Title of the Invention: A hygiene monitoring device

Abstract Title: Patient hydration and/or hygiene monitoring device

The invention provides a portable patient monitoring device 50 comprising a body 1 having at least one sensor for detecting a characteristic of a patient, a printed circuit board and a communication output for communicating the output of the at least one sensor, wherein the detected patient characteristic is hygiene and/or hydration. The characteristic may be skin tension, skin conductivity, odour or presence of bacteria. In embodiments the sensor may comprise of a pair of contacts. In an embodiment the sensor may use bioluminescence to detect the presence of bacteria. In another embodiment, the device may be calibrated to recognize the odour or chemical makeup of a compound present in a detergent to check if a user has washed their hands.

FIGURE 1
A HYGIENE MONITORING DEVICE

[001] The present invention relates to a patient monitoring device, in particular a patient health monitoring device for monitoring the health and hygiene of a patient; more particularly but not exclusively to a patient monitoring device for monitoring vulnerable patients who may not be maintaining good conditions of hygiene.

[002] Increasing age of populations can lead to reliance on external help from carers as higher numbers of persons become recognised as vulnerable persons or patients. Such carers or users need therefore to monitor their patients’ health and may be over-pressed and unable to devote appropriate time to basics of health, for example the patient’s hygiene.

[003] In particular patients who are disabled, elderly or otherwise vulnerable may be ineffective in cleaning themselves, or other carers may have accomplished this task ineffectively, which needs to be identified immediately in order to ensure dignity of the patient.

[004] Accordingly a number of patent applications have been filed in an attempt to resolve these problems or similar issues, including the following: international patent application WO 2009 069 016 (PHILLIPS et al) which discloses a wound suture containing a solvatochromatic indicator that undergoes a colour change in the presence of bacteria often associated with surgical site infection. United States patent US 7 978 083 (MELKER et al) discloses systems and methods for monitoring use of hand washing agents to determine compliance with hand hygiene guidelines. Granted European patent EP 0 794 731 (BINDER) discloses a device for optical examination of human skin and its pigmentation.

[005] Further ways of ameliorating the problems have been sought.

[006] According to the invention there is provided a portable patient monitoring device comprising a body having at least one sensor for detecting a characteristic of a patient, a printed circuit board and a communication output for communicating the output of the at least one sensor; wherein the detected patient characteristic is a hygiene and/or hydration characteristic.

[007] According to the invention there is also provided a patient monitoring device having a portable body comprising at least one topical sensor, at least one contact means configured for contacting and allowing analysis of skin of a patient, a printed circuit board and a user display.

[008] According to the present invention there is further provided a system of monitoring health and/or hygiene of a patient wherein the patient is maintained in an environment with only a certain
detergent compound, and a device substantially as described herein is calibrated to recognise the odour and/or chemical material of the compound, and wherein an alert means is provided in relation to the recognition or lack thereof. Said alert may be local, remote and/or time-delayed.

[009] According to the present invention there is also provided a device with updatable software, firmware or hardware wherein a portable device is provided with two contacts and a plurality of available sensors or detector, calibrated according to compound sensing or detecting requirements.

[0010] Advantages of the present invention include that it provides a simple way for a carer or relative of a patient to monitor the status of the patient through detecting a characteristic of a patient.

[0011] In some embodiments, the printed circuit board (PCB) may typically comprise a CPU providing processing power. Typically at least one topical sensor assesses uric acid and salinity of sweat by assessing conductivity over a short distance, consequently comprising contact means at a fixed distance apart. In some embodiments, the device may be proportioned to be handheld.

[0012] In some embodiments, a hygiene characteristic is a detectable characteristic such as an odour (for example an odour such as a human axillary odour, urine (uric acid), absence of a cleansing agent ingredient (for example a perfume)) or presence of bacteria. In some embodiments, a hydration characteristic is a detectable characteristic such as skin tension or skin conductivity.

[0013] In some embodiments, the at least one sensor comprise a topical sensor for sensing a skin characteristic of a patient, or an odour sensor such that a characteristic such as hygiene or cleanliness may be detected. A skin characteristic may be a dehydration state of the skin and/or the presence of a skin treatment such as an aqueous cream (indicating presence of a hygiene characteristic). A topical sensor may comprise a pair of contacts for measuring skin conductivity. In some embodiments, the at least one sensor may comprise an odour sensor. The odour sensor may be suitable for detecting the presence of a unique scent associated with a skin cleansing product for detecting a characteristic of a cleansed patient, the presence of a body odour such as uric acid for detecting a characteristic of lack of hygiene.

[0014] In this way a user caring for a patient is enabled to monitor the hygiene of the patient, wherein the at least one sensor is typically operable through the contact to analyse the patient’s skin for presence of undesirable or desirable material. In preferred embodiments the device comprises at least one detector. Such detector comprises a means of assessing volatile organic compounds (VOCs) which bond to a sensor plate to change resistance. Internal circuits in the detector include at
least one odour sensitive transistor having a conduction channel whose conductivity changes in response to certain odours, more particularly odours associated with hygiene or lack thereof. The transistors are interconnected to increase their response to selected odour signals. For example in some embodiments, sensors such as metal–oxide–semiconductors, organic polymers that conduct electricity, surface acoustic wave sensors or other microelectromechanical systems (MEMS) for example which rely on the modulation of surface acoustic waves to sense a physical phenomenon. Some embodiments may combine plural sensor types for provision of multiple cross-reference signals. Preferably the device further includes two contacts wherein a small electrical current may be passed through a patient’s skin for evaluating its composition. Advantageously in this way the skin may be analysed for water content, indicating hydration levels and allowing monitoring of body mass index in addition or the alternative. These contacts allow bioelectric impedance analysis readings to be conducted. Such contacts are typically metallic and may be used for and comprise other sensors in addition or the alternative. In some embodiments the contacts may be sprung and capable of measuring skin tension in addition or the alternative.

[0015] In some embodiments, the sensor or detector used in the invention comprises a means of evaluating presence of bacteria commonly associated with unhygienic skin. Advantageously therefore the user is enabled to monitor whether the patient or patient’s skin has become overly dirty.

[0016] In some embodiments, the device according to the invention has a body which presents an elongate shape with sensors and contacts arranged at one substantially pointed or minimal end. In this way the user is envisaged to be enabled press a sensor or detector in the form of skin contacts and sensors against the patient’s skin without further physical contact, and enabled to direct such sensors or contacts towards most body parts.

[0017] The contacts provide a direct mechanism for analysing skin topically. In some embodiments a separate or combined sensor comprises a means of evaluating presence of detergent, handwash product or soap. Advantageously therefore the sensor permits the user to ensure that a patient has washed their hands.

[0018] In some embodiments a means of distancing the contact means from each other is provided, for example wherein at least a part of the device may be telescopic and/or extendable or flexible. In this way readings across larger distances may be facilitated, for example so as to assess body mass index (BMI) or other readings. Preferably the user display comprises display items referencing readings from the contacts and sensors, and in some embodiments showing user control
thereof. In some embodiments the display may comprise a simple traffic light system wherein lighting of indicator lights signifies activity or findings of each sensor.

[0019] In some embodiments, the body or device further provides an odour detector such as odour detection means, comprising typically a detector capable of detecting odours. The device may additionally comprise an indicator that communicates detection of the odour to the PCB and subsequently display.

[0020] Advantageously therefore the odour detector provides a means of evaluating general cleanliness of the patient, wherein the patient may be release odours generally but the topical sensors may not have detected any issues locally.

[0021] In some embodiments, an odour detector used in the invention may comprise a mouthpiece for the odour’s ingress into the device. The mouthpiece may have a perforated cover for ingress of the odour whilst substantially preventing ingress of moisture or solids.

[0022] In some embodiments, the device may include a local energy source so as to enable the device’s use in a most effective manner, particularly with respect to disabled or troublesome patients. A local energy source may comprise one or more batteries, for example a rechargeable battery. In some embodiments, the device may be part of an apparatus containing a charging dock. In some embodiments, the device may have a body which includes a socket for receiving a dock charging connector, for example a charging pin. The dock may be connectable a power supply, e.g. to a mains electrical supply. In some embodiments, the device may be waterproof or water-resistant at least in part, so as to facilitate maintenance of clean contacts and/or sensors. In some embodiments, the user may be instructed to wipe the sensors or contacts after each use.

[0023] In some embodiments, the printed circuit board of the device may include memory, data analysis and/or a communication output. The device may be enabled to recall previous readings such that they might be compared with the current readings. Such readings may be from the sensors. A communication output may be, for example, a display such as one or more LED indicators and/or a LCD screen, a data transfer port such as a universal serial bus socket, and/or a wireless data transfer connection such as intermachine operability such as Bluetooth (RTM).

[0024] In some embodiments, the device may include a remote computing apparatus to allow monitoring of a plurality of patient’s readings, so as to ensure ward or home standards. In some embodiments the apparatus and device connect wirelessly. In other embodiments a universal serial bus connection or similar is provided.
In some embodiments, the device may thereby advantageously provides a means of monitoring current status of the patient, ensuring that the patient is at all times hydrated and clean, without requiring input from the patient or any other carers. In this way even unresponsive or difficult patients may be properly cared for and dealt with appropriately.

In some embodiments the device may include a timed deactivation mechanism to prevent wastage of battery life. In some embodiments the device includes an accelerometer or internal gyroscope, and is capable of detecting movement to activate or deactivate accordingly.

The invention will now be illustrated with reference to the following Figures of the accompanying drawings which are not intended to limit the scope of the invention claimed:

Figure 1 shows an isometric view of the device according to the invention;

Figure 2 shows a reverse isometric view of the device according to the invention;

Figures 3a, 3b, 3c, 3d and 3e show different views of a dock for the device according to the invention;

Figure 4 shows a side view of the device according to the invention mounted on a dock;

and

Figures 5a and 5b show isometric views of device according to the invention mounted on a dock.

An embodiment of a device according to the invention is generally indicated at 50 on Figures 1 and 2 of the accompanying drawings. With reference to the figures there is provided a device 50 for checking the cleanliness of a patient through odour, urine and dehydration detection. Advantageously this allows for maintenance of the patient’s overall physical cleanliness, limiting causes of infection. The device 50 comprises a body 1, formed in an elongated planar construction, having an upper first surface 51 on which various features are provided including a mouthpiece 2 and two sensor contacts 3, which are arranged on each side of mouthpiece 2 at a peripheral edge, an activation button 4 centrally on first face 51, a communication output indicated generally at 53 on first surface 51, a connection socket 10 for a dock on opposing second face 52 and a micro USB socket 11 on a peripheral edge. The body 1 is advantageous dimensioned to be held in one hand.

A detector (not shown) is arranged inside mouthpiece 2. The detector comprises odour sensors (not shown) in the form of organic field effect transistors (OFET). The odour sensors may be
for uric acid and/or soap and may detect if the patient has excessive or long standing sweat on their skin or if they have been washed correctly. A mesh cover 54 over the mouthpiece 2 of the detector on the front of the device 50 allows odours to pass through to the sensors but prevents excessive ingress of moisture or solids. The mesh cover 54 may be detachable so as to provide access for maintenance of the detector as required. The detector comprises an infrared sensor (not shown) to detect blockage in mesh cover 54. In an alternative embodiment, the OFET sensors may be replaced by a conducting polymer sensor, a polymer composite sensor or an alternative electronic nose sensor as would be well known to a person of skill in the art.

[0030] The communication output 53 is formed by three light emitting diodes (LEDs) 5, 6, 7 and a liquid crystal screen 8. The LEDs 5, 6, 7 are inset in hollows 80 to avoid damage. The body 1 is formed of multiple components, and the mouthpiece 2 comprises a scooped form 9 raising from the otherwise substantially planar first face 51. A printed circuit board (not shown) and a lithium ion battery (not shown) for powering the printed circuit board and the other features of the device 50 are housed in body 1. The printed circuit board includes a central processing unit (CPU) and electrical connections to other features of the device 1 such as the communication output 53, the sensor contacts 3, the detector connection socket 10, the micro USB socket 11. In an alternative embodiment, the communication output 53 may be provided by micro USB socket 11 and/or a wireless communication connector provided on the printed circuit board alone which may be connected to a computer or server (not shown) for output of the sensor and/or detector results.

[0031] The device 50 is placed onto the docking station 20, which is wired 21 to a mains electrical supply (not shown), to charge the internal lithium-ion battery of the device 50. Docking station has a charging state indicator 55 which illuminates a green LED when the device 50 is charging, and a blue LED is illuminated to indicate that device 50 is fully charged.

[0032] The two metal sensor contacts 3 are used to detect conductivity between two fixed points defining or sensing if the patient is dehydrated. The central button 4 starts the testing process. The three LEDs 5, 6, 7 of the communication output 53 comprise the display and indicate clean or dirty, detection of urine and aqueous cream. In this way the device 50 is simple to use and not prone to misreading. Calibration of the display parameters is ideally accomplished at manufacture or retail. Further calibration may be accomplished by the user prior to use, ideally through independent hardware. In an alternative embodiment, the two metal sensor contacts 3 may be used to detect skin tension as a measure of skin hydration.
Placing the mesh cover 54 of mouthpiece 2 up to the patient’s skin and pressing the central button 4 starts the odour detection wherein an infrared sensor is configured to register blockages in front of the mesh and commence. Holding the central button 4 whilst the sensor contacts 3 are in contact with the patient’s skin senses for dehydration. The left orange light 5 indicates presence of urine. The central red light 6 means that no soap was detected. These results are displayed and listed on the LCD screen 8 along with the results such as if aqueous cream has been sensed.

A right hand green light 7 indicates that the patient is clean and hydrated. The device can be linked to a computer via its USB connection 11. The system is linked up to a central database for centralised records. The results can then be collated and printed.

The device is charged through a connector port 10, and the wired dock 20 having a connector 12. The invention has been described by way of examples only and it will be appreciated that variation may be made to the above-mentioned embodiments without departing from the scope of invention. Firstly it will be understood that any features described 30 in relation to any particular embodiment may be featured in combinations with other embodiments.

With respect to the specification therefore, it is to be realised that the optimum dimensional relationships for the parts of the invention, to include variations in size, materials, shape, form, function and manner of operation, assembly and use, are deemed readily apparent and obvious to one skilled in the art, and all equivalent relationships to those illustrated in the drawings and described in the specification are intended to be encompassed by the present invention.

Therefore, the foregoing is considered as illustrative only of the principles of the invention, with variation and implementation obvious and clear on 5 the basis of either common general knowledge or of expert knowledge in the field concerned. Further, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation shown and described, and accordingly, all suitable modifications and equivalents may be resorted to, falling within the scope of the invention as set out in the accompanying claims.
CLAIMS

1. A portable patient monitoring device comprising a body having at least one sensor for detecting a characteristic of a patient, a printed circuit board and a communication output for communicating the output of the at least one sensor; wherein the detected patient characteristic is a hygiene and/or hydration characteristic.

2. A device as defined in Claim 1 wherein the printed circuit board comprises a CPU providing processing power.

3. A device as defined in Claim 1 or Claim 2 wherein the at least one sensor comprises a topical sensor for sensing a skin characteristic of a patient and/or an odour sensor.

4. A device as defined in any one of the preceding claims wherein a hydration characteristic is skin tension and/or skin conductivity.

5. A device as defined in any one of the preceding claims wherein the hygiene characteristic is an odour or presence of bacteria.

6. A device as defined in Claim 3 which has a mouthpiece inside which the odour sensor is mounted.

7. A device as defined in Claim 6 wherein the mouthpiece has a perforated cover.

8. A device as defined in any one of claims 3 to 7 wherein the odour sensor detects the presence of a body odour or a scent.

9. A device as defined in any one of claims 3 to 8 wherein the topical sensor comprises a pair of contacts for measuring skin conductivity.

10. A device as defined in any one of claims 3 to 9 wherein the sensor evaluates presence of bacteria.

11. A device as defined in Claim 10 wherein the sensor uses bioluminescence to detect presence of bacteria.

12. A device as defined in any one of the preceding claims wherein the communication output comprises a display, a data transfer port and/or a wireless data transfer connection.
13. A device as defined in any one of the preceding claims which comprises a local energy source.

14. A patient monitoring device having a portable body comprising at least one topical sensor, at least one contact means configured for contacting and allowing analysis of skin of a patient, a printed circuit board and a user display.

15. A system of monitoring health and/or hygiene of a patient wherein the patient is maintained in an environment with only a certain detergent compound, and a device as defined in any one of the preceding claims is calibrated to recognise the odour and/or chemical material of the compound, and wherein an alert means is provided in relation to the recognition or lack thereof.
Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

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<td>1-13 &amp; 15</td>
<td>US 8903484 A1 (MAZAR) See figure 1 and associated parts of the description.</td>
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<td>WO 02/086149 A2 (SAINI et al.) See &quot;Detector assembly&quot;.</td>
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- A  Document indicating technological background and/or state of the art.
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Field of Search:
Search of GB, EP, WO & US patent documents classified in the following areas of the UKC¹:

Worldwide search of patent documents classified in the following areas of the IPC
A61B
The following online and other databases have been used in the preparation of this search report
WPI, EPODOC

International Classification:

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