email, SMS. The contacts are linked to actions/alerts.

[0111] - Early Dose: allowing for the release of specific doses.

20 [0112] When loading/unloading array-type pill packages 13, as shown in Figure 8, a Green button flashes while the pill-dispensing system 10 is unlocked. When the Green button is pressed, it the pill-dispensing system 10 will use the sensors 34 to verify that the pill-dispensing system 10 is closed and the reader 30 to verify that one or more new array-type pill package 13 has been loaded.

25 [0113] If the pill-dispensing system 10 is still open and the Green button is pressed, a message is displayed to close the pill-dispensing system 10.

[0114] While the pill-dispensing system 10 is in the unlocked state (i.e. open), nothing else can be done until the pill-dispensing system 10 is closed and ready to be locked.

[0115] The Calendar screen, shown in Figure 9, allows for the adding of events, such as appointments, and to set daily medication dispensing cycles (if not preprogrammed by the
5 identifier of the array-type pill package 13).

[0116] The Configuration screen, shown in Figure 10, allows the modifying of the current settings, enabling/disabling of features, voice instructions, early dose, alerts, reminders, etc. More specifically:

[0117] - General: allows the modifying of date/time, language, the
10 enabling/disabling of early dose release, etc.

[0118] - Alerts: allows the configuring of messages (e.g. text, voice, Email, SMS, Zwave), the recording of voice message, the configuring of which messages to send to which contacts.

[0119] - Emergency Call: allows the setting of the contact to call or message in
15 case of an emergency.

[0120] - Reminders: allows the setting of reminders, their frequency, what to do if the patient is non-responsive, links to pill dispensing and calendar appointments.

[0121] - Video Chat: allows the configuring of the video chat session, permissions, etc.

[0122] - Connectivity: allows the configuring of Network settings, Zwave or other
20 interface setups.

[0123] The General screen, shown in Figure 11, displays the date/time, language, enable/disable early dose release by contact (patient, caregiver...), etc. The Store Local option enables or disables the storage of data locally including audit trails. The Auto
25 Firmware Update enables or disables automatic updates. The Cloud Sync Interval specifies how often the pill-dispensing system 10 will synchronize data with a remote system or server. The Save displays a confirmation that the settings have been saved while the Return returns to the Configuration Screen.

[0124] The Alerts screen, shown in Figure 12, allows the enabling of the various types of alerts.

[0125] The Emergency Call screen, shown in Figure 13, allows the setting of who to reach in case of an emergency and in which manner, i.e. call, Email, SMS, etc.

- 5 [0126] The Reminders screen, shown in Figure 14, allows the enabling of reminders, the configuring of reminder frequency, the number of reminder repetitions when the patient is non-responsive, etc. Alerts be triggered after Reminders have expired.

[0127] The Video Chat screen, shown in Figure 15, allows the enabling of the Video Chat and access parameters.

- 10 [0128] The Connectivity screen, shown in Figure 16, allows the configuring of the various I/O interface 28 parameters, which will vary depending on the provided I/O interfaces.

- [0129] The Patient Profile screen, shown in Figure 17, allows the modifying of the patient's information (e.g. name, address, telephone number, Email, language), the
15 enabling/disabling or voice instructions, early dose, etc.

[0130] The System Status screen, shown in Figure 18, displays various information about the pill-dispensing system 10, for example how many containers have been dispensed or remain in the array-type pill packages 13, estimated refill date, version of firmware, software and any other pertinent info such as power source 32 status, etc.

- 20 [0131] The Contacts screen, shown in Figure 19, allows for the adding and modifying of contacts, e.g. pharmacy, doctor, with their name, address, telephone number, Email, SMS, and the linking of each contact to actions/alerts.

[0132] The Early dose screen, shown in Figure 20, allows the recording and programming of an early dose (i.e. vacation mode).

- 25 [0133] The Release screen, shown in Figure 21, instructs the patient that it is time to take meds. The patient must press Button to release the pills through the pill dispensing mechanism 18.

[0134] Finally, the Confirmation screen, shown in Figure 22, instructs the patient to confirm that he/she has taken the medication by pressing the Button, after which the Home screen is displayed. In the case of the presence of the optional camera used to capture images of the pills as they are dispensed and released, the Confirmation screen may be displayed only when the removal of the pills from the pill dispensing mechanism 18 is detected.

[0135] Although the present disclosure has been described with a certain degree of particularity, it is to be understood that the disclosure has been made by way of example only and that the present disclosure is not limited to the features of the embodiments described and illustrated herein, but includes all variations and modifications within the scope of the disclosure as hereinafter claimed.

CLAIMS

1. A pill dispensing system for dispensing pills to a user, said pills being located in individual scheduled containers of an array-type pill package provided with an identifier,
5 said pill dispensing system comprising:
- a pill release mechanism;
 - a reader for reading the array-type pill package identifier; and
 - a processing unit in communication with the pill release mechanism and the reader, the processing unit comprising:
10
 - an identifier acquisition module configured to acquire the array-type pill package identifier from the reader;
 - an identifier interpretation module configured to obtain a package user ID, a layout format information and a pill distribution schedule using the acquired identifier;
 - 15 - a matching module configured to match the package user ID with a system user ID associated with the system; and
 - a dispensing module configured to, upon a match of the package user ID and the system user ID, operate the pill release mechanism to release pills from at least one of the scheduled containers of the
20 array-type pill package in accordance with the layout format information and the pill distribution schedule.
2. The pill dispensing system of claim 1, wherein the package user ID corresponds to a patient to whom the pills in the array-type pill package are prescribed.
3. The pill dispensing system of claims 1 or 2, wherein the system user ID
25 corresponds to a patient associated with the pill dispensing system.
4. The pill dispensing system of any one of claims 1, wherein the package user ID corresponds to a patient to whom the pills in the array-type pill package are prescribed, the system user ID corresponds to a patient associated with the pill dispensing system and the matching module is configured to match the patient

associated with the system with the patient to whom the pills in the array-type pill package are prescribed.

5. The pill dispensing system of claim 4, wherein the dispensing module is configured to prevent operation of the pill release mechanism if the pills in the array-type pill package are not prescribed to the patient associated with the pill dispensing system.
6. The pill dispensing system of any one of claims 1 to 5, wherein the scheduled containers are ordered in the array-type pill package and the pill release mechanism is configured to release pills from the at least one of the scheduled containers out of order.
7. The pill dispensing system according to claim 6, wherein the layout format information comprises a position of the scheduled containers in the array-type pill package in relation to their order.
8. The pill dispensing system of claim 6 or 7, wherein the dispensing module is configured to operate the release mechanism to skip at least one of the individual scheduled containers in the array-type pill package when releasing pills from another one of the individual scheduled containers in the array-type pill package.
9. The pill dispensing system according to any one of claims 1 to 8, wherein the pills dispensed from the at least one of the scheduled containers correspond to an early dose, wherein the identifier interpretation module is further configured to obtain an early dosage permission indicator from the acquired identifier, and wherein the processing unit further comprises an early dose verification module configured to verify that the early dosage permission indicator indicates that the early dose is permitted.
10. The pill dispensing system according to any one of claims 1 to 9, wherein the pills dispensed from the at least one of the scheduled containers correspond to doses during an anticipated absence, the dispensing module being configured to operate the release mechanism to release pills from a plurality of scheduled containers corresponding to a period of anticipated absence of the user.
11. The pill dispensing system according to any one of claims 1 to 10, wherein the pill distribution schedule comprises a day and a time during which the pills in the scheduled containers are to be dispensed to the user.

12. The pill dispensing system according to claim 11, wherein the dispensing module is configured to automatically operate the pill release mechanism when a current day and time correspond to the day and time during which the pills in the scheduled containers are to be dispensed to the user.
- 5 13. The pill dispensing system of any one of claims 1 to 12, further comprising a camera configured to capture images of at least one of the releasing and dispensing of pills from the at least one of the scheduled containers.
14. The pill dispensing system of claim 13, where the processing unit further comprises an image analysis module configured to analyze the images captured
10 by the camera and validate that the pills were correctly released or dispensed.
15. The pill dispensing system of any one of claims 1 to 14, wherein the reader comprises a Radio-Frequency Identification (RFID) reader configured to read the array-type pill package identifier from an RFID chip in the array-type pill package.
16. The pill dispensing system of any one of claims 1 to 15, wherein the reader
15 comprises an optical sensor for reading the array-type pill package identifier.
17. The pill dispensing system of claim 16, wherein the optical sensor comprises a barcode scanner or a Quick Response (QR) code scanner for reading a barcode or a QR code on the array-type pill package.
18. The pill dispensing system of claims 16 or 17, wherein the optical sensor
20 comprises a camera for capturing an image of text on the array-type pill package.
19. The pill dispensing system of claim 18, wherein the identifier interpretation module is configured to optically recognize characters in the image of text in order to obtain at least one of the package user ID, the layout format information and the pill distribution schedule.
- 25 20. The pill dispensing system of claim 19, wherein the identifier interpretation module is configured to optically recognize the characters in a plurality of different languages.
21. The pill dispensing system of any one of claims 1 to 20, wherein the pill package
30 identifier comprises a link to a remote system, and the processing unit further comprises a remote communications module configured to retrieve at least one of

the package user ID, the layout format information and the pill distribution schedule from the remote system.

22. The pill dispensing system of any one of claims 1 to 21, wherein the processing unit further comprises a user interface module.

5 23. The pill dispensing system of claim 22, wherein the user interface module is configured to initiate at least one of a visual prompt and an audible prompt indicating to the user that it is time to take their medication.

24. The pill dispensing system of claims 22 or 23, wherein the user interface module is configured to initiate at least one of a visual prompt and an audible prompt
10 indicating to the user that they missed a dose of medication.

. The pill dispensing system of any one of claims 22 to 24, wherein the user interface module is configured to display a visual indicator corresponding to the system user ID, the visual indicator allowing the user to recognize that the system user ID is associated to said user.

15 26. The pill dispensing system of claim 25, wherein the visual indicator comprises at least one of a name of the user and a picture of a face of the user.

27. The pill dispensing system of any one of claims 22 to 26, wherein the processing unit further comprises a proximity sensing module configured to detect a user in proximity to the pill dispensing system and activate the user interface in response
20 thereto.

28. The pill dispensing system according to any one of claims 22 to 27, wherein the dispensing module is configured to wait for a user dispense command signal before operating the pill release mechanism to release pills from the at least one of the scheduled containers.

25 29. The pill dispensing system according to claim 28, wherein the dispensing module is configured to receive a user confirmation signal confirming that the dispensed pills were taken by the user.

30. The pill dispensing system according to claim 29, wherein the user interface module is configured to generate at least one of the user dispense command signal and the user confirmation signal in response to a user interaction with the
30 interface module.

- 5 31. The pill dispensing system of any one of claims 22 to 30, wherein the pill dispensing system is operable between an open state wherein the pill dispensing system is configured to receive at least one array-type pill package, and a closed state wherein the pill dispensing system is configured to dispense pills from the at least one array-type pill package.
- 10 32. The pill dispensing system of claim 31, wherein the processing unit further comprises a sensing module configured to detect whether the pill dispensing system is in the open state or the closed state, the identifier acquisition module being configured to wait for the pill dispensing system to be in the closed state before acquiring the pill package identifier from the reader.
33. The pill dispensing system of claims 31 or 32, wherein the user interface module is configured to initiate at least one of a visual prompt and an audible prompt indicating to the user that the pill dispensing system is in the open state.
- 15 34. The pill dispensing system of any one of claims 1 to 33, wherein the processing unit further comprises an input/output interface module configured to send an alert to a caregiver in response to the user not taking its medication within a predefined amount of time.
- 20 35. The pill dispensing system of any one of claims 1 to 34, further comprising a user portable component in wireless communication with the processing unit, the user portable component providing emergency notifications and indicating to the user that it is time to take their medication.
- 25 36. The pill dispensing system of any one of claims 1 to 35, wherein the processor further comprises a user identification module configured to identify the user and validate that the package user ID and the system user ID are associated with the user.
37. The pill dispensing system according to claim 36, further comprising an RFID reader operable by the user identification module, the user identification module being configured to read an RFID tag through the RFID reader and validate that the RFID tag corresponds to the package user ID and the system user ID.

38. The pill dispensing system according to claim 37, wherein the RFID tag is embedded in a hospital wristband issued to the user.
39. A method for dispensing pills from individual scheduled containers of an array-type pill package provided with an identifier, the method comprising the steps of:
- 5 a) providing a pill dispensing system comprising a pill release mechanism and a reader;
- b) loading the array-type pill package in the pill dispensing system;
- c) reading the array-type pill package identifier using the reader;
- d) obtaining a package user ID, a layout format information and a pill distribution
10 schedule using the pill package identifier;
- e) matching the package user ID with a system user ID associated to the pill dispensing system; and
- f) upon a match of the package user ID and the system user ID, operating the pill
15 release mechanism of the pill dispensing system to release pills from at least one of the scheduled containers of the array-type pill package in accordance with the layout format information and the pill distribution schedule.
40. The method according to claim 39, wherein the array-type pill package identifier is generated by a pharmacist.
41. The method according to claims 39 or 40, further comprising an initial step of
20 detecting that the pill dispensing system is in an open state, and waiting for the pill dispensing system to be in a closed state before continuing from step a).
42. The method according to any one of claims 39 to 41, wherein step b) comprises optically recognizing characters in the pill package identifier in order to obtain at
25 least one of the package user ID, the layout format information and the pill distribution schedule.
43. The method according to any one of claims 39 to 42, further comprising the step of receiving a user input corresponding to a pill dispense command prior to proceeding with step d).

44. The method according to any one of claims 39 to 43, wherein the scheduled containers of the array-type pill package are ordered, and wherein in step d), the pill release mechanism is operated to release pills from the at least one of the scheduled containers out of order.
- 5 45. The method according to any one of claims 39 to 44, wherein the pills released from the at least one of the scheduled containers correspond to an early dosage, the method further comprising the step of verifying if the acquired identifier comprises an early dosage permission prior to proceeding with step d).
- 10 46. The method according to any one of claims 39 to 45, further comprising the step of capturing an image of the pills released from the at least one of the scheduled containers to confirm that the pills were properly released.
- 15 47. The method according to any one of claims 39 to 46, further comprising the steps of identifying a user using an RFID tag embedded in a hospital wristband issued to said user, and validating that the user is associated with the package user ID and the system user ID.
- 20 48. A computer readable medium comprising instructions executable by a processor in a pill dispensing system for dispensing pills located in individual scheduled containers of an array-type pill package provided with an identifier, the instructions causing the processor to perform the steps of:
- acquiring the array-type pill package identifier using a reader;
 - obtaining a package user ID, a layout format information and a pill distribution schedule from the acquired identifier;
 - matching the package user ID with a system user ID associated with the pill dispensing system; and
 - 25 - upon a match of the package user ID and the system user ID, operating a pill release mechanism to release pills from at least one of the scheduled containers of the array-type pill package in accordance with the layout format information and the pill distribution schedule.

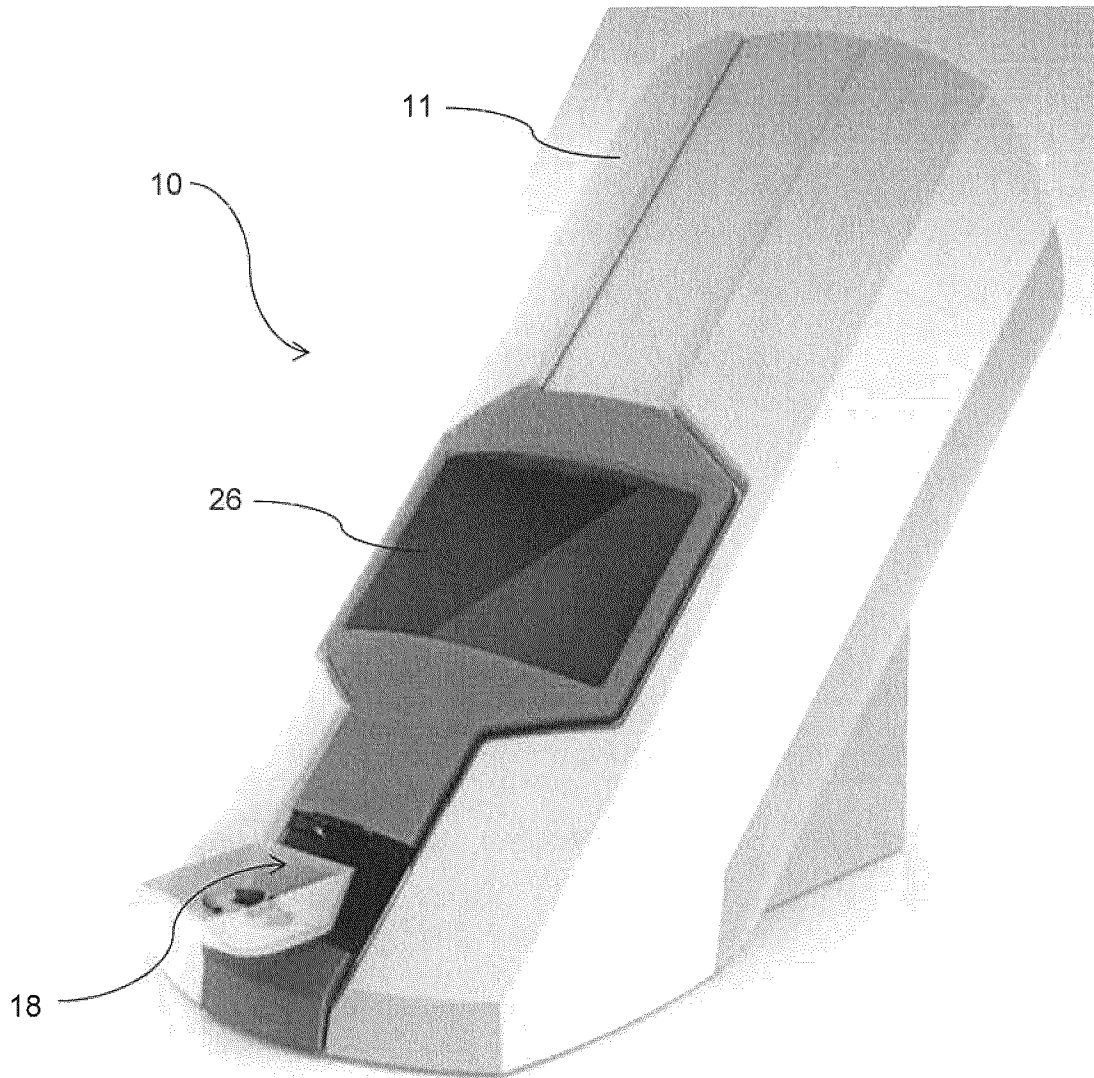


Figure 1

2/14

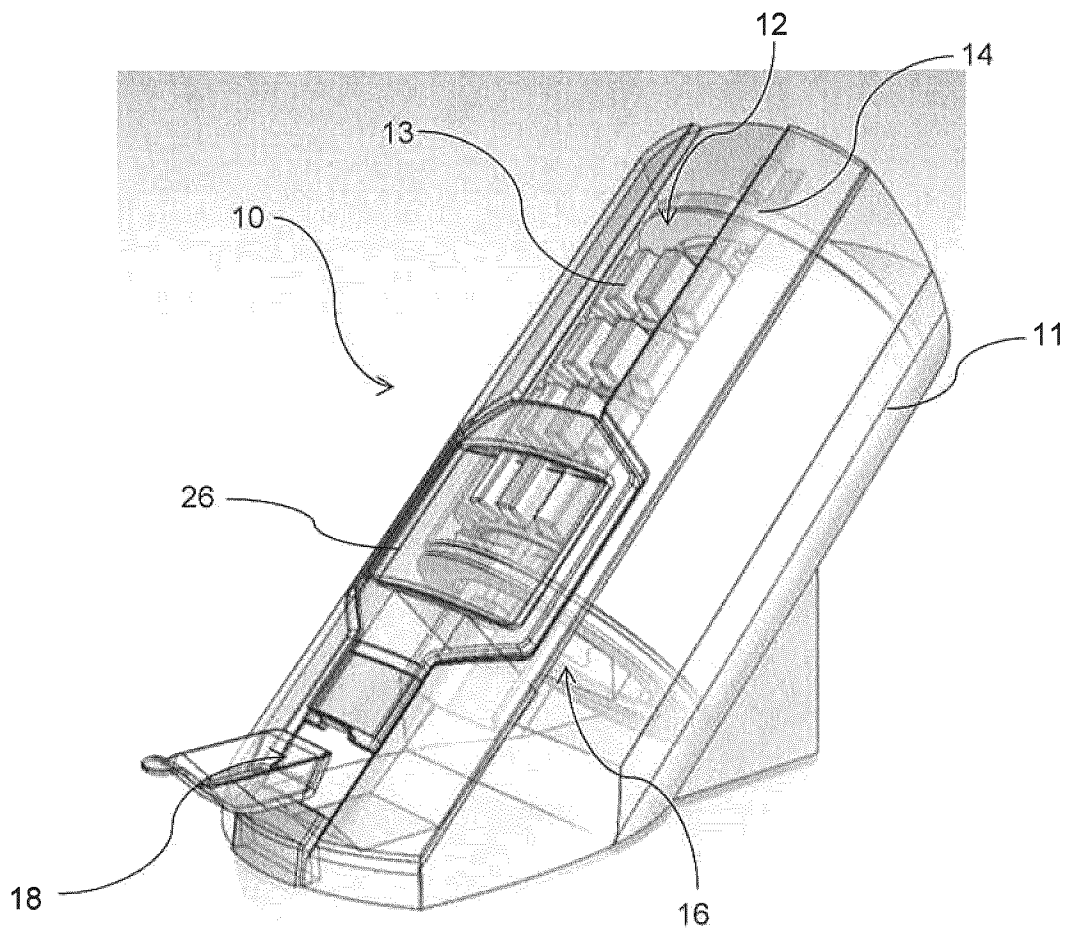


Figure 2

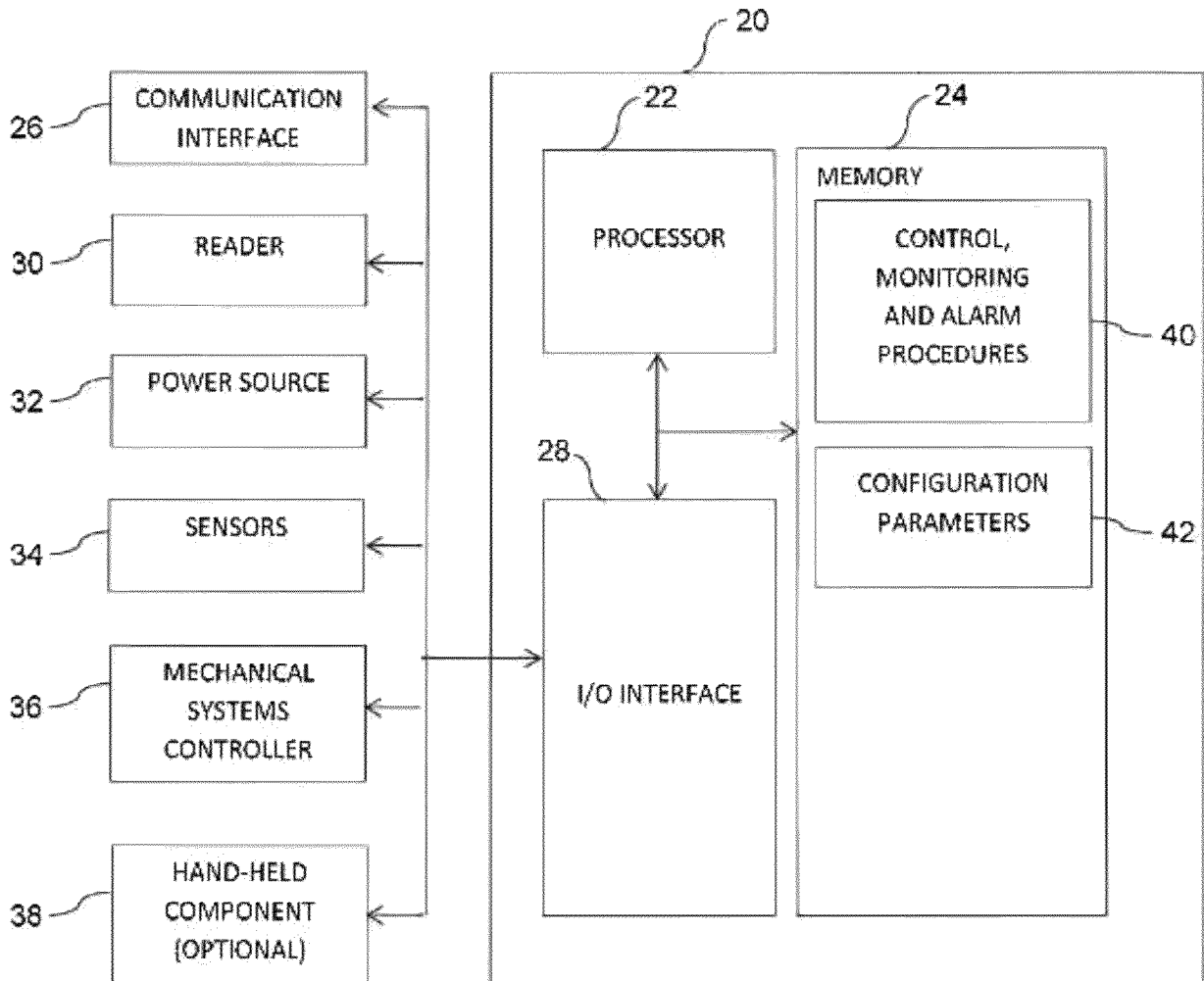


Figure 3A

4/14

22

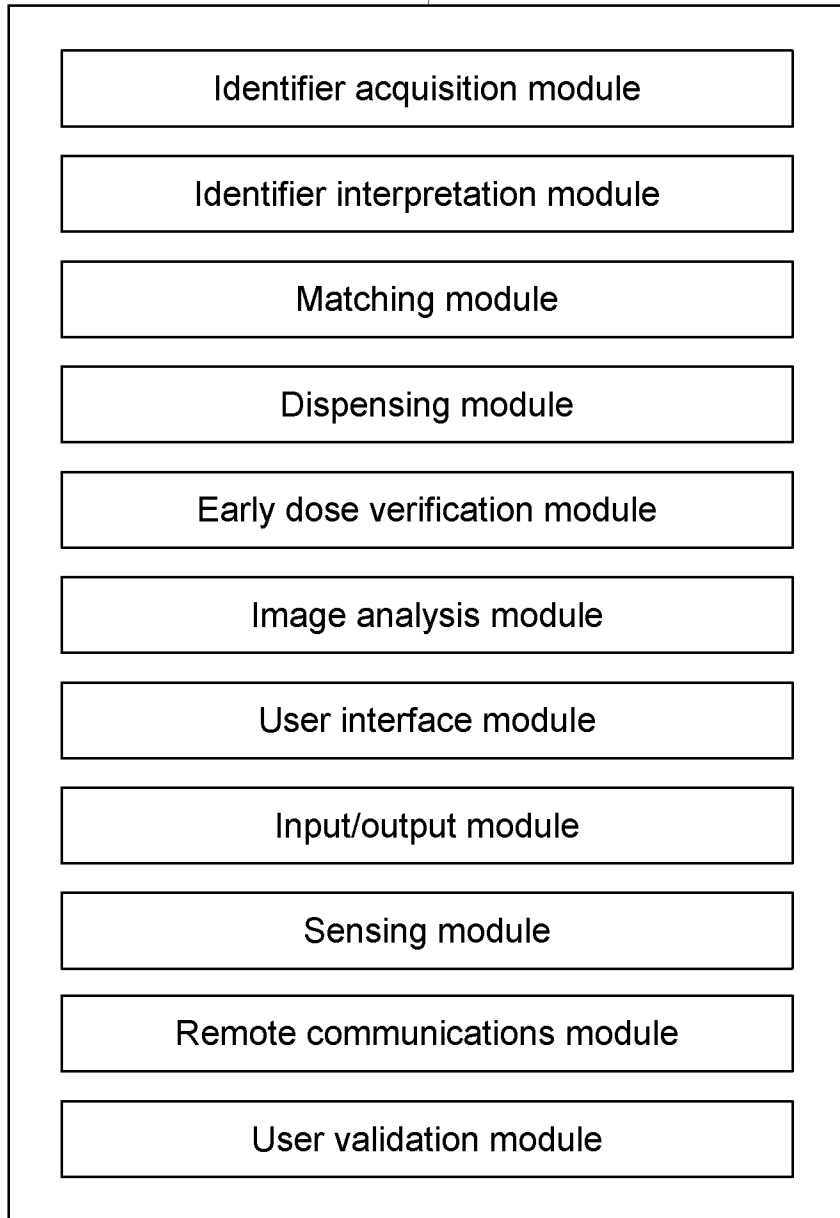


Figure 3B

5/14



Figure 4

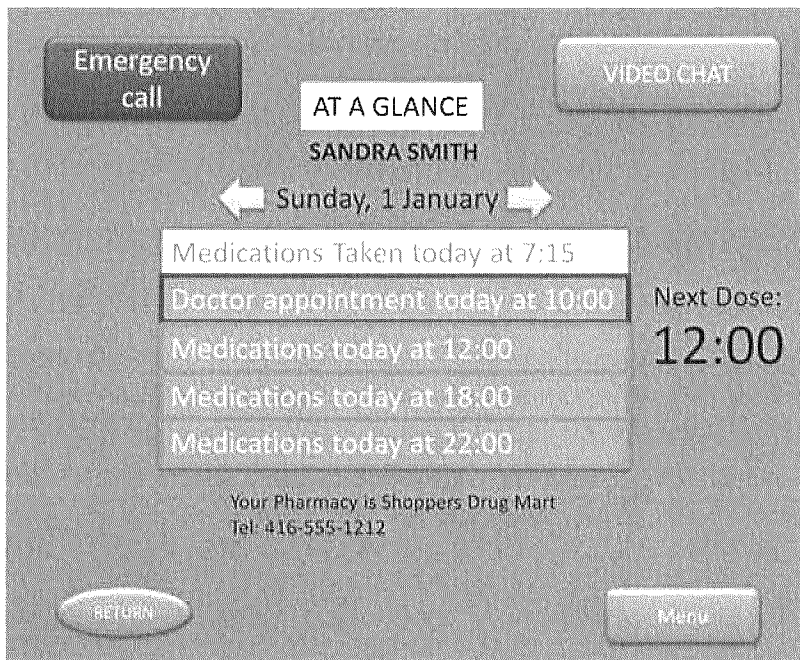


Figure 5

6/14



Figure 6

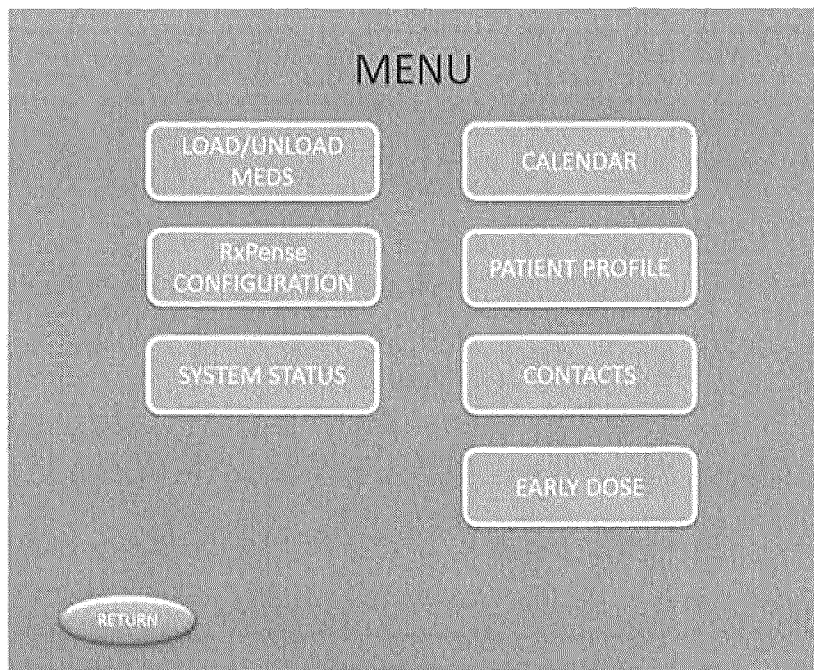


Figure 7

7/14

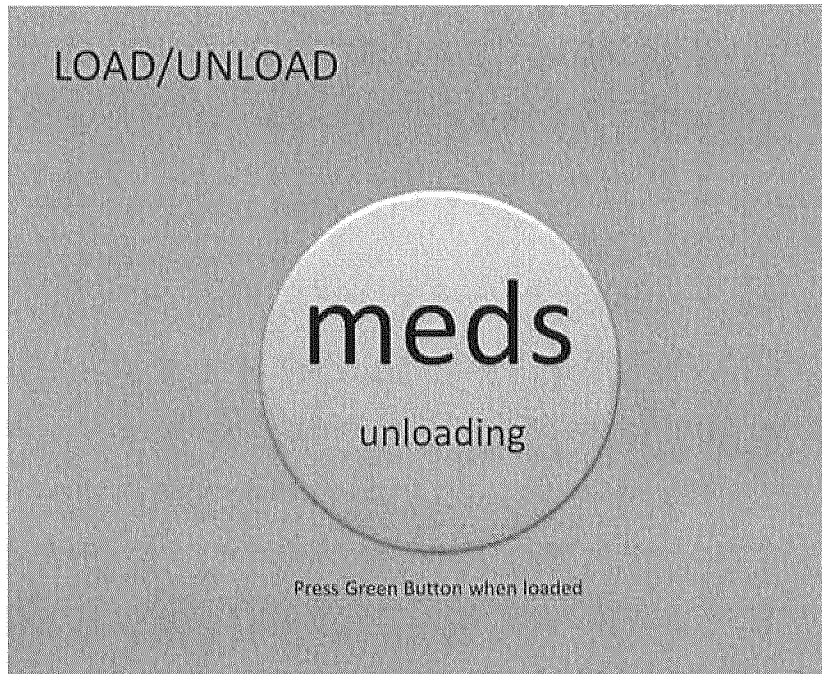


Figure 8



Figure 9

8/14

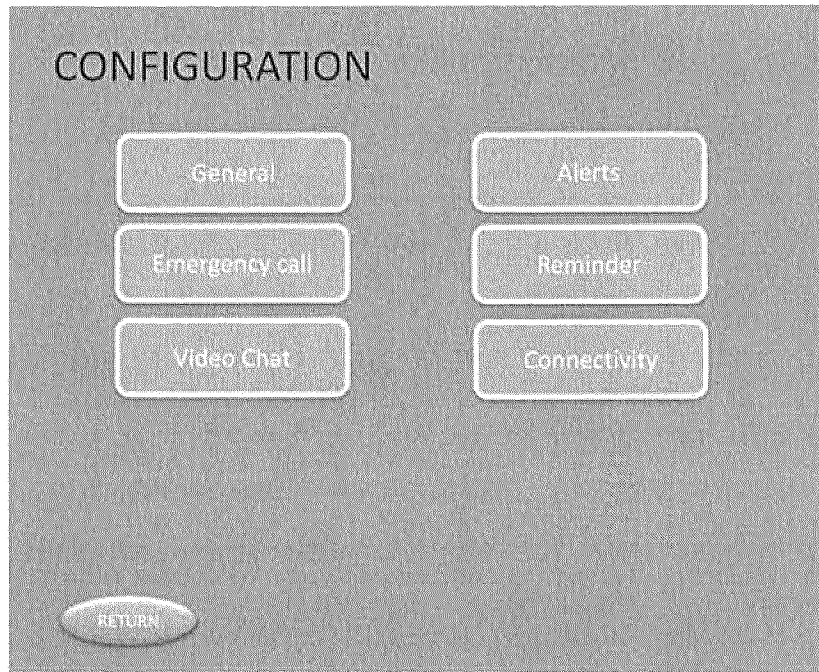


Figure 10

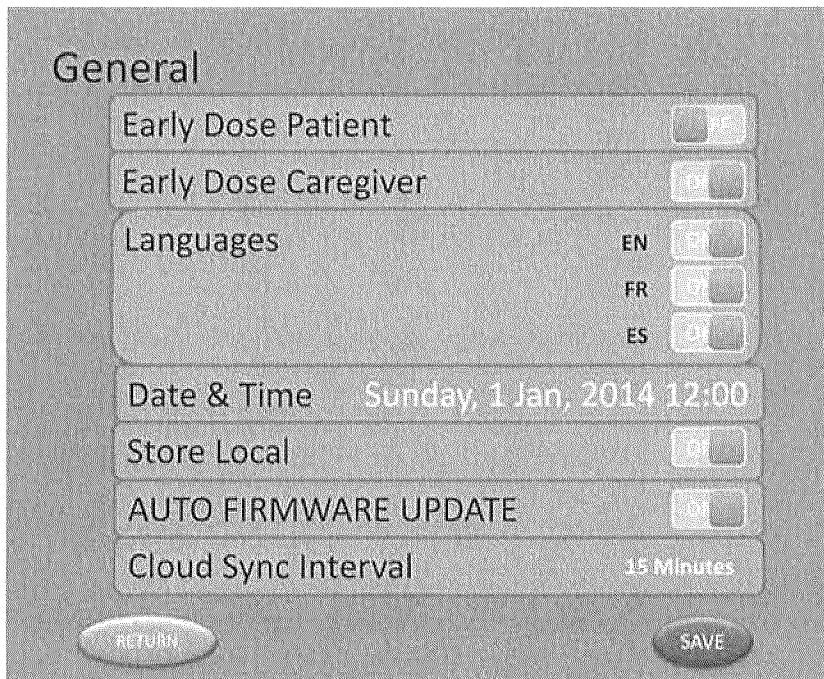


Figure 11

9/14

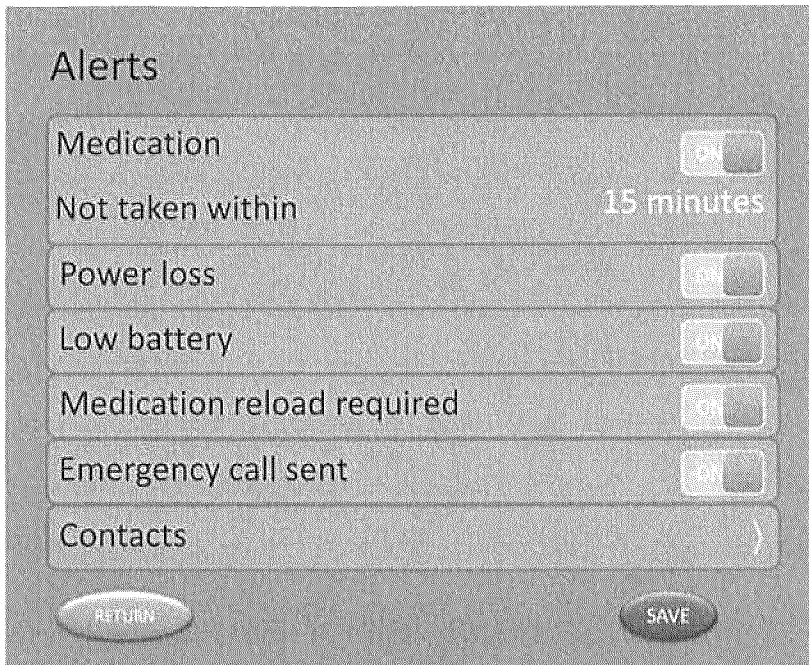


Figure 12

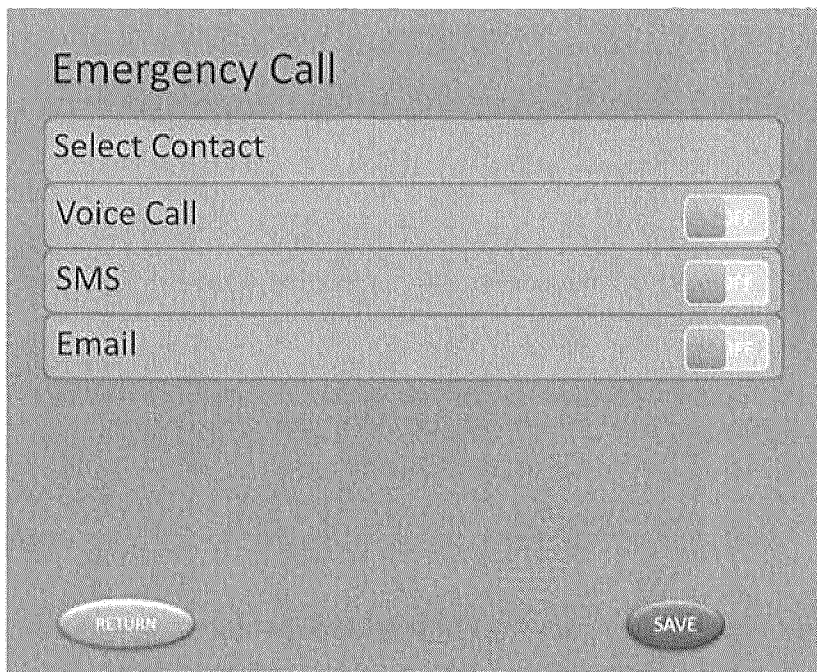
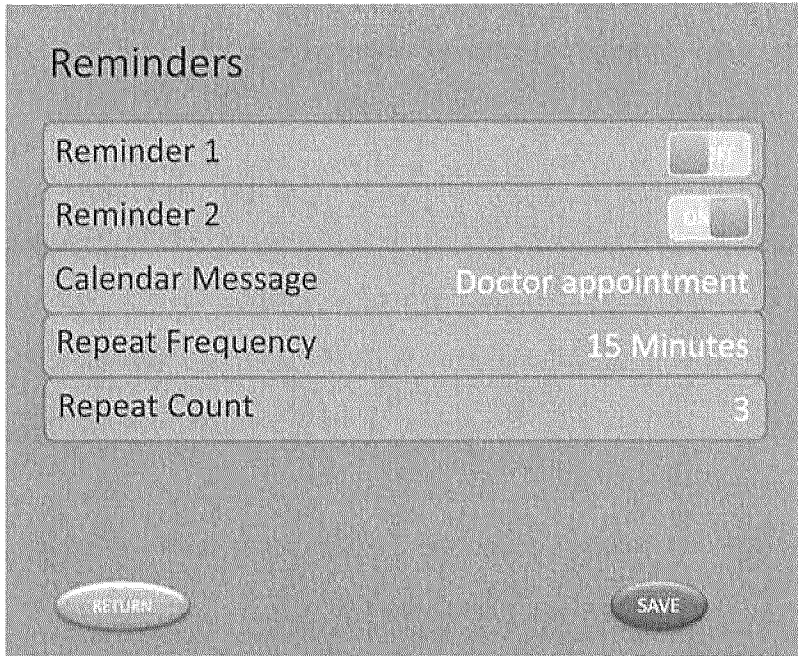


Figure 13

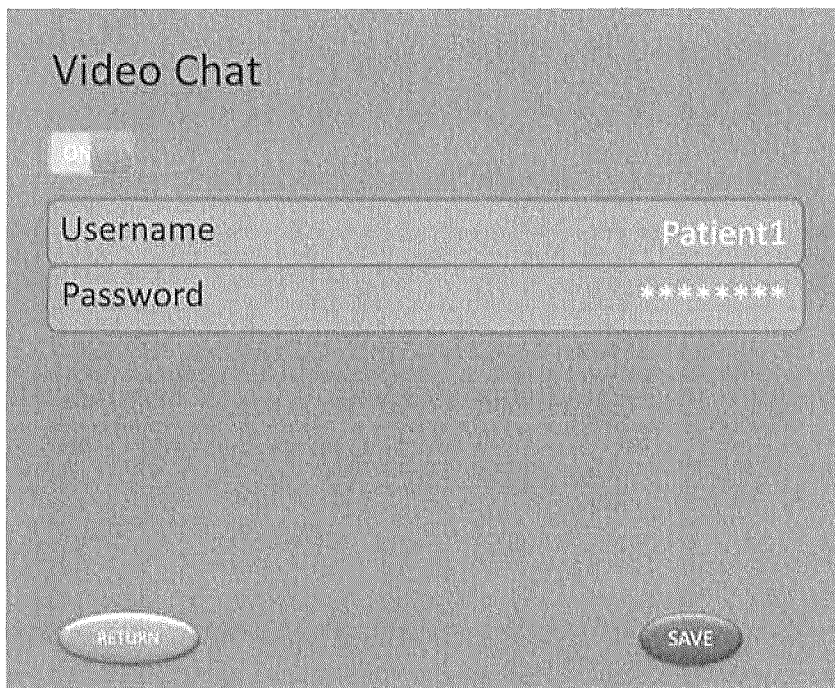


Reminders

Reminder 1	<input type="checkbox"/>
Reminder 2	<input type="checkbox"/>
Calendar Message	Doctor appointment
Repeat Frequency	15 Minutes
Repeat Count	3

RETURN SAVE

Figure 14



Video Chat

Username	Patient1
Password	*****

RETURN SAVE

Figure 15

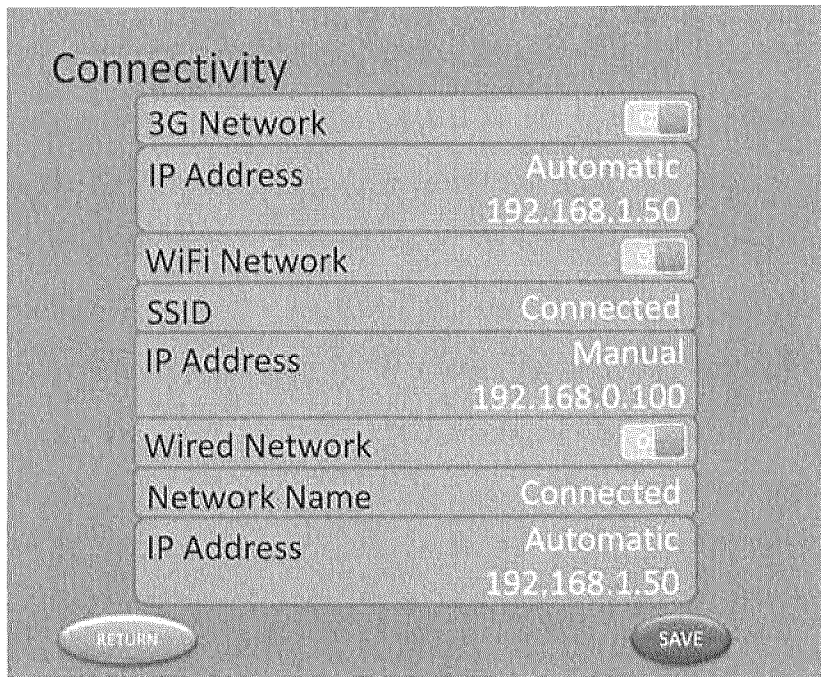


Figure 16

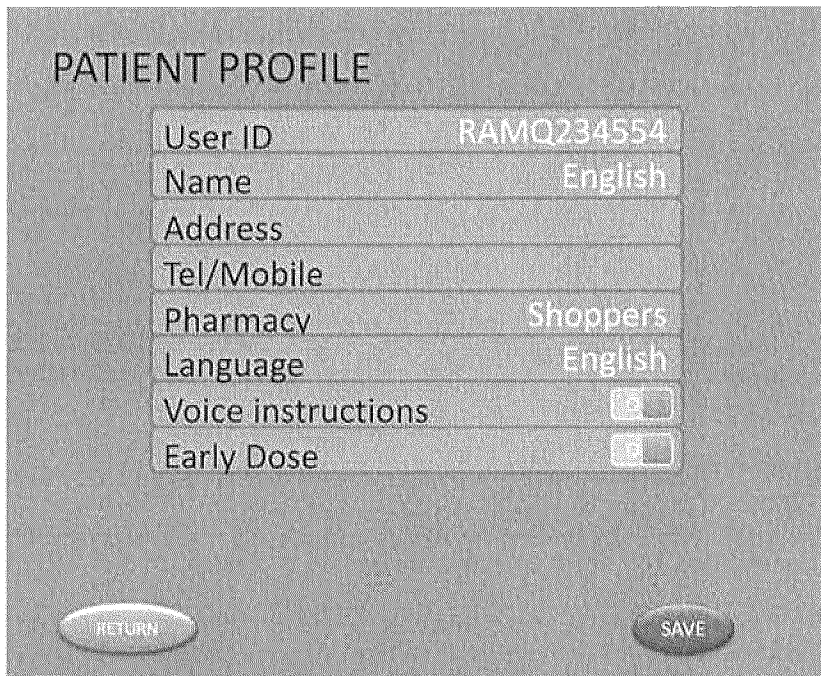


Figure 17

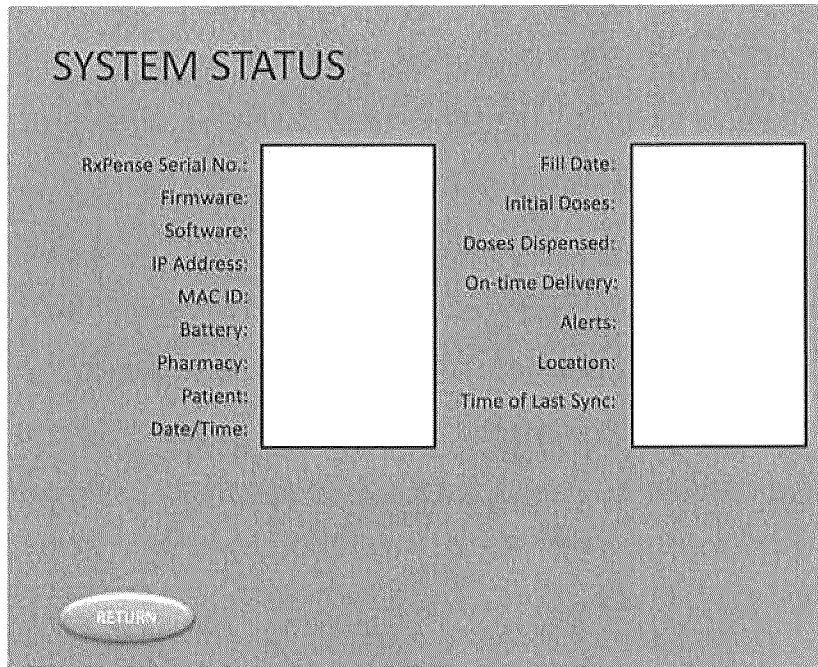


Figure 18

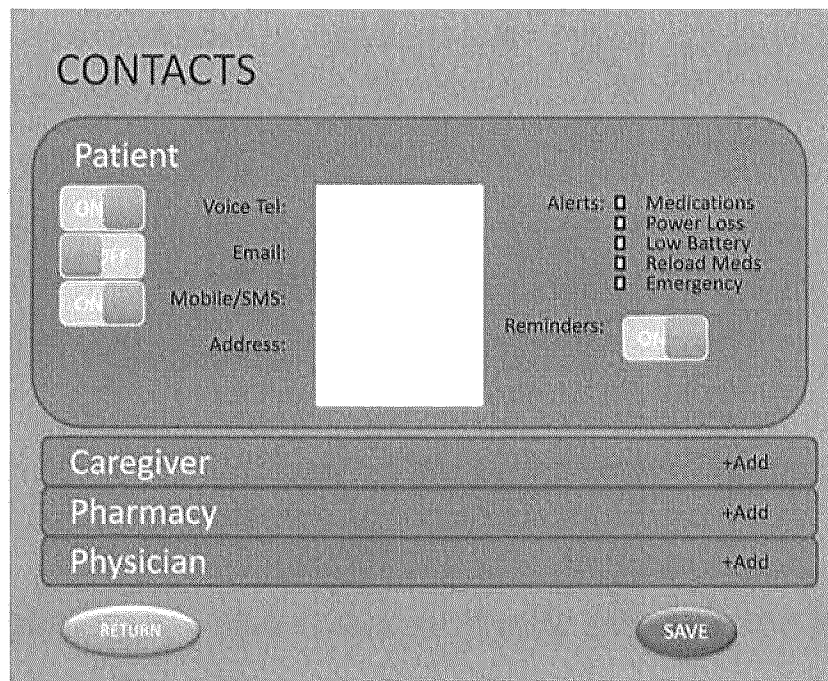


Figure 19

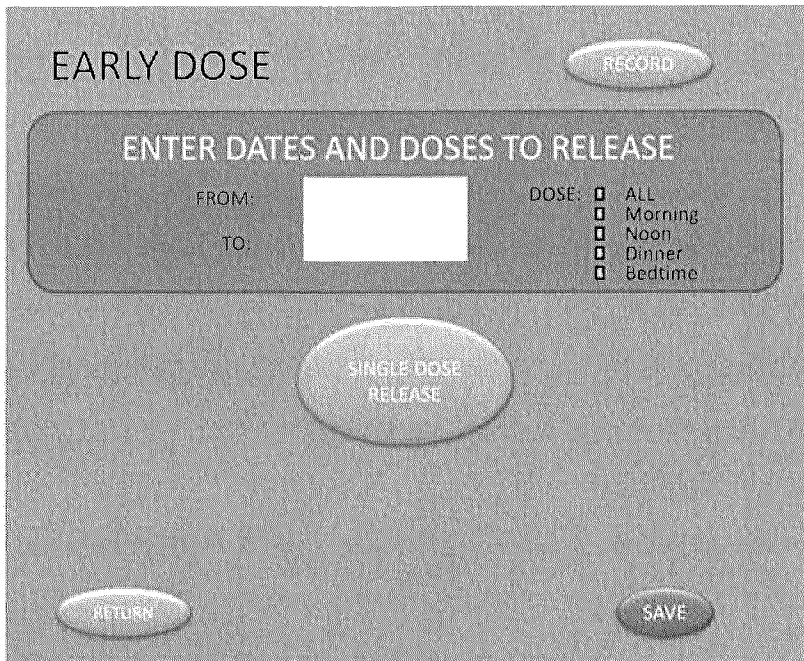


Figure 20

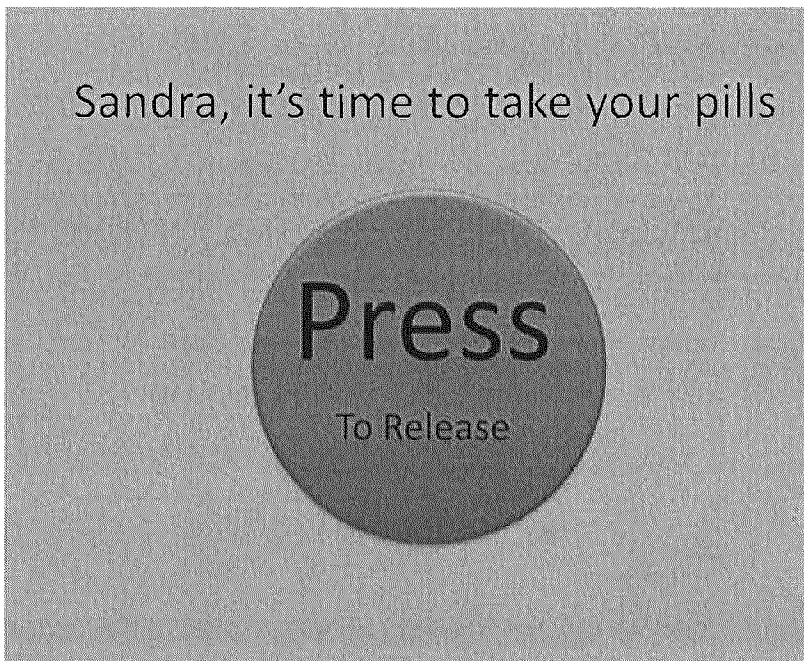


Figure 21

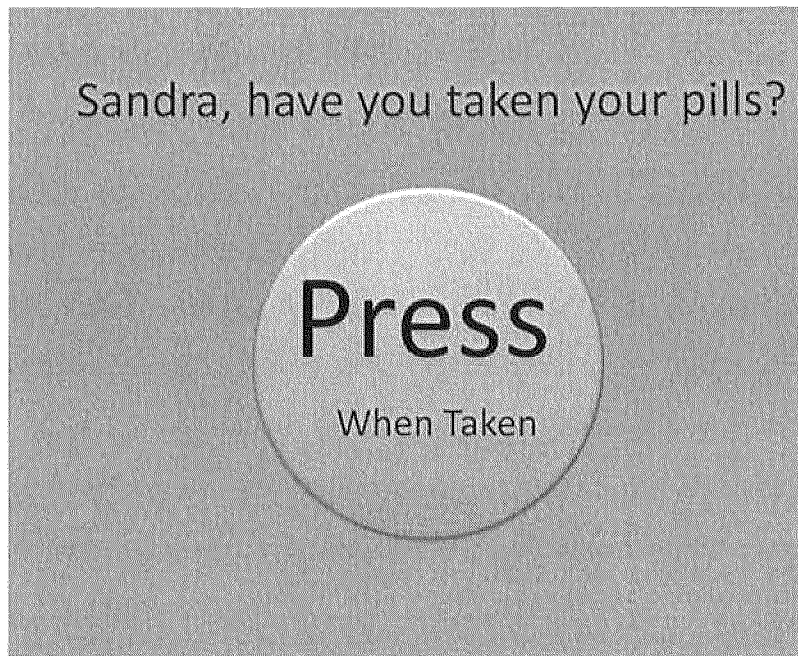


Figure 22

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CA2015/050591

A. CLASSIFICATION OF SUBJECT MATTER IPC: <i>A61J 7/02</i> (2006.01), <i>A61G 12/00</i> (2006.01), <i>A61J 7/04</i> (2006.01)		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
Minimum documentation searched (classification system followed by classification symbols) IPC: <i>A61J 7/02</i> (2006.01), <i>A61G 12/00</i> (2006.01), <i>A61J 7/04</i> (2006.01)		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic database(s) consulted during the international search (name of database(s) and, where practicable, search terms used) Full-text databases using QUESTEL-ORBIT		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US2013110283 A1 (BAARMAN ET AL.) 02 May 2013 (02-05-2013) - Refer to abstract, figs. 1-10; paras.0004- 0007, 0011, 0064-0067, 0091-0095, 0098-0105	1-48
A	WO2011042840 A1 (HORST ET AL.) 14 April 2011 (14-04-2011) - Refer to entire document	1, 39 and 48
A	WO2013013108 A1 (LUOMA ET AL.) 24 January 2013 (24-01-2013) - Refer to entire document	1, 39 and 48
A	WO2013040075 A1 (GRAHAM) 21 March 2013 (21-03-2013) Refer to entire document	1, 39 and 48
<input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C. <input checked="" type="checkbox"/> See patent family annex.		
* "A" "E" "L" "O" "P"	Special categories of cited documents: document defining the general state of the art which is not considered to be of particular relevance earlier application or patent but published on or after the international filing date document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) document referring to an oral disclosure, use, exhibition or other means document published prior to the international filing date but later than the priority date claimed	"T" "X" "Y" "&"
Date of the actual completion of the international search 18 September 2015 (18-09-2015)		Date of mailing of the international search report 02 October 2015 (02-10-2015)
Name and mailing address of the ISA/CA Canadian Intellectual Property Office Place du Portage I, C114 - 1st Floor, Box PCT 50 Victoria Street Gatineau, Quebec K1A 0C9 Facsimile No.: 001-819-953-2476		Authorized officer Ishtiaque Ibne Rashid (819) 953-0787

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CA2015/050591

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	CA2806903 A1 (SALTSOV) 09 October 2013 (09-10-2013) - Refer to entire document	1, 39 and 48
A	WO2011130840 A1 (SALTSOV) 27 October 2011 (27-10-2011) - Refer to entire document	1, 39 and 48

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CA2015/050591

Patent Document Cited in Search Report	Publication Date	Patent Family Member(s)	Publication Date
US2013110283A1	02 May 2013 (02-05-2013)	US2013110283A1 CN103491927A JP2014515684A KR20140018309A RU2013152056A WO2012148976A1	02 May 2013 (02-05-2013) 01 January 2014 (01-01-2014) 03 July 2014 (03-07-2014) 12 February 2014 (12-02-2014) 27 May 2015 (27-05-2015) 01 November 2012 (01-11-2012)
WO2011042840A1	14 April 2011 (14-04-2011)	WO2011042840A1 CN102548525A CN102548525B EP2485704A1 EP2485704B1 JP2013506487A JP5671045B2 RU2012118815A US2012199650A1	14 April 2011 (14-04-2011) 04 July 2012 (04-07-2012) 17 June 2015 (17-06-2015) 15 August 2012 (15-08-2012) 17 April 2013 (17-04-2013) 28 February 2013 (28-02-2013) 18 February 2015 (18-02-2015) 10 November 2013 (10-11-2013) 09 August 2012 (09-08-2012)
WO2013013108A2	24 January 2013 (24-01-2013)	WO2013013108A2 WO2013013108A3 EP2734171A2 EP2734171A4 US2013066463A1	24 January 2013 (24-01-2013) 04 April 2013 (04-04-2013) 28 May 2014 (28-05-2014) 18 March 2015 (18-03-2015) 14 March 2013 (14-03-2013)
WO2013040075A2	21 March 2013 (21-03-2013)	WO2013040075A2 WO2013040075A3 AU2012308712A1 CA2853886A1 EP2756479A2 EP2756479A4 JP2014526746A US2013088328A1	21 March 2013 (21-03-2013) 10 May 2013 (10-05-2013) 20 March 2014 (20-03-2014) 21 March 2013 (21-03-2013) 23 July 2014 (23-07-2014) 06 May 2015 (06-05-2015) 06 October 2014 (06-10-2014) 11 April 2013 (11-04-2013)
CA2806903A1	09 October 2013 (09-10-2013)	CA2806903A1 CA2701396A1 CA2796700A1 EP2560603A1 US2012259456A1 US8874260B2 US2015012131A1 WO2011130840A1	09 October 2013 (09-10-2013) 22 October 2011 (22-10-2011) 27 October 2011 (27-10-2011) 27 February 2013 (27-02-2013) 11 October 2012 (11-10-2012) 28 October 2014 (28-10-2014) 08 January 2015 (08-01-2015) 27 October 2011 (27-10-2011)
WO2011130840A1	27 October 2011 (27-10-2011)	WO2011130840A1 CA2701396A1 CA2796700A1 CA2806903A1 EP2560603A1 US2012259456A1 US8874260B2 US2015012131A1	27 October 2011 (27-10-2011) 22 October 2011 (22-10-2011) 27 October 2011 (27-10-2011) 09 October 2013 (09-10-2013) 27 February 2013 (27-02-2013) 11 October 2012 (11-10-2012) 28 October 2014 (28-10-2014) 08 January 2015 (08-01-2015)