Title: SYSTEM FOR MONITORING DRUG COMPLIANCE USING HIGH RESOLUTION FORCE SENSING

Abstract: The goal of the invention described in this document is to provide a portable drug compliance system with the following capabilities: i) Alerting patients to take their medication, ii) Monitoring the amount of medication that has been consumed by the patient, iii) Warning patients of an accidental overdose of medication, iv) Automatic re-ordering medicines before they run out. This goal is realized by a) measuring the weight of the medication remaining in a medication container by a force sensor with sub-milliNewton resolution and by b) control electronics (720) for transmitting an alert.
System for Monitoring Drug Compliance using High Resolution Force Sensing

[0001] The invention relates to a system for the monitoring of drug consumption with the features given in claim 1.

BACKGROUND OF THE INVENTION

[0002] The present invention is in the technical field of health management. More particularly, the present invention is in the technical field of medication compliance and health monitoring systems. Poor medication compliance is one of the leading reasons for spiraling health costs and premature death among the elderly. A Healthcare Intelligence Network report titled "The 2011 Benchmarks in Improving Medication Adherence" estimates that poor medication adherence contributes to a loss of US$ 290 billion to the U.S. economy and also results in the avoidable death of 125,000 people every year in the United States. The report further says that although similar statistics for Europe are not available, it is still safe to assume that they're not very different from the U.S.

[0003] The World Health Organization (WHO) estimates that only 50 percent of patients follow their doctor's prescription. Further, WHO estimates that this figure goes down to 25 percent for elderly patients who are at the maximum risk of death and disability due to medication non-compliance. Poor medication compliance is attributed to many reasons. The most common ones are as follows:

- High cost of medication,
- Unpleasant side effects of medicines,
- Forgetfulness in taking medicines,
- Difficulty in reordering of medicines,
- Poor visibility on the benefits of treatment to the healthcare provider,
- Mix-up of different medicines.
PROBLEM TO BE SOLVED

[0004] The goal of the invention described in this document is to provide a drug compliance system, preferably portable, with the following capabilities:

1. Alert patients to take their medication.
2. Monitor the amount of medication that has been consumed by the patient.
3. Warn patients of an accidental overdose of medication.
4. Automatically reorder medicines before they run out.

[0005] This is realized by measuring the weight of the medication remaining in a medication container by a force sensor with sub-milliNewton resolution.

PRIOR ART

[0006] There are many variations of medication adherence systems available in the market. These adherence systems address some but not all of the issues surrounding medication compliance.

[0007] Med-Time XL automatic pill dispenser from e-pill (http://www.epill.com) comprises a lockable unit that automatically "beeps" at the designated times, and then rotates to open a compartment revealing the correct pills to take. To turn off the "beeping", the patient picks up the dispenser and pours out the pills. The pill dispenser then automatically resets for the next set of medications.

[0008] MedSignals (http://www.medsignals.com) is an integrated pill reminder system that alerts the patient via four distinct signals (beep, flashing light, voice, and text) to take the pill at pill time. The device automatically detects the opening of the pillbox and maintains a history of lid openings during the week. MedSignals provides a personalized web page to the patient and authorized health providers showing the patient's monthly pill adherence.

[0009] GlowCaps (http://www.vitality.com) is a screw-on cap for a standard prescription medicine bottle, but it has a sensor and transmitter embedded in the cap. GlowCaps are
programmed via a home computer to send pill reminder alerts to the patient. The system works by flashing a light on the GlowCaps at the pill time. If the pill bottle is not opened within the next half-hour of pill time, a three-tone alert and then a five-tone alert is sounded. If the bottle is still not opened, the system makes an automated reminder phone call to the patient or a caregiver. The GlowCaps system compiles adherence data that anyone can be authorized to track. GlowCaps can also send a pill order request to the pharmacy via a push button under the GlowCaps.

[0010] Additionally, many medication adherence systems have been invented but not commercialized yet.

[0011] US 6,294,999 B1 describes a Smart Tray and intelligent medication containers that facilitates self-management of medication regimes by the patient. The medication containers are affixed with electromagnetic tags that provide information about medication containing within the container. The Smart Tray has sensors to read the information encoded in the electromagnetic tags and provide visual / audio cues to the patient to remind it to take the medication at the prescribed time. The Smart Tray also monitors via a weight sensor when the medication was removed for consumption.

[0012] US 7,928,835 B1 describes a medication system comprising a portable drug container that has a sensor and control logic to detect when a pill or a liquid has been consumed from the drug container. The system, based on the sensor, automatically estimates and tracks drug consumption and provides a patient with reminders when a dosage is currently due. If the patient deviates from an expected drug regime, the system automatically senses this event and provides a notification to the patient or caregiver.

[0013] US 8,069,056 B2 describes systems, methods and apparatus for improving and/or monitoring a patient's compliance with a medication schedule. The methods and apparatus in this invention comprise a plurality of medication containers that are able to wirelessly communicate with
each other and alert the patient to consume the medication stored in the containers in the prescribed sequence. The system further comprises a central monitoring station/cradle that calibrates the medication containers with the information for alerting patients from consuming wrong medicine. The central monitoring station also measures medication compliance by computing the weight of the medication container each time the container is returned to the station.

Problems with Prior-Art

[0014] While the existing medication adherence systems do an excellent job of reminding the home patients to take medication, they don't address patients with a mobile lifestyle such as for example working professionals who take daily medication but also go to the office 5 days a week. The existing system can alert the patient to take medication only when they're in close proximity of the medication container. Most existing medication adherence systems are not mobile and cannot be simply carried around.

[0015] None of the existing adherence systems are capable of unambiguously measuring drug removal from the medication container. Existing systems measure drug removal based on the number of times a medication container was opened and closed. This mechanism triggers false alerts and is unable to prevent an accidental drug overdose.

[0016] None of the existing adherence systems can automatically issue a medication reorder request before the medicines run out of stock. Only GlowCaps provides an option to send a medication reorder request. However, this is also a manual process that must be initiated by pressing a push button at the underside of GlowCap.

[0017] None of the existing systems interact with Smart Cards or the EMR (Electronic Medical Records) Cloud gateway to provide better visibility on the patient's health record to the healthcare providers and medical researchers.

[0018] Most of the existing systems cannot be used in combination with the original drug container provided by the
Pharmacy or Doctor. The drugs have to be transferred into the existing medication adherence systems, which is a source of error since the label (name of the drug, dosage, expiration date) of the original container is not transferred during that process. This results in the danger that the patient is accidentally taking the wrong medicine or the wrong dosage.
DESCRIPTION OF THE INVENTION

[0019] The working principle of the invention will now be described more in detail with reference to the accompanying drawings wherein

[0020] Figure 1 System overview with medication container inserted;

[0021] Figure 2 System Overview with medication container not inserted;

[0022] Figure 3a) System buildup with a low amount of medication in the medication container;

[0023] Figure 3b) System buildup with a large amount of medication in the medication container;

[0024] Figure 4 Differential force sensor interface electronics;

[0025] Figure 5a) System - alternative sensor/housing configuration with a low amount of medication in the medication container;

[0026] Figure 5b) System - alternative sensor/housing configuration with a large amount of medication in the medication container;

[0027] Figure 6 System - alternative Representation.

[0028] The present invention comprises a system 700 - instead of system the term device can also be used - for monitoring drug compliance of patients. The system monitors medicine consumption through a weight sensor 709 featuring sub-milliNewton resolution to detect the remaining drug 712 or the remaining medication 712 in the medication container (e.g. pill bottle, vial box, pill organizer). The system alerts the patient to take medication at the prescribed time through visual / audio cues and by triggering a telephonic reminder if the patient did not respond to the earlier alerts. When all reminder attempts fail, a missed dose is recorded in the system. When the medication stock reaches a critical threshold, the system automatically sends a reorder
request. In other words, the present invention provides a mechanism to:
- alert/remind patients to take their medication;
- warn patients of an accidental overdose of medication;
- automatically reorder medications before they run out;
- capture and share the patient's medication compliance reports with the healthcare providers and caregivers.

**Buildup and Working Principle**

[0029] Figure 1 and Figure 2 show the basic buildup of the system 700 respectively device 700. A standard medication container 710 such as a pill bottle, pill organizer or vial box is inserted into the system 700 using the medication container holder 711. Since the original medication container 710 is filled with medication 712 or drug 712, the medication container 710 can be mounted/attached to the system 700. For that reason it is not required to pour the medication from the original container into system-specific container. The label by the pharmacy or doctor on the medication container 710 which contains information about the medication 712 is visible to the patient. This is considerable advantage, since no confusion can arise and the risk of contamination is significantly reduced.

[0030] The medication container holder is attached to the force sensor 709. The force sensor 709 is used to measure the weight of the medication container 710 including the weight of the medication 712. The mass of the medication container holder 711 is measured as well but is constant. This medication 712 can be any kind of drug or nutrition additive and can have the form of pills, powder or liquid solution. By measuring the weight of the medication container 710 and knowing the physical properties of the medication 712, the load measured by the force sensor 709 can be used to estimate the amount of medication 712 that remains in the medication container 710. For different medication containers 710 the medication container holder 711 can be replaced by re-attaching it to the force sensor 709. The medication container holder 711 may include...
adjustable clamps 732 to snap onto the medication container 710 which exist in standard shapes; there is no need to
design customized medication containers especially for this
system 700 respectively device 700. Also, the medication
container holder 711 may have a tubular shape to insert the
medication container.

[0031] Using this weight information provided by the force
sensor 709, the system 700 can measure the medication
consumed by the patient and compare it with the prescribed
medication planned by the doctor. The system automatically
warns the patient by an optical signal on the display 726 or
the status lamp 729 if she/he forgets to take the medication
712 in time. Also, the system may include a speaker 728 to
create acoustic signal to warn the patient if she/he does
not adhere to the medication plan. If the patient does not
react to either signal, an alert is sent to the patient and
or the caregiver by phone or short message service (SMS)
respectively. For sensing out the alert signal, a wireless
transmitter 721 is included in the system control
electronics 720. Instead of a phone transmitter, a different
wireless transmitter 721 may also be used to send out alerts
by WLAN or Bluetooth, e.g. generate warning emails or send
signals to a Bluetooth receiver integrated inside a mobile
phone, watch or jewelry. The control electronics 720 have a
slot for inserting a subscriber identification module (SIM)
card for communication by phone and short message service
(SMS).

[0032] If the force sensor 709 measures that a higher amount
of drugs is consumed than planned by the doctor or pharmacy,
an overdose is identified. This overdose alert is also sent
to the patient, the caregiver, the doctor and/or the
hospital directly by the wireless transmitter 721. The
information flow is displayed in Fig. 7.

[0033] The system 700 is powered by a rechargeable or non-
rechargeable battery 722. Since the system 700 is a mobile
device the patient can take it with her/him all the time;
for that reason the system 700 is called also a portable
system 700. The typical size for the portable system 700 is smaller than 20cm x 20cm x 20cm and the weight is below 1.5kg. This typical size allows a use of this system 700 also on travels. The system 700 must for the operation be placed on a stable ground; details for operation are explained in the following paragraph. If the battery runs low the patient is warned by the display 726, speaker 728 and/or status lamp 729. Also, the patient and/or caregiver may be warned by a wireless transmission.

[0034] To ensure an accurate weight measurement, the portable system 700 has to be in an upright position. To measure the orientation, the system 700 may include a tilt sensor 730 such as at least one single-axis or multi-axis accelerometer. The signal by the tilt sensor 730 may be used to compensate the load signal by the force sensor 709 for small angles by an angle-dependent correction factor. For larger angles, the portable system 700 can warn the patient by the display 726, status lamp 729 or speaker 728 to rotate the system into an upright position if the portable system 700 has been tilted for a longer time (e.g. 30 minutes or longer).

[0035] Most micro scales for measuring small weights such as the weight of an individual medication pill are not a suitable technology for a portable device due to the sensitivity to shock and the large weight. Also, this technology is quite complex and expensive. To be useful for a system 700 which is measuring medication compliance, a different type of force sensor 709 must be used. Suitable technologies include piezoelectric sensors, piezoresistive sensors, strain-gauge sensors, optical sensors, electromagnetic sensors as well as capacitive sensors. Also, any other type of weight sensor with sub-milliNewton resolution may be integrated in the portable system 700 for the weight sensing task. Capacitive force sensing is a powerful technology due to the advantages like temperature insensitivity, long-term stability, high resolution, compactness and the simple buildup. Sub-milliNewton resolution is required in order to measure the removal of
small medication 712 quantities from the medication container 710 such as a single pill. A temperature sensor 739 may be integrated in the portable system to compensate for signal drift of the force sensor 709 signal due to temperature variations.

[0036] Figure 3 shows the buildup of the portable system 700 with an integrated capacitive force sensor 709. The medication container holder 711 is attached to the force sensor movable part 714. Elastic elements 717 such as double-clamped straight beams connect the force sensor movable part 714 with the force sensor non-movable part 715. These parts are forming a compliant mechanism. To avoid damage to the sensitive elastic elements 717, one or more overload protections 716 which limit the deformation of the elastic elements 717 are used. Having the overload protection 716, the patient can perform tasks like replacing, opening and closing of the medication container without damaging the force sensor 709. Figure 3a) shows the portable system 700 with a low amount of medication 712 inside the medication container 710 while Figure 3b) shows the portable system 700 with a large amount of medication 712 remaining in the medication container 710. The weight of the medication container 710 with the medication 712 create a deflection of the elastic elements 717. This deflection is measured by capacitor electrodes as a change of the air gap between the capacitor plates or as a change of the overlapping area of the capacitor plates. In case of a differential capacitive force sensor 709 configuration, one or more movable electrodes 718 are attached to the force sensor movable part 714. One or more fixed electrodes are attached to the force sensor non-movable part 715.

[0037] The force sensor 709 sensing range and resolution can be changed by modifying the stiffness of the elastic elements 717. The stiffness k of two double-clamped elastic beams as shown in Figure 3 is given by:

\[ k = 2Ei^3w/l^3 \]
where \( E \) is the Young's Modulus of the elastic element 717
material, \( t \) the thickness of the beam, \( w \) the width of the
beam and \( l \) the length of the beam.

[0038] However, the elastic elements 717 may also have a
different shape than a double clamped beam. Typically, the
elastic elements 717 are made of a metal alloy or silicon.

[0039] The deformation \( z \) is then given by:
\[
z = \frac{(m_c+m_h+m_m)g}{k}
\]
where \( m_c \) is the mass of the medication container 710, \( m_h \) the
mass of the medication container holder 711, \( m_m \) the mass of
the medication 712 and \( g \) the gravity constant.

[0040] The electrical capacitance \( C \) of a parallel plate
capacitor is given by:
\[
C = \varepsilon \frac{A}{d}
\]
where \( \varepsilon \) is the dielectric constant of air, \( A \) is the
overlapping area of the capacitor electrodes and \( d \) is the
spacing (air gap) between the capacitor electrodes. Figure 3
and figure 5 show a differential parallel plate configuration with a transverse sensing direction (change of air gap
is measured). The electrical capacitances \( C_1 \) and \( C_2 \) by the
fixed electrodes 719 and movable electrodes 718 is given by:
\[
C_i = \varepsilon \frac{A}{d(4+z)} \text{ and } C_2 = \varepsilon \frac{A}{(d-z)}
\]

[0041] To measure the change of electrical capacitance,
interface electronics as shown in Figure 4 can be used to
transduce and amplify the capacitance signal into an analog
or a digital output signal \( V_{out} \). A 180° phase shifted signal
is given to the fixed electrode pair 719. The movable
electrode 718 is the common electrode in this example where
the charge is integrated by an operation amplifier with
feedback capacitor \( C_F \).

\[
V_{out} = i_1(C_1-C_2)/C_F
\]
or
\[
V_{out} = i_2(C_1-C_2)/(C_1+C_2)
\]
respectively, where \( i_1 \) and \( i_2 \) are constants given by the
interface integrated circuits (ICs). Sensor ICs are
commercially available such as the MS3110 by Irvine Sensors Ltd. and the PS021 by ACAM Messelectronic GmbH. Studying the specifications of the interface ICs show that the resolution of the force sensor is good enough to measure forces up to single Newtons with a resolution around 10 microNewtons (more than 10\(^0\)000 divisions at a readout frequency of 10Hz), which corresponds to weights from several 100grams down to tens of milligrams resolution. This resolution is high enough the measure the consumption of single pills.

[0042] Alternatively, instead of measuring the weight of the medication container 710, the weight measurement may also be performed by the force sensor 709 which can mechanically excite the medication container 710 and the medication 712 inside by electrostatic actuation or piezoelectric actuation. The sensing capabilities of the force sensor 709 are then used to measure the natural frequency of the vibrating system that has been induced.

[0043] Besides the sensor interface IC, the control electronics 720 contain a microcontroller and memory. Figure 5 shows an alternative design of the portable system 700 with a different configuration of the force sensor 709. Here, the force sensor 709 is placed directly underneath the medication container 710. The medication container 710 is inserted into the housing 724. A medication container holder 711 is not required. A transparent window 725 in the housing ensures that the label on the medication container is readable by the patient, doctor, pharmacy or caregiver. The housing 724 can be closed by the closure 723 so the medication container 710 doesn't drop from the portable system 700 while handling or during transport.

[0044] To save the planned medication doses and consumption times, the system control electronics 720 includes a timer and a memory such as an EEPROM. The memory can be programmed using the wireless transmitter 721. Alternatively, the planned medication doses and consumption times can be saved on a memory card (e.g. flash-cards, SD-cards) that can be
inserted into the memory card reader 734 of the portable system. The EEPROM or memory card may be used to save statistics about the drug consumption which helps the doctor to optimize the treatment of the patient. Wireless communication using the wireless transmitter 721 can be used to program the EEPROM or memory card as well.

[0045] To charge the battery 722 of the portable system 700 it is simply connected to the battery charger by the electrical plug 731. Alternatively, energy may be harvested by small solar panels mounted on the housing 724. Since the system is portable, electro-mechanical harvesting is also an option. When the portable system 700 is using a rechargeable battery, the battery can be charged through the built-in USB/Firewire interface 738 by connecting the portable system 700 to a computer.

[0046] Future medication containers 710 may include an RFID tag 733 with information about the medication 712, also including the weight of the medication container 710 and the weight of the individual pill or the density of the drug. The pharmacy or the doctor may also save data on the RFID tag 733 containing information about the correct dosage and timing of the drug consumption for the individual patient. This information may include information for the patient about the optimal dosage over time. Alternatively, this information may be stored in form of a barcode. Therefore, the portable system 700 may be equipped with a RFID reader 727 and/or a barcode reader 740. The portable system 700 may be logically integrated into a network together with pharmacies to realize an automated medication reorder if the force sensor 709 shows that the medication 712 in the medication container 710 is low. This process is visualized in figure 7.

[0047] Besides monitoring drug compliance, the portable system 700 may be amenable to automatic calibration with the correct medication 712 dosage based on the weight, age and gender of the patient or via an adaptive drug delivery process based on machine learning. Additionally, the system
may provide interfaces to capture data from health monitoring devices that measure health statistics like the patient's heart rate, blood pressure, temperature etc., thus providing a more comprehensive feedback to the doctors treating the patient. When a patient has consumed medication 712 that is responding negatively on his body, he can trigger an alert to the healthcare provider / caregiver by pressing an authenticated, preferably a biometric emergency button 736. The emergency button 736 will communicate the patient's GPS coordinates obtained by the GPS locator 735 integrated in the control electronics 720 and also communicate the medication 712 he consumed and as well as the dosage measured by the weight sensor 709.

[0048] To assist visually challenged patients in reaching out to the correct medication 712, the portable system 700, includes an NFC proximity sensor 737. The NFC proximity sensor 737 drives an acoustic alert or a vibrator in the portable system 700. When a visually challenged patient wants to take its medication 712, it can connect to the portable system 700 through an NFC transmitter embedded in a cell phone or in a wrist watch/jewelry. Bringing the NFC transmitter 737 closer to the portable system 700 results in an acoustic alert and/or a vibration in the portable system 700.

List of used reference numerals and acronyms

- 700 portable system, system, device
- 710 medication container
- 711 medication container holder
- 712 medication, drug
- 713 stand
- 714 force sensor movable part
- 715 force sensor non-movable part
- 716 overload protection
- 717 elastic element
- 718 movable electrode
- 719 fixed electrode
720 control electronics
721 wireless transmitter, means
722 battery
723 cap
5 724 housing
725 window
726 display
727 RFID reader
728 speaker
10 729 status lamp
730 tilt sensor
731 electrical plug
732 adjustable clamps
733 RFID tag
15 734 memory card reader
735 GPS locator
736 emergency button
737 NFC proximity sensor, means
738 USB / Firewire Interface, means
20 739 temperature sensor
740 barcode reader
k mechanical stiffness of the elastic element
C Electrical capacitance
c1 Capacitance of the first capacitor in a differential configuration
c2 Capacitance of the second capacitor in a differential configuration
ε Dielectric constant of air
A Overlapping area
30 d spacing between capacitor plates
l length of elastic beam
w width of elastic beam
t thickness of elastic beam
E Youngs Modulus
35 z deflection
m_m mass of medication
m_h mass of medication container holder
m_c \text{ mass of medication container}
g \text{ gravity constant}
C_F \text{ capacitance of feedback capacitor}
V_{out} \text{ output signal}

5 \hspace{5pt} \text{USB} \hspace{5pt} \text{Universal Serial Bus}
\text{SMS} \hspace{5pt} \text{Short Message Service}
\text{WLAN} \hspace{5pt} \text{Wireless Local Area Network}
\text{RFID} \hspace{5pt} \text{Radio Frequency Identification}
\text{SIM} \hspace{5pt} \text{Subscriber Identity Module}

10 \hspace{5pt} \text{EEPROM} \hspace{5pt} \text{Electrically Erasable Programmable Read-only Memory}
\text{GPS} \hspace{5pt} \text{Global Positioning System}
\text{NFC} \hspace{5pt} \text{Near Field Communication}
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«Systems and methods for monitoring patient compliance with
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US 7,928,835 B1

10 Jovanov et al.
«Systems and methods for drug compliance monitoring»
US 8,069,056 B2
Walker et al.
«Methods and apparatus for increasing and/or for monitoring
a party's compliance with a schedule for taking medicines»

http://www.epill.com

http://www.medsignals.com

http://www.vitality.com
Claims

1. A system (700) for monitoring of drug consumption of a patient characterized by:
   
a. a medication container holder (711) to mount a medication container (710) on the system (700), the medication container (710) being filled with medication (712);

   b. the medication container (710) being attached to at least one force sensor (709) with milliNewton or better resolution for measuring a medication (712) removal from the medication container (710) as a weight change of said medication container (710);

   c. an overload protection (716) to protect the sensitive force sensor (709) against excessive forces;

   d. control electronics (720) that interface the force sensor (709) and having means to send out an alert when a deviation from a planned drug consumption is detected.

2. The system (700) for the monitoring of drug consumption according to claim 1, wherein said force sensor (709) is a capacitive force sensor, a piezoelectric force sensor or a piezoresistive force sensor, a strain-gauge force sensor or an electromagnetic balanced force sensor.

3. The system (700) for the monitoring of drug consumption according to claim 1 or 2, wherein a wireless transmitter (721) is part of the control electronics (720) to send alerts by phone, SMS, WIFI or Bluetooth when a deviation from a planned drug consumption is detected.

4. The system (700) for the monitoring of drug consumption according to one of the claims 1 to 3, wherein said system (700) comprises a display (726) and/or a status lamp (729) to communicate the status of the system and for reminding the patient of taking the medication (712).
5. The system (700) for the monitoring of drug consumption according to one of the claims 1 to 4, wherein said system has a speaker (728) to acoustically communicate the status of the system and for acoustically reminding the patient of taking the medication (712).

6. The system (700) for the monitoring of drug consumption according to claim 5, wherein said system shows/sounds an alert if said battery is nearing empty and/or an alert is sent by the wireless transmitter.

7. The system (700) for the monitoring of drug consumption according to claim 5 or 6, wherein said system shows/sounds an alert if a cap (723) of the medication container (710) is not securely closed to allow the system to work as designed.

8. The system (700) for the monitoring of drug consumption according to one of the claims 1 to 7, wherein said system communicates via a wireless transmitter (721) and GPS locator (735) the patient's GPS coordinates to healthcare providers/caregivers upon pressing of an authenticated emergency button (736).

9. The system (700) for the monitoring of drug consumption according to one of the claims 1 to 8, wherein said system (700) includes at least one accelerometer or different type of tilt sensor (730) for measuring the orientation of the system and for adjusting the output-signal of said force sensor (709) or to warn the patient to adjust the orientation of the system (700) by a visual or acoustic signal.

10. The system (700) for the monitoring of drug consumption according to one of the claims 1 to 9, which includes a RFID reader (727) to read information being stored on a RFID tag (733) attached to the medication container (710).
11. The system (700) for the monitoring of drug consumption according to one of the claims 1 to 10, which enables an automatic medication reordering service by sending a message to a provider of the medication by a wireless transmitter (721).

12. The system (700) for the monitoring of drug consumption according to one of the claims 5 to 7, wherein said system plays a tune using a speaker (728) and/or vibrates when an NFC transmitter (737) such as a wrist band or a cell phone is brought close to said system (700).

13. The system (700) for the monitoring of drug consumption according to one of the claims 1 to 12, wherein said medication container (710) is a pill bottle, a vial box or a pill organizer.

14. The system (700) for the monitoring of drug consumption according to one of the claims 1 to 13, wherein said system is has a battery (722) and for their recharge a built-in USB/Firewire interface (738) is provided (738).

15. The system (700) for the monitoring of drug consumption according to one of the claims 1 to 14, wherein said system is portable.

16. The system (700) for the monitoring of drug consumption according to claim 15, wherein portable is defined by - a size smaller than 20cm x 20cm x 20cm and by - a weight being below 1.5kg.
Fig. 7
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER
G01G17/00 A61J7/04 G01G19/42
G01G17/06 G01G23/37

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)
G01G A61J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal , WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
<thead>
<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
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<tr>
<td>X</td>
<td>WO 2012/011919 AI (TAI AND TSENG INVESTMENTS LLC [US]; TAI CHIH-CHENG [US]; MYSLINSKI LUC) 26 January 2012 (2012-01-26) page 1, line 1 - page 3, line 24 page 7, line 14 - page 9, line 21 page 16, line 21 - line 31 page 19, line 1 - page 20, line 16 page 24, line 28 - page 25, line 9 figures 1-9 -----</td>
<td>1-16</td>
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Date of the actual completion of the international search 11 June 2013

Date of mailing of the international search report 24/06/2013

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Authorized officer

Koch, Flori an
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<td>US 5 014 798 A (GLYNN KENNETH P [US]) 14 May 1991 (1991-05-14) column 1, line 58 - column 2, line 8 column 2, line 27 - column 4, line 16 figures 1-4</td>
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