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(54) Title of the Invention: **A portable device for the monitoring of medical conditions**
Abstract Title: **Configurable portable device to monitor long term health conditions**

(57) A portable device 11 (e.g. mobile phone, PDA, tablet computer etc.) for remote monitoring of patients with long term conditions, measures data and sends it to an external service 17 via a communication network 16. The set-up of the device 11 is configured to match the monitoring requirements of the type of condition to be measured (e.g. which of a number of measurement modules (25, fig. 2) are to be used). The device comprises: a module controller (24, fig. 2) to access a plurality of modules (25, fig. 2) each module being configured to receive patient medical or biomedical data; a configuration controller (26, fig. 2) to issue a request to the module controller for the execution of at least two of the plurality of modules in accordance with a predetermined order; and a data store (22, fig. 2) to store patient medical or biomedical data received from each module. The configuration controller includes a workflow engine (28, fig. 2). Patient data may be received from auxiliary measurement device 14 connected to the device 11 by wireless link 15, or the patient may be asked questions via a display 12. Long term conditions (LTCs) may include diabetes, asthma, chronic obstructive pulmonary disease and chronic heart failure.
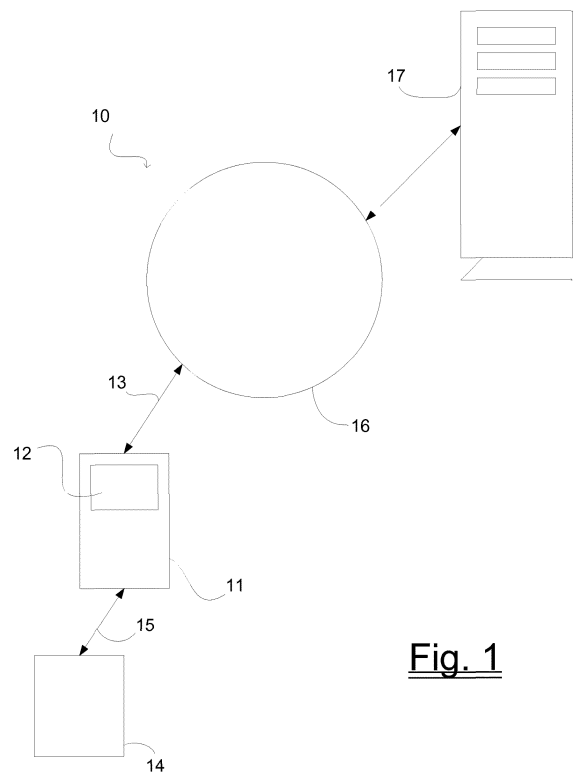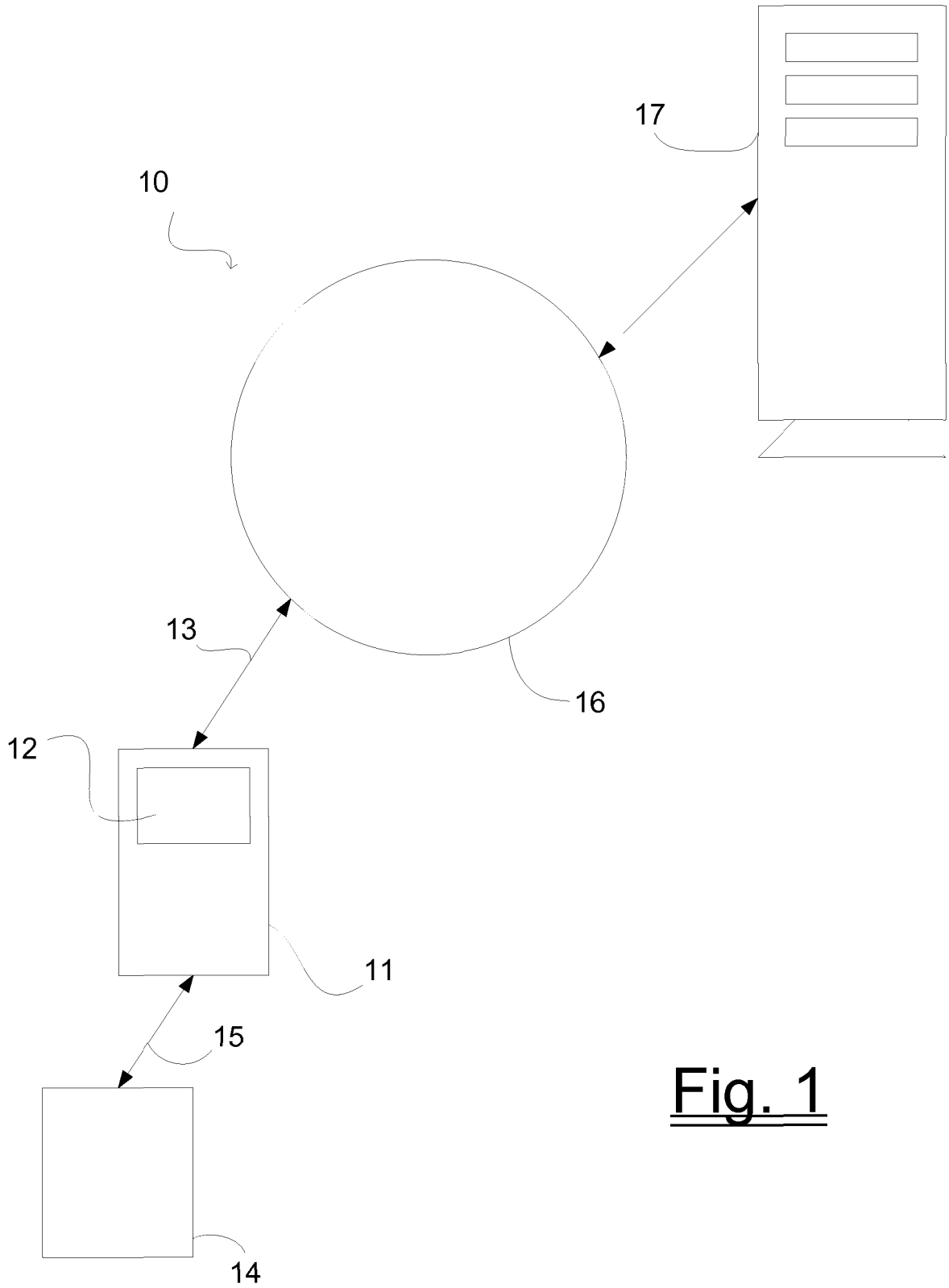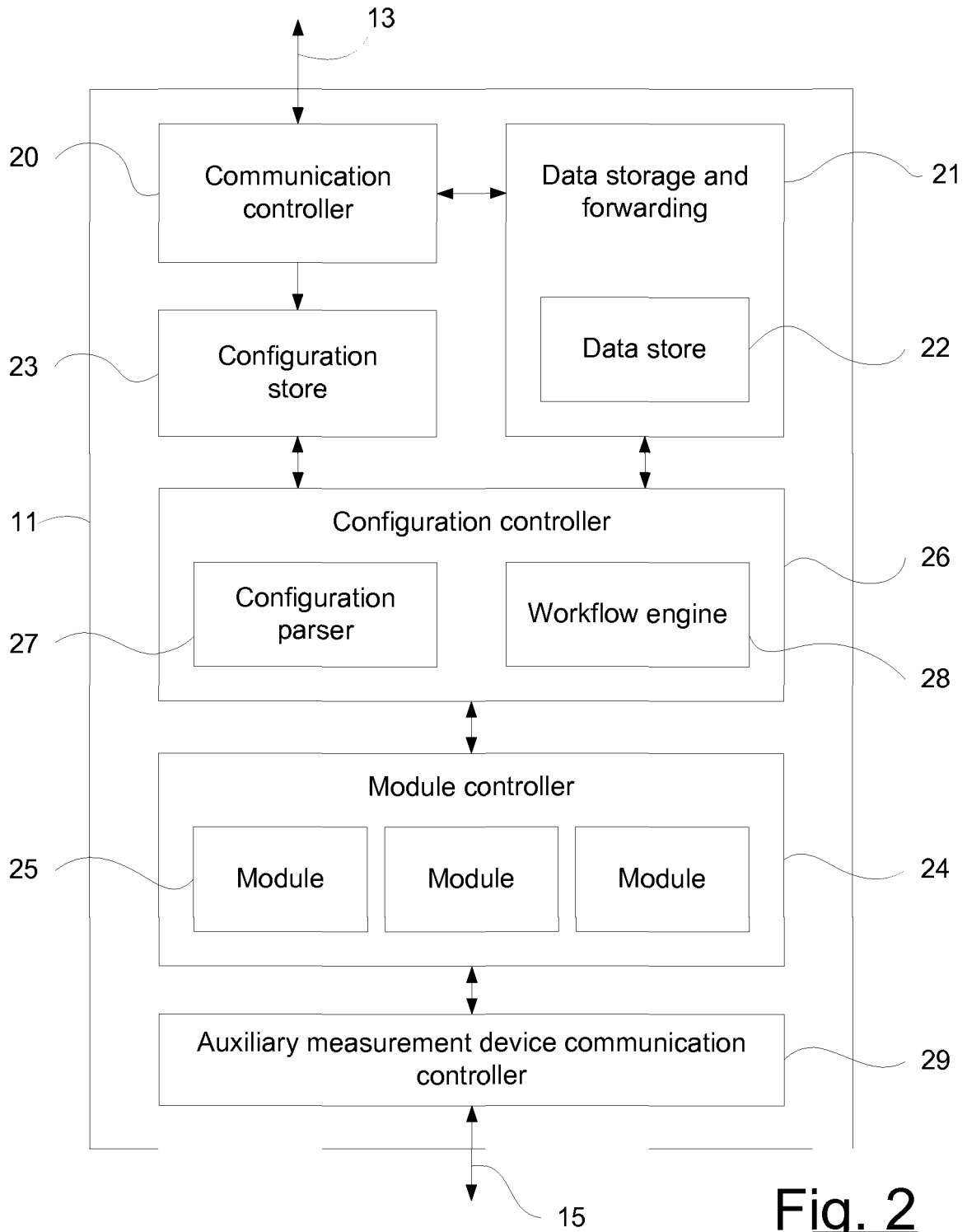

Fig. 1

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Fig. 1

Fig. 2

30 — Receive configuration information from external service

31 — Store configuration information

32 — Load configuration information into workflow engine

Workflow engine determines appropriate next action based on configuration information and/or preceding module output(s) ⌐ 33

35

34 — Further action required? — No → Store and/or forward data

Yes

Execute appropriate module determined by workflow engine — 36

Initialise auxiliary measurement device and record medical data from auxiliary measurement device — 37

Process data recorded from auxiliary measurement device using module and configuration information — 38

<u>Fig. 3</u>

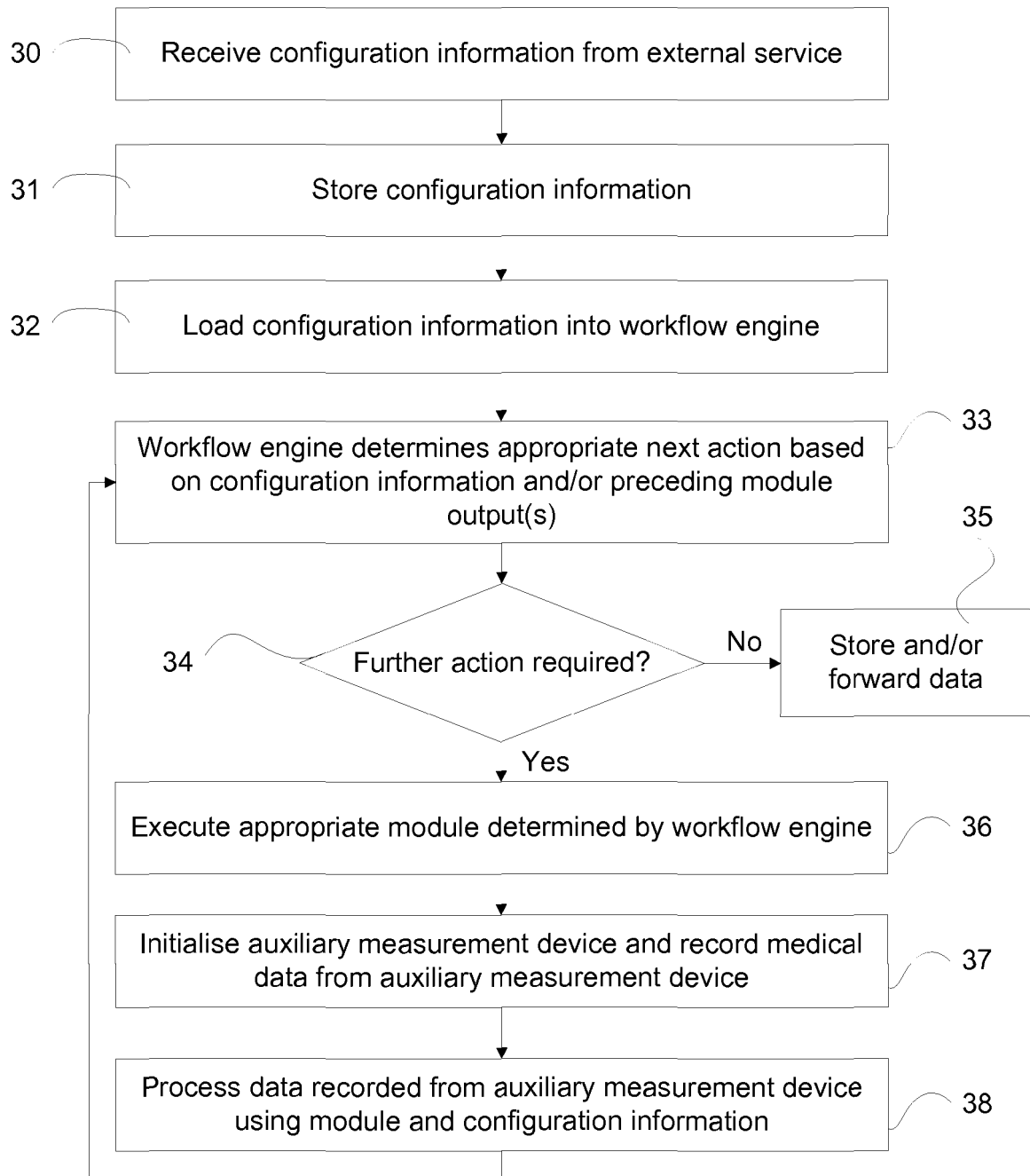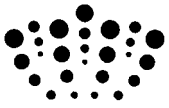Application No. GB1213888.9   RTM   Date :14 November 2012

The following terms are registered trademarks and should be read as such wherever they occur in this document:

Bluetooth
Android

Title: A portable device for the monitoring of medical conditions

Description of invention

This invention relates to a portable device for recording patient data, a system including the portable device, and a method of recording patient data.

A long term condition (LTC) is a term applied to a medical condition, the more common being diabetes, asthma, chronic obstructive pulmonary disease and chronic heart failure.

Many LTCs can be managed in the community, i.e. the patient does not require routine hospital or clinic admission but can be educated to manage their LTC at home, outside of the clinical environment. Long term conditions are particularly time consuming for the patient to manage as they typically have to record information such as medical data (blood pressure, blood glucose, etc.) relating to their condition, sometimes several times a day.

This places a burden on the patient, not only to record the information and ensure its accuracy, but to meet a healthcare professional routinely to discuss the recorded information and to adjust their LTC management regime. Allied to this is the cost burden to the patient's healthcare provider for the healthcare professional's time and other incidentals.

In response to these perceived inefficiencies in the delivery of healthcare to LTC sufferers, telehealth has been favoured as a means of providing a cost-effective method of LTC management.

Broadly, telehealth involves the use of telecommunications technology to deliver health services to patients. In particular, telehealth approaches to LTC management

frequently include a device which is allocated to a patient, whereby the device collects medical data and transmits this over a telecommunications network to a healthcare professional for analysis.

Telehealth devices are generally cumbersome and not easily moved. These devices are items of custom-designed hardware which has to be statically situated in the patient's house. This causes problems for the patient when they are away from their house (e.g. at work, on vacation, etc.) when they cannot use the device to record measurement information.

A further problem with telehealth devices is that they are inefficient to configure.

Given the range of LTCs, specific monitoring regimes need to be programmed into the telehealth devices before being issued to the patient. This does not account for LTC co-existence (e.g. when the patient may be suffering from diabetes and asthma at the same time) where the patient needs to record data relating to two or more conditions. Consequently, because the device cannot be tailored specifically to the patient's LTC combination it is not possible for the telehealth device to provide adequate feedback to the patient, relying on the healthcare professional to perform this task at routine intervals. By not providing feedback to the patient in a timely fashion their LTC is at risk of deteriorating to the point at which medical intervention is required (e.g. hospital admission).

The aim of this invention is to seek to provide a new or improved telehealth device for the recording of a patient's medical data and to seek to provide a method of configuring such a portable device which overcomes one or more of the above problems.

Accordingly, an aspect of the present invention provides a portable device for recording patient data, comprising: a module controller configured to access a plurality of modules, each module being configured to receive patient medical or biomedical data; a

configuration controller communicatively coupled to the module controller, the configuration controller including a workflow engine and configured to issue a request to the module controller for the execution of at least two of the plurality of modules in accordance with a predetermined order; and a data store configured to store patient medical or biomedical data received from each module.

The plurality of modules may be stored in the module controller.

The portable device may further comprise a first interface for a remote auxiliary measurement device, wherein a first of the plurality of modules is configured to collect patient medical or biomedical data from an auxiliary measurement device through the first interface.

The first interface may be further configured to transmit measurement device configuration data to the remote auxiliary measurement device, the measurement device configuration information including one or more instructions for controlling the operation of an aspect of the remote auxiliary measurement device.

The portable device may further comprise an internal measurement device, wherein a second of the plurality of modules is configured to collect patient medical or biomedical data from the internal measurement device.

The portable device may further comprise a display screen and a user input arrangement, wherein a third of the plurality of module is configured output a graphical user interface to the display screen, the graphical user interface prompting a user of input, and to receive a user input through the user input arrangement in response.

The display screen and user input arrangement may comprise a touch-sensitive screen.

The portable may further comprise a configuration store, wherein the configuration is store is configured to store the predetermined order.

The predetermined order may include a scheduled time for the execution of one or more of the plurality of modules.

The portable device may further comprise a third interface configured for communicative connection to a communications network such that received patient medical or biomedical data is transmittable through the third interface to a remote monitoring system.

The third interface may be an Internet connection.

The third interface may be configured to receive configuration information from the remote monitoring system, the configuration information including the predetermined order.

Another aspect of the present invention provides a patient monitoring system including a portable device and the remote monitoring system.

The remote monitoring system may be configured to receive patient medical or biomedical data.

The received patient medical or biomedical data may be displayed on a display screen of the remote monitoring system.

Another aspect of the present invention provides a method of recording patient data, the method comprising: providing a portable device; and executing the at least two of the plurality of modules in accordance with the predetermined order.

According to a described embodiment, we provide a portable device for the recording and reacting to a patient's medical data, the function of the device being dependent on the type and number of long term conditions to be monitored, wherein the portable device comprises a configuration controller, and a configuration store to store configuration information relating to the configuration controller, the configuration information relating (but not limited) to the long term conditions to be monitored, the module controller which executes and coordinates the activities of software modules based on the configuration information, the portable device being operable to receive input data from a measurement device, pass the input data to one or more modules, and receive one or more outputs from the modules which are passed to the configuration controller workflow engine, the portable device being adaptable to record and react to one or more long term conditions by receiving configuration information, store the configuration information in the configuration store, configure the workflow engine to control the module controller based on the configuration information and operate in accordance with the output of the workflow engine.

The configuration information may include references to the modules required to be executed in accordance with the output of the workflow engine, the calendar dates and times of day that modules shall be executed, and information relating to the execution of the workflow engine which may include baseline medical values, default answers to questions and conditional logic instructions on how the workflow engine shall respond to data passed into the workflow engine from one or more modules.

The module controller may contain one or more modules. A module may be operable to receive input data from one or more auxiliary measurement devices.

The portable device may have a wireless connection to the auxiliary measurement device whereby the portable device may receive the input data from the auxiliary measurement device.

The portable device may be operable to process the information in accordance with configuration information.

The portable device may be operable to update the configuration information in accordance with at least one of the outputs of the configuration controller. The portable device may be operable to update the configuration information held in the configuration store in accordance with at least one of the outputs of the configuration controller.

The portable device may be operable to transmit at least one of the input data and the output of the configuration controller to an external service.

The portable device may be operable to receive configuration information from an external service and store the configuration information in the configuration store.

The portable device may comprise one of a mobile telephone and a personal digital assistant and a tablet personal computer.

According to a described embodiment, we provide a method of providing a portable device for the recording and reacting to a patient's medical data, the portable device comprising a configuration controller, and a configuration store for holding configuration information comprising information relating to the execution of the workflow engine and the modules required to be executed in accordance with the outputs of the workflow engine, the

method comprising the steps of on a separate device, generating the configuration information and transmitting the configuration information to the portable device.

The method may comprise the step of providing an instruction set corresponding to an auxiliary measurement device operable to generate the input data and transmitting the instruction set to the portable device.

According to a described embodiment, we provide a method of recording and reacting to a patient's medical data using a portable device comprising a configuration controller, and a configuration store for holding configuration information, comprising the steps of receiving configuration information relating to the workflow engine, the configuration information comprising information relating to the modules required to be executed in accordance with the output of the workflow engine, the calendar dates and times of day that modules shall be executed, baseline medical values, default answers to questions and conditional logic instructions on how the workflow engine shall respond to data passed into the workflow engine from one or more modules, and storing the configuration information in a configuration store of the portable device, receiving input data, passing the input data to the workflow engine, and receiving an output from the workflow engine.

The method may comprise a step of transmitting at least one of the input data and the output to an external service.

The method may comprise the step of receiving the input data from an auxiliary measurement device.

The invention is described, by way of example only, with reference to the accompanying drawings in which:

Figure 1 is a diagrammatic illustration of a system including a portable device embodying the present invention;

Figure 2 is a block diagram of a portable device embodying the present invention; and

Figure 3 is a flow diagram of a method embodying the present invention.

Referring to Figure 1, a system including a portable device embodying the present invention is generally shown at 10. A portable device embodying the invention is generally shown at 11; in this example, the portable device 11 is operable to communicate with an auxiliary measurement device 14 via a short range communications link 15.

The short range communications link 15 may be any appropriate link as desired: for example, a physical/wired connection or a wireless connection (such as an infrared link or a radio connection such as a Bluetooth connection).

The auxiliary measurement device 14 may be operable to capture any desired medical or biomedical data and transmit the data via the communication link 15 to the portable device 11.

In embodiments, the portable device 11 is itself provided with an appropriate measurement device to capture the required data shown in 12, in which case the auxiliary measurement device 14 may be omitted.

As an example, the portable device 11 may comprise a mobile telephone and the measurement device 12 might simply be a touch sensitive visual display of the mobile telephone which may also provide an output to be viewed by the user.

The portable device 11 is further connected to a communication network generally illustrated at 16, via an appropriate link 13. The link 13 may be a wired or wireless link 13.

The network 16 enables the portable device 11 to communicate with any appropriate desired system. In the present example, an external service operable to receive data is generally shown at 17. The communication network 16 may be any communication network, such as a cellular radio mobile telecommunications network, a public switched telephone network, the Internet or any other communications network or combination of networks as desired. For example, the portable device 11 may connect to a cellular radio telephone network to connect to a service providing Internet access; and so connect to the external data receiving service 17 via the Internet.

The communication network 16 may, as will be appreciated, comprise one or more wired and/or one or more wireless sub-networks.

Referring to Figure 2, the architecture of an example embodiment of the portable device 11 is generally shown.

With reference to Figure 2 the portable device 11 comprises of a communications controller 20 operable to establish the communications link 13 with the communications network 16.

Preferably, this communications link 13 is secure – for example, encrypted; advantageously, where the portable device 11 comprises a mobile telephone, the controller 20 may be operable to establish a digital GSM link with a cellular radio telephone network.

To provide for recording and reacting to a patient's medical data, the portable device 11 comprises a configuration controller 26, which comprises a configuration parser 27 and workflow engine 28.

The configuration controller 26 is operable to read configuration information from a configuration store 23, to perform any pre-processing of the configuration information with the configuration parser 27 and to pass the parsed configuration information to the workflow engine 28.

The configuration information comprises one or more of information relating which of a plurality of modules 25 shall be executed, the sequence in which the modules 25 shall be executed, conditional logic that the workflow engine 28 shall use to determine the succeeding module 25 execution sequence based on one or more outputs from preceding module 25 executions, the calendar times and dates that modules 25 shall be executed, and medical baseline values which may be used by the workflow engine 28.

The configuration store 23 is operable to store configuration information. The configuration information held in the configuration store 23 may be updated by instructions received by the communications controller 20 from the external service 17. The configuration information held in the configuration store 23 may be updated by the workflow engine 28.

The workflow engine 28 may be operable to instruct a module controller 24 to execute one or more modules 25 in parallel or in sequence or any combination thereof, in accordance with the configuration information.

In an example a module 25 may comprise one or more user interface screens which the user views on a screen of the portable device 12 which gives the user information on how to operate the auxiliary measurement device 14 in capturing medical data, and may further comprise instructions which are passed to the auxiliary measurement device communication controller 29 in operating one or more of the auxiliary measurement device(s) 14 in recording medical data, and shall pass the recorded data from the auxiliary measurement device(s) 14 to the workflow engine 28.

In another example a module 25 may comprise one or more user interface screens which the user views on the portable device screen 12 which pose questions for the user to answer by pressing parts of the screen 12, and shall pass the recorded data from the screen 12 to the workflow engine 28.

In another example a module 25 may comprise one or more user interface screens which the user views on the portable device screen 12 which gives the user instructions on how to operate the auxiliary measurement device 14 in capturing medical data, and may further comprise instructions which are passed to an auxiliary measurement device communication controller 29 in operating one or more of the auxiliary measurement device(s) 14 in recording medical data, and may further comprise user interface screens which the user views on the portable device screen 12 which pose questions for the user to answer by pressing parts of the screen 12, and shall pass the recorded data from the screen 12 and auxiliary measurement device(s) 14 to the workflow engine 28.

A data storage and forwarding block is generally shown at 21, which in this example comprises a data store 22 in which medical or biomedical data is stored.

The data storage and forwarding block 21 enables medical data and the outputs of the workflow engine to be stored prior to transmittal to the external service 17 via communications link 13.

The auxiliary measurement device communication controller is shown at 29 operable to link to an auxiliary measurement device 14 , to receive data from the auxiliary measurement device 14 and to pass it to the module 25 and/or the data storage and forwarding block 21, and to transmit control instructions to the auxiliary medical device 14 over the link 15.

In the an example, the mobile device 11 is a device capable of executing applications written for the Android operating system using the Java programming language, the processor technology having an operating frequency in the range of 600 MHz and 512 megabytes of available memory storage; and may advantageously comprise a visual display screen which is responsive to touch. This configuration is purely by way of example and it will be apparent that a portable device 11 may be programmed and configured on any appropriate platform and using any appropriate technology or programming language as available.

Operation of the portable device 11 will now be described by way of example with reference to Figure 3. At step 30, the portable device 11 receives the configuration information from the external service 17. The received configuration information is stored in the configuration store 23 at step 31.

At step 32 the configuration information is read from the configuration store 23, and loaded into the workflow engine 28.

At step 33 the workflow engine 28 interprets the configuration information.

At step 34 the workflow engine 28 determines which course of action is required in accordance with the configuration information, which in this example is the execution of a module 25. The module 25 that the workflow engine 28 determined shall be executed in accordance with its interpretation of the configuration information, in this example, captures medical data from auxiliary measurement device 14.

At step 36 the module 25 is executed and the module displays appropriate information to the user via the portable device screen 12 where such information instructs the user in the operation of the auxiliary measurement device 14, and given that there may be a plurality of modules 25 operable on the portable device 11, we shall refer to this module as 25a purely to clarify subsequent steps in this example.

At step 37 the auxiliary measurement device 14 operating in accordance with the configuration information transmits medical data to the module 25a.

At step 38 the module 25a processes the data transmitted by the auxiliary measurement device 14 and passes this data to the workflow engine 28. This returns algorithmic flow to step 33 where in this example the workflow engine 28 in accordance with the configuration information and the outputs of the module 25a determine at step 34 that a module 25 (henceforth referred to as module 25b purely for clarity in this example) shall be executed which may be different to the module 25a executed previously in this example.

At step 36 the module 25b is executed, which may be operable to pose a series of questions to the user via the portable device screen 12 and the user may provide responses by pressing specific areas of screen 12.

At step 37 the data input method is via the portable device touch screen 12 rather than an auxiliary measurement device 14.

At step 38 module 25b processes the data entered via portable device screen 12 and returns this data to the workflow engine 28 at step 33.

At step 33 the workflow engine 28 in accordance with the configuration information and results passed from modules 25a and 25b determines that no further action is required.

At step 35 the medical data, and/or outputs from the modules 25a and 25b, and/or outputs from workflow engine 28 are passed to the data storage and forwarding block 21 for transmission to the external service 17 via link 13.

This step may be adapted dynamically by the portable device 11; it may for example be envisaged that the portable device 11 is in an area where there is for example no mobile telephone coverage in which case the portable device 11 may store the data in the data store 22 until a communication link 13 is re-established, whereupon the data may be retrieved from the data store 22 and forwarded to the external service 17.

It will be apparent that the portable device 11 may be responsive to other instructions, for example instructions sent by the external service 17 via the communication network 16 to, for example, instruct the portable device to generate a status message, or to perform an immediate execution of the workflow engine 28 as opposed to waiting until the specific calendar date and time which may be included in the configuration information, or indeed any appropriate operations as required.

The portable device 11 may be notified if there is an updated set of configuration information and/or modules 25 and/or functions provided by the portable device 11.

It will be apparent that the present invention provides a highly flexible and adaptable system. The portable device 11 can be reconfigured to monitor any condition remotely and may be kept with the patient with no appreciable problem or inconvenience.

The portable device 11 may provide both a monitoring service for providing alerts in case of abrupt changes in the person's condition and also provide long term clinical trend data.

Possible auxiliary measurement devices include, but are not limited to: blood pressure monitors; electrocardiograms, pulse monitors, oximeters, respiratory function monitors, pedometers, electronic stethoscopes, electroencephalograms, plethsmography, ultrasonography, electromyography, electroneuronography, lung and heart sounds, fetal sounds, thermometers, nanotechnology agents and devices, biochemical monitors (e.g. blood sugar), multisensory arrays (e.g. electronic nose, gas chromatography, mass spectrometry, ion mobility spectrometry).

The medical data and workflow engine 28 outputs may be forwarded or acted upon by the external service 17 in any appropriate manner, for example to allow a physician to perform a diagnosis placed on the received data for output, establish the requirements of patients in the context of treatment and/or surgery where the requirements are to be assessed based on the medical data obtained from the active patients, assessing the clerical clinical support where the long term health of the patient is important, for example, if a patient has a long term condition and/or chronic disease, and monitoring a patient's condition after treatment, particularly where data over a long term is required and where monitoring the patient's conditions may be otherwise inconvenient.

This is also advantageous given that substantial health organisation resources are devoted to monitoring patient's health.

The portable device 11 may be a mobile telephone or personal digital assistant or a tablet personal computer or any other appropriate device as required.

In the present specification "comprises" means "includes or consists of" and "comprising" means "including or consisting of".

The features disclosed in the foregoing description, or the following claims, or the accompanying drawings, expressed in their specific forms or in terms of a means for performing the disclosed function, or a method or process for attaining the disclosed result, as appropriate, may, separately or in any combination of such features, be utilised for realising the invention in diverse forms thereof.
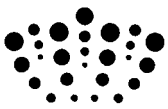
Claims

1.   A portable device for recording patient data, comprising:

        a module controller configured to access a plurality of modules, each module being configured to receive patient medical or biomedical data;

        a configuration controller communicatively coupled to the module controller, the configuration controller including a workflow engine and configured to issue a request to the module controller for the execution of at least two of the plurality of modules in accordance with a predetermined order; and

        a data store configured to store patient medical or biomedical data received from each module.

2.   A portable device according to claim 1, wherein the plurality of modules are stored in the module controller.

3.   A portable device according to claim 2, further comprising a first interface for a remote auxiliary measurement device, wherein a first of the plurality of modules is configured to collect patient medical or biomedical data from an auxiliary measurement device through the first interface.

4.   A portable device according to claim 3, wherein the first interface is further configured to transmit measurement device configuration data to the remote auxiliary measurement device, the measurement device configuration information including one or more instructions for controlling the operation of an aspect of the remote auxiliary measurement device.

5.   A portable device according to any of claims 2 to 4, further comprising an internal measurement device, wherein a second of the plurality of modules is configured to collect patient medical or biomedical data from the internal measurement device.

6.   A portable device according to any of claims 2 to 5, further comprising a display screen and a user input arrangement, wherein a third of the plurality of module is configured output a graphical user interface to the display screen, the graphical user interface prompting a user of input, and to receive a user input through the user input arrangement in response.

7.   A portable device according to claim 6, wherein the display screen and user input arrangement comprise a touch-sensitive screen.

8.   A portable device according to any preceding claim, further comprising a configuration store, wherein the configuration is store is configured to store the predetermined order.

9.   A portable device according to any preceding claim, wherein the predetermined order includes a scheduled time for the execution of one or more of the plurality of modules.

10.   A portable device according to any preceding claim, further comprising a third interface configured for communicative connection to a communications network such that received patient medical or biomedical data is transmittable through the third interface to a remote monitoring system.

11.   A portable device according to claim 10, wherein the third interface is an Internet connection.

12.   A portable device according to claim 10 or 11, wherein the third interface is configured to receive configuration information from the remote monitoring system, the configuration information including the predetermined order.

13.   A patient monitoring system including a portable device according to claim 10, 11, or 12, and the remote monitoring system.

14.   A patient monitoring system according to claim 13, wherein the remote monitoring system is configured to receive patient medical or biomedical data.

15.   A patient monitoring system according to claim 14, wherein the received patient medical or biomedical data is displayed on a display screen of the remote monitoring system.

16.   A method of recording patient data, the method comprising:

        providing a portable device according to any of claims 1 to 12; and

        executing the at least two of the plurality of modules in accordance with the predetermined order.

17.   A portable device substantially as herein described with reference to the accompanying drawings.

18.   A patient monitoring system substantially as herein described with reference to the accompanying drawings.

19.   A method substantially as herein described with reference to the accompanying drawings.

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Application No:	GB1213888.9	Examiner:	Ella Hogan
Claims searched:	1-19	Date of search:	14 November 2012

Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance
A	-	US 2012/044069 A1 (SAXENA et al)
A	-	WO 2006/090371 A2 (SOFTWARE SOLUTIONS LTD)
A	-	US 2006/178914 A1 (BROWN)
A	-	US 2007/027367 A1 (OLIVER et al)
A	-	US 2011/275907 A1 (INCIARDI et al)

Categories:

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC^X :

Worldwide search of patent documents classified in the following areas of the IPC

A61B; G06F

The following online and other databases have been used in the preparation of this search report

EPODOC, WPI, MEDLINE, IEL, SPRINGER.

International Classification:

Subclass	Subgroup	Valid From
A61B	0005/00	01/01/2006