

SYSTEM AND METHOD FOR OBTAINING DATA ASSOCIATED WITH AN INJURY

Field of Invention

5 The present invention relates to a system and method for obtaining data associated with an injury, in particular, an injury image for assessment of the injury.

Background Art

10 The following discussion of the background to the invention is intended to facilitate an understanding of the present invention only. It should be appreciated that the discussion is not an acknowledgement or admission that any of the material referred to was published, known or part of the common general knowledge of the person skilled in the art in any jurisdiction as at the priority date of the invention.

15 While advances in medical technology have helped bring new treatment modalities to the various types of injuries, there is a large unmet need for accurate and objective assessment of an injury. Objective assessment of the injury during healing progress of the injury is a basis for determining effectiveness of a treatment pathway, and critical in selecting the best treatment plan.

20 However, in the clinical setting, such assessment is usually inaccurate, subjective and inconsistent. This is because conventional injury assessment is usually based on qualitative and subjective visual assessment, which lacks a holistic, objective and consistent measurement. In particular, where a reassessment of the injury is needed over a long period of time for the assessment of the injury healing progress, inconsistency of the visual assessments is a problem for an accurate assessment of the injury healing progress.

25 In addition, even though technology advancement have improved the assessment of the injury, current technology still lacks reliability and consistency to have an automated assessment of the injury without human's intervention, in particular the experienced medical staff's intervention. This is in part because the information related to a patient's body and surrounding environment where the patient is affect the assessment of the

injury. For example, if the patient's skin colour is similar to the injury's colour, the assessment of the injury based on an injury image is unlikely to be accurate.

In light of the above, there exists a need to seek a system and method for obtaining data associated with an injury that ameliorates or overcomes the above disadvantages.

5 **Summary of the Invention**

The present invention seeks to provide a system and method that addresses the aforementioned need at least in part.

Throughout the specification, unless the context requires otherwise, the word "comprise" or variations such as "comprises" or "comprising", will be understood to imply the inclusion of a stated integer or group of integers but not the exclusion of any other integer or group of integers.

Furthermore, throughout the specification, unless the context requires otherwise, the word "include" or variations such as "includes" or "including", will be understood to imply the inclusion of a stated integer or group of integers but not the exclusion of any other integer or group of integers.

The technical solution is provided in the form of a system and method for obtaining data associated with an injury. In particular, the data includes at least one of an injury image, information such as size, colour, location and temperature, and clinical information associated with the injury.

In some embodiments, the system is suited for obtaining the data in the form of one or more injury image(s). The system also comprises an information system operable to store information relating to the injury; at least one sensor operable to sense the injury; and a device operable to control the sensor, obtain sensing data from the sensor, and display the data associated with the injury based on the sensing data, wherein information relating to the injury is used for controlling the sensor to obtain the sensing data of a characteristic of the injury.

The invention seeks to improve the accuracy and efficiency of the injury assessment by obtaining accurate and proper data associated with the injury using machine intelligence

and assistance of experienced medical staff who could be located remotely in real-time. In particular, the machine intelligence may include one or more learning algorithms based on supervised or unsupervised learning models.

5 The invention further seeks to reduce time of exposure of the injury during the injury assessment.

10 In accordance with an aspect of the present invention, there is a system for obtaining data associated with an injury comprising: an information system operable to store information relating to the injury; at least one sensor operable to sense the injury; and a device operable to control the sensor, obtain sensing data from the sensor, and display the data associated with the injury based on the sensing data, wherein the information relating to the injury is used for controlling the sensor to obtain the sensing data of a characteristic of the injury.

Preferably, the device is operable to set a sensing parameter using the information relating to the injury to operate the sensor.

15 Preferably, the data includes at least one of an injury image, information such as size, colour, location and temperature, and clinical information associated with the injury.

Preferably, the device is operable to generate interactive information of the injury using the information relating to the injury and the sensing data, and display the interactive information with the injury image.

20 Preferably, the device is operable to receive a first input on the injury image or the interactive information from a first user, and modify or add the interactive information based on the first input.

25 Preferably, the system further comprises a remote device operable to receive the modified or added interactive information, receive a second input on the injury image or the received interactive information from a second user, and modify or add the received interactive information based on the second input.

Preferably, the modified or added interactive information based on the second input is stored on the information system for future use.

Preferably, the first input and the second input comprises at least one of a touch input, key input, gesture input and voice input.

Preferably, the device is operable to generate 3D reconstructed information using 3D information acquired by at least one 3D imaging sensor, and display the 3D reconstructed information with at least one of the injury image, an anatomy image and the interactive information.

Preferably, the device is operable to toggle at least one of the interactive information and the injury image, based on the users' input.

Preferably, the device is operable to display the interactive information overlaying on the injury image in a mixed reality format.

Preferably, the device is operable to display the interactive information beside the injury image.

Preferably, the device is operable to display a historical trend of the injury.

Preferably, a previous injury image is overlapped with a current injury image.

Preferably, the interactive information comprises machine intelligence generated suggestions.

Preferably, the suggestions include description of the injury and information of medical supplies for the injury.

Preferably, the information system comprises at least one of a local database and a remote database.

Preferably, the information stored on the information system comprises at least one of the following information: injury information, patient information, environment information, medication product information and algorithms for machine intelligence.

Preferably, the sensor is installed in the device.

Preferably, the device comprises a first device and a second device, the sensor is installed in the first device, the first device is operable to control the sensor using the information relating to the injury, and the second device is operable to obtain the

sensing data from the first device, display the data associated with the injury based on the sensing data, generate the interactive information of the injury using the information relating to the injury and the sensing data, and display the interactive information with the data associated with the injury.

- 5 In accordance with another aspect of the present invention, there is a method for obtaining data associated with an injury comprising: storing information relating to the injury in an information system; sensing, by at least one sensor, the injury; controlling, by a device, the sensor; obtaining, at the device, sensing data from the sensor; and displaying, on the device, the data associated with the injury based on the sensing data,
10 wherein the information relating to the injury is used for controlling the sensor to obtain the sensing data of a characteristic of the injury.

Preferably, the method further comprises a step of: setting, by the device, a sensing parameter using the information relating to the injury to operate the sensor.

- Preferably, the data includes at least one of an injury image, information such as size,
15 colour, location and temperature, and clinical information associated with the injury.

Preferably, the method further comprises steps of: generating, by the device, interactive information of the injury using the information relating to the injury and the sensing data; and displaying, on the device, the interactive information with the injury image.

- Preferably, the method further comprises steps of: receiving, by the device, a first input
20 on the injury image or the interactive information from a first user; and modifying or adding, by the device, the interactive information based on the first input.

- Preferably, the method further comprises steps of: receiving, at a remote device, the modified or added interactive information; receiving, at the remote device, a second input on the injury image or the received interactive information from a second user; and
25 modifying or adding, by the remote device, the received interactive information based on the second input.

Preferably, the modified or added interactive information based on the second input is stored on the information system for future use.

Preferably, the first input and the second input comprises at least one of a touch input, key input, gesture input and voice input.

Preferably, the device is operable to generate 3D reconstructed information using 3D information acquired by at least one 3D imaging sensor, and display the 3D reconstructed information with at least one of the injury image, an anatomy image and the interactive information.

Preferably, the device is operable to toggle at least one of the interactive information and the injury image, based on the users' input.

Preferably, the device is operable to display the interactive information overlaying on the injury image in a mixed reality format.

Preferably, the device is operable to display the interactive information beside the injury image.

Preferably, the device is operable to display a historical trend of the injury.

Preferably, a previous injury image is overlapped with a current injury image.

Preferably, the interactive information comprises machine intelligence generated suggestions.

Preferably, the suggestions include description of the injury and information of medical supplies for the injury.

Preferably, the information system comprises at least one of a local database and a remote database.

Preferably, the information stored on the information system comprises at least one of the following information: injury information, patient information, environment information, medication product information and algorithms for machine intelligence.

Preferably, the sensor is installed in the device.

Preferably, the device comprises a first device and a second device, the sensor is installed in the first device, the first device is operable to control the sensor using the information relating to the injury, and the second device is operable to obtain the

sensing data from the first device, display the data associated with the injury based on the sensing data, generate the interactive information of the injury using the information relating to the injury and the sensing data, and display the interactive information with the data associated with the injury.

- 5 Other aspects of the invention will become apparent to those of ordinary skilled in the art upon review of the following description of specific embodiments of the invention in conjunction with the accompanying drawings.

Brief Description of the Drawings

10 The present invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

Fig. 1 illustrates a block diagram of an information system, a device and a remote device in accordance with an embodiment of the invention.

Fig. 2 illustrates a flow diagram of an information system, a device and a remote device in accordance with an embodiment of the invention.

- 15 Fig. 3 illustrates a block diagram of an information system, a first device, a second device and a remote device in accordance with another embodiment of the invention.

Fig. 4 illustrates a flow diagram of an information system, a first device, a second device and a remote device in accordance with another embodiment of the invention.

- 20 Figs. 5 to 7 illustrate examples of displaying wound image and/or interactive information in accordance with various embodiments of the invention.

Figs. 8 and 9 illustrate examples of modifying the interactive information in accordance with various embodiments of the invention.

Figs. 10 to 14 illustrate examples of interfaces showing 3D reconstructed information in accordance with various embodiments of the invention.

- 25 Figs. 15 to 19 illustrate examples of interfaces in an interactive mode in accordance with various embodiments of the invention.

Other arrangements of the invention are possible and, consequently, the accompanying drawings are not to be understood as superseding the generality of the preceding description of the invention.

Description of Embodiments of the Invention

- 5 Fig. 1 illustrates a block diagram of an information system, a device and a remote device in accordance with an embodiment of the invention. It should be appreciated that the injury may include, but not be limited to a wound, bruise, abrasion, fracture and/or combinations of two or more of the aforementioned injuries.

10 In accordance with an embodiment of the invention, there is a system for obtaining data associated with an injury. The data may be in the form of, for example, an injury image, for example a wound image. The system comprises an information system 100 and at least one device 200. The system may further comprise at least one remote device 300.

15 In some embodiments, the information system 100 may include a local database on a device itself, for example a local database on the device 200, the remote device 300 or other devices. Alternatively, the information system 100 may be an on-premises server located at the same location as the device 200 and connected through local area network. In some embodiments, the information system 100 may be a remote server or cloud server which is connected to the device 200 or the remote device 300 through internet communication or any other types of communication.

20 The information system 100 comprises at least one database serving different functions or multiple databases each serving a specific function. For example, the information system 100 may comprise an injury database 110 such as a wound model database, a patient information database 120, a product database 130 and an algorithm database 140. The information system 100 therefore stores specific and holistic information about
25 one or more patients and the environment to provide the context for obtaining a wound image for the specific wound assessment.

The wound model database 110 contains physical attributes of the wound, for example size, colour, images, location and temperature, and clinical information, for example disease profile and correlation information.

The patient information database 120 includes at least one of the following data related to the patient: - historical data of the patient's health condition, allergy-related information, disease history, medication history, vital signs, physical attributes, temperature, skin conditions, anatomy related information such as body maps, and 3D models of patient's body. The patient information database 120 may further include environmental information of the patient, such as condition of the room where the patient is, a map of the room, and information and/or models relating to objects such as furniture. The condition of the room may include, but not be limited to lighting, temperature and humidity, and the information and/or models regarding the furniture may include, but not be limited to bed, chair and table information.

It should be appreciated that the patient information database 120 may be updated periodically or non-periodically (e.g. on-demand). For example, the patient information database 120 may update a vital sign of the patient in a real-time manner. The vital sign of the patient may be sensed through the device 200, remote device 300 or other devices such as vital sign sensing device. Alternatively, the vital sign of the patient may be manually inputted by the users. Alternatively, the vital sign information may be obtained from other database, for example electronic medical records storing the historical data of the vital sign of the patient.

The product database 130 contains at least one of inventory information of products, information related to cost and/or performance of the products, and clinical information related to the products. The products may include, but not be limited to medical supplies.

The algorithm database 140 contains at least one of data processing algorithms, control algorithms for software and/or hardware components, wound assessment tools and/or algorithms, and analytics algorithms. The data processing algorithms may include image processing algorithms.

Based on the information related to the patient and the environment, the algorithms are utilized to adjust and tune a sensing parameter to be used for sensing. For the purposes of 3D measurements and colour image processing of the injury based on the information, specific image processing algorithms are selected and utilized.

The algorithms are used to determine the assessment methodology of the injury. Each algorithm is used to assess corresponding injury. For example, an “algorithm A” is used to assess a specific type of “injury A” based on the patient information, medical history and/or injury information.

- 5 Based on the information related to the patient, the sensor data, assessment made by machine intelligence or user’s input and medical product information, the algorithms are utilized to provide suggestions related to interventions and medications used for managing the injury.

10 The information system 100 comprises at least one controller (not shown). The controller may include an artificial intelligence (AI) module. The controller may be arranged in signal/data communication with the algorithm database 140 to utilize one or more algorithms to generate information associated to the wound.

15 The system may further comprise an application provider (not shown). The application provider provides an application or a service to at least one device related to the described invention. The application is installable on at least one device. The application provider may include at least one of an application server and an application database. The application provider may be located remotely or independent from the information system 100. In some embodiments, the application provider may be the information system 100. The application may be executed on at least one of the device
20 200 and the remote device 300.

25 The at least one device, for example the device 200 and the remote device 300, may communicate with each other and with the information system 100. As shown in Fig. 1, the device 200 may be at the patient’s site and the remote device 300 may be at a remote site. As shown in Fig. 1, it may be appreciated that the device 200 and the remote device 300 may include, but not be limited to the following devices: mobile device such as mobile phone and tablet, head-mounted device, robotic platform, laptop and computer.

At least one sensor (not shown) is operable to sense the injury, for example wound for the measurement of the characteristics of the wound. The device 200 controls the

sensor and obtains sensing data from the sensor. The information relating to the wound stored in the information system 100 is used for controlling the sensor to obtain the sensing data of a characteristic of the wound.

The device 200 therefore is able to obtain the data associated with the wound, for example imaging information which focuses on the characteristic such as an area and colour of the wound. The characteristic of the wound may include, but not be limited to a characteristic of interest of the wound. For example, if a recovery of a left side of a wound is slow, the device 200 may control the sensor to obtain the sensing data of or on the left side of the wound in greater detail. As another example, if a patient's skin colour is similar to the wound's colour, the device 200 may control the sensor to obtain sensing data having more colours.

The sensor may include, but not be limited to a 2D imaging sensor and a 3D imaging sensor. The sensor may be attached or mounted to the device 200. It should be appreciated that a camera or an infrared sensor of the device 200 may be utilized to sense the wound. It is to be appreciated that other sensors or sensing modalities, for example biochemical sensor, thermal sensor and ultrasonic sensor, may be utilized individually or in combination to sense the presence of a wound, as well as the characteristic of the wound.

Alternatively, the sensor may be external and not be attached or mounted to the device 200. For example, the sensor may be attached to a body of the user, for example patient, clinician and non-clinician. For another example, the sensor may be attached to or installed in the robotic mechanism or in the environment such as bed or stand.

Fig. 2 illustrates a flow diagram of an information system, a device and a remote device in accordance with an embodiment of the invention.

There is a system for wound assessment comprising the information system 100 and the at least one device 200. The system may further comprises the at least one remote device 300. The device 200 comprises at least one sensor for sensing the injury, for

example wound. The device 200 may be at the patient's site and the remote device 300 may be at the remote site.

It should be appreciated that the users may include clinicians and non-clinicians such as care-givers, family members of the patient, patient him/herself, or any other person who need to use the device 200 or the remote device 300 to assist in the assessment of the wound condition. For example, there may be non-clinicians including the patient at the patient's site, and there may be clinicians at the remote site. For another example, there are clinicians and non-clinicians including the patient at the patient's site, and there are clinicians at the remote site. While the clinicians and non-clinicians may use the device 200 to assist in capturing the condition of the wound at the patient's site, the clinicians may assess the wound condition based on clinical protocol at the remote site.

First, the information system 100 sends information related to the injury, for example wound (S110). As described above, the information system 100 stores information related to the wound. As described above, the information comprises at least one of the following information: the wound information, the patient information, the environment information, wound medication product information and algorithms for implementation of machines intelligence such as image processing algorithms, pattern recognition algorithms, learning algorithms, control algorithms, injury assessment algorithms, etc. The device 200 receives the information related to the wound from the information system 100. It should be appreciated that the device 200 may receive the information from the information system 100 through at least one of internet communication, BluetoothTM communication, near-field communication (NFC), local area network communication, etc.

The device 200 controls the sensor using the information (S120). The device 200 is operable to set a sensing parameter using the information to operate the sensor. Based on the information related to the patient, the environment or the injury, the algorithms are utilized to adjust and tune the sensing parameter to be used for sensing. For example, based on physical attributes of the patient, the environment and injury type, for example wound type, a controller of the device 200 may decide on one or more sensors to be used to capture a specific attribute of the wound, as well as the sensing

parameter to be used for the sensing. In some embodiments, a machine-controllable mechanism may be attached to the one or more sensors. In this case, based on the information related to the patient, the environment and the injury, a control parameter may be set to control the sensor attaching the mechanism for the sensing.

- 5 For the purposes of 3D measurements and colour image processing of the injury based on the information, specific image processing algorithms are utilized. If there are a plurality of sensors, the device 200 may control at least one sensor among the plurality of sensors based on the information. Thereafter, the sensor is operable to sense the wound based on the sensing parameter, in particular a characteristic of the wound, for
10 the measurement of the characteristics of the wound (S130).

The device 200 may obtain or receive the sensing data (S140). As earlier described, the device 200 may obtain or receive the sensing data of a characteristic of the wound from the sensor.

- The device 200 may generate interactive information for the wound using the
15 information related to the wound and the sensing data (S150). The interactive information may comprise machine intelligence generated suggestions provided from an interactive interface of the device 200. The suggestions include description of the wound and information of medical supplies (also referred to as “products”) for the wound. It should be appreciated that the interactive information may also comprise non-
20 suggestive information such as reference frame of measurements. It should be appreciated that the interactive information may be provided to the users in the form of 3D reconstructed information showing measuring results of the wound or 3D features of the wound, to assist the users in assessing the wound. The interactive information may be provided to the users in the form of image overlay in real-time based on sensor-
25 driven assessment and the users’ input, as described below.

- In some embodiments, the device 200 displays the data associated with the wound, for example a wound image (S160). The data includes at least one of the wound image, information such as size, colour, location and temperature, and clinical information associated with the wound. The device 200 further displays the interactive information
30 with the wound image (S170). Here, the device 200 may control the display of the

interactive information relative to the wound image. For example, the device 200 is operable to toggle at least one of the interactive information and the wound image, based on the users' preference, for example the users' input.

5 In some embodiments, the device 200 is operable to display the interactive information overlaying on the wound image. Here, the interactive information is displayed as a colour image. In another embodiment, the device 200 is operable to display the interactive information beside the wound image, pertaining to the descriptions of the wound appearance according to the sensing data of the wound. In this regard, the users are able to control the reference images to be displayed. For example, the users are
10 able to choose different set of reference images through at least one of a touch input, key input, gesture input and voice input.

It should be appreciated that the device 200 is operable to generate 3D reconstructed information using 3D information acquired from one or more 3D imaging sensors. The device 200 is further operable to display the 3D reconstructed information, for example
15 3D reconstructed image, in a virtual reality mode. The 3D reconstructed image may be projected in a purely virtual 3D environment. In the virtual reality mode, the users are able to interact with the 3D reconstructed image in the 3D environment. The virtual reality mode may be used for interactive operations for the enhancement of user experience.

20 Next, the device 200 receives an input (hereinafter referred to as "first input") on the interactive information or the wound image from the user (hereinafter referred to as "first user") (S180). In some embodiments, the first user may include non-clinicians such as care-givers, family members of the patient, patient him/herself, or any other person. In another embodiment, the first user may include clinicians.

25 Thereafter, the device 200 may modify the interactive information based on the first input (S190). It should be appreciated that the device 200 may delete the interactive information or add new interactive information.

The device 200 sends the modified or added interactive information (hereinafter referred to as "first modified interactive information") to the information system 100 (S200). The

information system 100 may store the first modified interactive information for the wound. The information system 100 may send the first modified interactive information to the remote device 300 (S210). Here, the information such as the wound information, the patient information, the environment information, wound medication product
5 information and algorithms for machine intelligence may be sent to the remote device 300.

The remote device 300 is operable to display the first modified interactive information and/or the wound image. Here, the remote device 300 may control the display of the first modified interactive information relative to the wound image, for example toggle at
10 least one of the interactive information and the wound image based on the second users' preference.

The remote device 300 is operable to display the first modified interactive information overlaying on the wound image in a mixed reality format. Here, the first modified interactive information is displayed as a colour image. In another embodiment, the
15 remote device 300 is operable to display the first modified interactive information beside the wound image, pertaining to the descriptions of the wound appearance according to the sensing data of the wound. In this regard, the user (hereinafter referred to as "second user") is able to control the reference images to be displayed. For example, the second user is able to choose different set of reference images through at least one of a
20 touch input, key input, gesture input and voice input.

In another embodiment, the remote device 300 is operable to generate 3D reconstructed information using 3D information acquired from one or more 3D imaging sensors. The remote device 300 is further operable to display the 3D reconstructed information, for example 3D reconstructed image, in a virtual reality mode. The 3D
25 reconstructed image may be projected in a purely virtual 3D environment. In the virtual reality mode, the users are able to interact with the 3D reconstructed image in the 3D environment. The virtual reality mode may be used for interactive operations for the enhancement of user experience.

Next, the remote device 300 receives an input (hereinafter referred to as "second input")
30 on the first modified interactive information or the wound image from the user (S220). In

some embodiments, the second user may include clinicians who are remote from the patient. In another embodiment, the second user may include non-clinicians such as care-givers, family members of the patient, or any other person who are remote from the patient.

- 5 Thereafter, the remote device 300 may modify the first modified interactive information based on the second input (S230). It should be appreciated that the remote device 300 may delete the first modified interactive information or add new interactive information.

The remote device 300 sends the modified or added interactive information (hereinafter referred to as “second modified interactive information”) to the information system 100
10 (S240). The information system 100 may store the second modified interactive information as the information for future analysis.

The objective of the remote device 300 is to provide a means for the second user, for example a clinician at the remote site, to conduct and monitor the assessment from afar without the constraint of location and distance. The second user may modify the
15 assessment done by the first user, for example a non-clinician, at the remote site.

The described invention allows the information related to the wound to be stored both locally and remotely, for modification and/or assessment in real-time or in an on-demand format.

It should be appreciated that the described invention may be integrated seamlessly with
20 tele-medicine infrastructure such as tele-presence and other remote sensors for remote-communication and assessment.

Figs. 3 and 4 illustrate a block diagram and a flow diagram of an information system, a first device, a second device and a remote device in accordance with another
25 embodiment of the invention.

As described above with Fig. 1, the system comprises the information system 100, the at least one device 200 and the at least one remote device 300. The device 200 comprises at least one first device 210 and at least one second device 220.

The first device 210, the second device 220 and the remote device 300 may communicate with each other and with the information system 100. The sensor (not shown) is installed in or attached to the first device 210.

As shown in Fig. 3, the first device 210 may be at the patient's site and the remote device 300 may be at a remote site. In some embodiments, the second device 220 may be at the patient's site. Alternatively, the second device 220 may be at a remote site. It may be appreciated that the first device 210, the second device 220 and the remote device 300 may include, but not be limited to the following devices: mobile device such as mobile phone and tablet, head-mounted device, robotic platform, laptop and computer.

As shown in Fig. 4, the information system 100 sends information related to the injury, for example wound to the second device 220 (S110). The second device 220 controls the first device 210 using the information related to the wound (S120). The second device 220 is operable to set a sensing parameter using the information related to the wound to operate the first device 210 so that the first device 210 controls the sensor. Thereafter, the sensor of the first device 210 is operable to sense the wound, in particular a characteristic of the wound, for the measurement of the characteristics of the wound (S130). The first device 210 may obtain the sensing data of a characteristic of the wound and display data associated with the wound, for example a wound image based on the sensing data. The data includes at least one of the wound image, information such as size, colour, location and temperature, and clinical information associated with the wound.

The first device 210 may send the sensing data obtained from the sensor to the second device 220 (S140). The second device 220 may generate interactive information for the wound using the information and the sensing data (S150). The interactive information may comprise machine intelligence generated suggestions provided from an interactive interface of the second device 220. It should be appreciated that the interactive information may also comprise non-suggestive information such as reference frame of measurements.

Thereafter, the second device 220 displays the wound image (S160). The second device 220 further displays the interactive information with the wound image (S170). Here, the second device 220 may control the display of the interactive information relative to the wound image.

- 5 Next, the second device 220 receives an input (hereinafter referred to as “first input”) on the interactive information or the wound image from the user (hereinafter referred to as “first user”) (S180). Thereafter, the second device 220 may modify the interactive information based on the first input (S190). It should be appreciated that the second device 220 may delete the interactive information or add new interactive information.
- 10 The second device 220 sends the modified or added interactive information (hereinafter referred to as “first modified interactive information”) to the information system 100 (S200). The information system 100 may store the first modified interactive information for the wound. The information system 100 may send the first modified interactive information to the remote device 300 (S210). Here, the information such as the wound
- 15 information, the patient information, the environment information, wound medication product information and algorithms for machine intelligence may be sent to the remote device 300.

Next, the remote device 300 receives an input (hereinafter referred to as “second input”) on the first modified interactive information or the wound image from the user

20 (hereinafter referred to as “second user”) (S220). Thereafter, the remote device 300 may modify the first modified interactive information based on the second input (S230). It should be appreciated that the remote device 300 may delete the first modified interactive information or add new interactive information.

The remote device 300 sends the modified or added interactive information (hereinafter

25 referred to as “second modified interactive information”) to the information system 100 (S240). The information system 100 may store the second modified interactive information as the information for future analysis.

Figs. 5 to 7 illustrate examples of displaying wound image and/or interactive information on the device 200 in accordance with various embodiments of the invention. It should be appreciated that Figs. 5, 6 and 7 may be also applied to the remote device 300.

5 The device 200 is operable to obtain the sensing data from the sensor and display the wound image 201 as shown in Fig. 5(a). The device 200 is further operable to generate interactive information for the wound using the information obtained from the information system 100 and the sensing data.

10 The interactive information may comprise machine intelligence generated suggestions provided from an interactive interface of the device 200. It should be appreciated that the interactive information may also comprise non-suggestive information such as reference frame of measurements.

15 The suggestions include description of the wound and information of medical supplies for the wound. The suggestions of the medical supplies to be applied may be derived based on at least one of the wound assessment results, the inventory information of the medical supplies and cost-performance of the medical supplies stored in the product database 130 of the information system 100. The suggestions of the medical supplies to be applied may also be derived based on patient's information such as allergy, medication history and disease profile, and/or environmental information such as temperature and humidity, stored in the patient information database 120 of the information system 100.

20 In some embodiments, the interactive information may be provided to the users in the form of image overlay. In this regard, as shown in Fig. 5(b), the device 200 displays the description of the wound 202 and the information of medical supplies for the wound 203 overlaying on the wound image 201 in a mixed reality format. Although not shown, the description of the wound 202 and the information of medical supplies for the wound 203 may be displayed as a colour image.

In another embodiment, as shown in Fig. 5(c), the device 200 displays the description of the wound 202 and the information of medical supplies for the wound 203, beside the

wound image 201, so that the wound image 201 is not covered by any interactive information.

Although not shown, it is to be appreciated that any description of the wound 202 and the information of medical supplies for the wound 203 can be shown on another interface such as a list which is not beside the wound image 201 or overlaid on the wound image 201.

In another embodiment, the device 200 may control the display of the interactive information relative to the wound image 201. For example, as shown in Fig. 6(a) and (b), the device 200 is operable to toggle the description of the wound 202, the information of medical supplies for the wound 203 and the wound image 201, based on the user's preference, for example the users' input. Although not shown, the user may toggle to a view that shows reference images of wounds from clinical literature, for the comparison of the current wound with the reference images, so that the user can assess the condition of the wound in a more informed manner. It is to be appreciated that the wound image 201 and the reference image(s) can be displayed together, for example side-by-side, so that the user can compare the current wound and the reference wound easily.

In another embodiment, the first user may toggle to another view where the historical trend of the wound will be shown. In this regard, the device 200 is operable to display a historical trend of the wound. For example, as shown in Fig. 7, a previous wound image 210 is overlapped with a current wound image 201. Although not shown, the device 200 is operable to display a plurality of previous wound images with the descriptions relevant to the historical trend of the wound. In another embodiment, the device 200 is operable to display charts of the wound images to show the change of condition, for example size and colour, of the wound.

Although not shown, other interactive features including 3D markers or reference frames for measurements may be displayed on the device 200. Also, it should be appreciated that the wound image 201 and the interactive information are displayed in the form of 3D interface. For example, the device 200 is operable to generate 3D reconstructed information using 3D information acquired from one or more 3D imaging

sensors. The device 200 is further operable to display the 3D reconstructed information, for example 3D reconstructed image, in a virtual reality mode. The 3D reconstructed image may be projected in a purely virtual 3D environment. In the virtual reality mode, the users are able to interact with the 3D reconstructed image in the 3D environment.

- 5 The virtual reality mode may be used for interactive operations for the enhancement of user experience.

Figs. 8 and 9 illustrate examples of modifying the interactive information in accordance with various embodiments of the invention.

- 10 As shown in Fig. 8(a) and (b), the device 200 displays the wound image 201 with the interactive information, for example the description of the wound 202 and the information of medical supplies for the wound 203. Here, the description of the wound 202 and the information of medical supplies for the wound 203 are generated by the device 200. Although not shown, it should be appreciated that the description of the wound 202 and the information of medical supplies for the wound 203 are generated by
15 any other device, such as the information system 100.

- If the first user is of the view that the interactive information generated by the device 200 is incorrect, the first user may modify the interactive information. Here, the first user may include non-clinicians such as care-givers, family members of the patient, patient
20 him/herself, or any other person. In another embodiment, the first user may include clinicians.

- As shown in Fig. 8(c), the device 200 receives an input 204 (hereinafter referred to as “first input”) on the wound image 201 from the first user. Although not shown, it should be appreciated that the device 200 is also operable to receive the first input 204 on the
25 description of the wound 202 and/or the information of medical supplies for the wound 203.

The objective of the first input 204 is to modify or add the interactive information regarding the wound. In this way, the first user is able to modify the assessment done

by the device 200. It should be appreciated that the first input 204 comprises at least one of a touch input, key input, gesture input and voice input.

Thereafter, the device 200 may modify or add the interactive information based on the first input 204. As shown in Fig. 8(d), the device 200 may re-generate the interactive information (hereinafter referred to as “first modified interactive information”) based on the first input 204 and display the first modified description of the wound 205 and the first modified information of medical supplies 206. Although not shown, it should be appreciated that the first user may manually enter the first modified description of the wound 205 and/or the first modified information of medical supplies 206, and the device 200 may display the same.

The device 200 may then send the first modified description of the wound 205 and/or the first modified information of medical supplies 206 to the information system 100 so that the information system 100 provide the same to the remote device 300.

In some embodiments, if the first user is of the view that the interactive information generated by the device 200 is correct or there is no need to modify the interactive information, the device 200 may send the description of the wound 202 and the information of medical supplies for the wound 203, to the information system 100. Alternatively, the device 200 may send the information system 100 instructions to inform that there is no modification on the interactive information.

Next, as shown in Fig. 9(a), the remote device 300 receives the first modified description of the wound 205 and/or the first modified information of medical supplies 206, and displays the same. The first input 204 may be displayed with the wound image 201 so that the second user is able to identify the first input 204.

If the second user is of the view that the first modified interactive information modified by the first user is incorrect, the second user may modify the first modified interactive information. Here, the second user may include clinicians at the remote site. In another embodiment, the second user may include non-clinicians such as care-givers, family members of the patient, or any other person at the remote site.

As shown in Fig. 9(b), the remote device 300 receives an input 207 (hereinafter referred to as “second input”) on the wound image 201 from the second user. Although not shown, it should be appreciated that the remote device 300 is also operable to receive the second input 207 on the first modified description of the wound 205 and/or the first modified information of medical supplies 206.

The objective of the second input is to modify or add the first modified interactive information regarding the wound. In this way, the second user is able to modify the assessment done by the device 200 or the first user. It should be appreciated that the second input 207 comprises at least one of a touch input, key input, gesture input and voice input.

Thereafter, the remote device 300 may modify or add the interactive information based on the second input 207. As shown in Fig. 9(c), the remote device 300 may re-generate the interactive information (hereinafter referred to as “second modified interactive information”) based on the second input 207 and display the second modified description of the wound 208 and the second modified information of medical supplies 209. Although not shown, it should be appreciated that the second user may manually enter the second modified description of the wound 208 and/or the second modified information of medical supplies 209, and the remote device 300 may display the same.

The information system 100 may store the second modified interactive information as the information for future analysis. The second modified interactive information may be sent to the device 200 or any other patient’s device.

Figs. 10 to 14 illustrate examples of interfaces showing 3D reconstructed information in accordance with various embodiments of the invention.

The sensor may include, but not be limited to a 2D imaging sensor and/or a 3D imaging sensor. In some embodiments, the imaging sensor may be attached or mounted to the device 200. It should be appreciated that the imaging sensor may include, but not be limited to a camera and/or an infrared sensor.

As shown in Fig. 10, a live preview image 211 generated by the 2D imaging sensor may be displayed. The 2D imaging sensor, for example 2D camera, may capture a 2D image

of an injury, for example wound. 3D information of the wound may be acquired in the form of a set of data points such as point clouds, etc. by using one or more 3D imaging sensors such as a 3D scanner, a stereo camera system or a mono-camera system with motion using algorithms installed on the 3D imaging sensors. These algorithms may include visual simultaneous localization and mapping (“Visual SLAM”) algorithms. Thereafter, the 3D information of the wound is visually reconstructed. The 3D reconstructed information is displayed in mixed reality or virtual reality format.

In some embodiments, as shown in Fig. 10, an anatomy image 218 may be displayed on the live preview image 211 or the captured 2D image, based on the information of a location of the wound. It should be appreciated that anatomy image 218 may include an anatomy image of whole body and/or a part of the body relating to the location of the wound, for example upper body. For example, the location of the wound may be a sacrum. Although not shown, it should be appreciated that the location of the wound may be shown using the anatomy image 218 by highlighting a corresponding part of the anatomy image 218.

The wound may be captured in various orientations and/or angles based on the user’s preference or input. An annotation showing the orientation and/or angle may be displayed with the live preview image 211 or the captured 2D image. For example, as shown in Fig. 10, the orientation of the head of the patient is shown using the anatomy image 218. In some embodiments, the anatomy image 218 can be used as a compass relative to the location of the wound. For example, the anatomy image 218 can be used to indicate a relative location of the head of the patient based on the location of the wound. It should be appreciated that the anatomy image 218 may be dynamically displayed. For example, if the orientation and/or angle is changed for capturing the wound, the anatomy image 218 may be rotated accordingly. It should be also appreciated that the anatomy image 218 may be displayed in a fixed format, for example fixed size, shape, orientation and/or location.

In some embodiments, an estimated distance between the wound plane and the sensor and/or camera may be displayed. The sensor and/or camera may sense a distance from the closest plane of an object such as a part of body being captured, and utilize the

distance as the estimated distance. For example, as shown in Fig. 10, “40 cm” is displayed as the distance from the plane of the body to the sensor and/or camera.

The display of the anatomy image 218 and/or the estimated distance can assist the user to capture the image of the wound in a consistent manner, for example, in a specific orientation in respect to the body of the patient, and from a known distance. Since a series of images can be captured from a consistent distance, the series of images can be recorded from a consistent perspective. Therefore, the user can check and compare the progress of the size of the wound in a consistent manner.

Fig. 11 shows an example of the 3D reconstructed information 210 in a mixed reality format. The 3D reconstructed information 210 that is obtained from the 3D imaging sensor may be superimposed on the live preview image 211 in real-time. The user can then interact with the information system 100 by actuating, for example by pressing or touching one or more buttons or icons 212 to capture the 3D reconstructed information 210 of the wound within a selected area 213. In some embodiments, the area 213 may be selected by the user’s input. In another embodiment, the area 213 may be selected automatically without the user’s input.

In some embodiments, as shown in Fig. 11, assistive information such as an anatomy image 218 and/or size of the targeted sensing volume may be displayed. For example, as shown in Fig. 11, the anatomy image 218 may be displayed in one colour, for example white colour, at the bottom of the live preview image 211. It should be appreciated that the colour of the anatomy image 218 may be changed in accordance with the colour of the live preview image 211.

The anatomy image 218 may show an orientation of a part of a body of a person, such as head of the patient. For example, as shown in Fig. 11, the targeted sensing volume may be set at 30×30×30 cm cube 219. The size of the targeted sensing volume may be adjusted by the user’s input such as touch input and/or voice input. The touch input may include pinch input. Although not shown, it should be appreciated that if the targeted sensing volume is adjusted, the 3D reconstructed information 210 may be newly acquired by the 3D imaging sensor using the adjusted sensing volume.

Figs. 12 to 14 show examples of the 3D reconstructed information 210 in a virtual reality format. The captured 3D reconstructed information 210 may be displayed in the virtual reality format. A plurality of viewing modes may be toggled based on the user's preference or input. As shown in Figs. 12 and 13, the user can view the 3D reconstructed information 210 from various view points and/or in various range of colours to examine the structure of the wound.

Further, the user can interact with the 3D reconstructed information 210 to perform various actions, such as obtain measurements or readings of the wound's size, etc. As shown in Fig. 14, the user can measure the perimeter of the wound by selecting an area 214 of the wound. The information system 100 may automatically calculate the perimeter and the depth of the wound area, based on the selected area of the wound by the user's input.

In some embodiments, the user can further perform actions, such as obtain measurements or readings of the length between two selected points using the 3D reconstructed information 210. The user can set the respective measurement results by selecting a specific button or icon on the interface to update the information system 100 relating to the wound attributes.

Figs. 15 to 19 illustrate examples of interfaces in an interactive mode in which the user is making assessment of the appearance of the injury, in accordance with various embodiments of the invention. The interfaces may display information of wound attributes such as location, category, type of appearance, size and/or smell of the wound. In the interactive mode, the user can use the interactive information obtained or received from the information system 100 to make a more accurate assessment of the injury, for example wound.

Fig. 15 shows an interface in which a window 216 for reference information is being prepared. For example, the window 216 may be displayed on the upper right side of the interface. The size and/or location of the window 216 may be changed based on the user's preference or input.

Wounds may be divided into some types according to their appearance. When the user selects a type of the appearance of the wound on the interface, as shown in Fig. 16, the information system 100 may display the respective reference information such as reference image 217 by the side of the captured wound image 215, to show the user how the appearance of the wound would look like for the specific type. For example, the reference image 217 of “Epithelising” is displayed when the user selects “Epithelising” as the type of the appearance of the wound. This function can help the user to make a more informed decision about the type. This is helpful for a less experienced user, for example non-clinician.

When the user selects “Granulating” as the type of the appearance, as shown in Fig. 17, the reference image 217 is interactively changed. When the user selects “Slough” as the type of the appearance, as shown in Fig. 18, the reference image 217 is interactively changed. When the user selects “Necrotic” as the type of the appearance, as shown in Fig. 19, the reference image 217 is interactively changed.

It should be appreciated that voice command may be used for the described invention. The examples of the voice command are as follows:

1) sensing commands, e.g. “take picture”, “start scanning”, “bigger area”, “smaller area”, “closer”, “further”, “right”, “left”, “up”, “down”, etc.

2) commands to toggle between different views: e.g. “show wound history”, “show wound reference”, “show 3D view”, “show wound attribute”, etc.

3) commands for recording and dictation functions

It should be appreciated by the person skilled in the art that variations and combinations of features described above, not being alternatives or substitutes, may be combined to form yet further embodiments falling within the intended scope of the invention.

CLAIMS

1. A system for obtaining data associated with an injury comprising:
an information system operable to store information relating to the injury;
at least one sensor operable to sense the injury; and

5 a device operable to control the sensor, obtain sensing data from the sensor, and display the data associated with the injury based on the sensing data, the data including at least one of an injury image, information such as size, colour, location and temperature, and clinical information associated with the injury;

10 wherein the information relating to the injury is used for controlling the sensor to obtain the sensing data of a characteristic of the injury; and

wherein the device is operable to generate interactive information of the injury using the information relating to the injury and the sensing data, and display the interactive information with the injury image, the interactive information comprising machine intelligence generated treatment suggestions.

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2. The system according to claim 1, wherein the device is operable to set a sensing parameter using the information relating to the injury to operate the sensor.

20 3. The system according to claim 1, wherein the device is operable to receive a first input on the injury image or the interactive information from a first user, and modify or add the interactive information based on the first input.

25 4. The system according to claim 3 further comprising a remote device operable to receive the modified or added interactive information, receive a second input on the injury

image or the received interactive information from a second user, and modify or add the received interactive information based on the second input.

5 5. The system according to claim 4, wherein the modified or added interactive information based on the second input is stored on the information system for future use.

6. The system according to claim 5, wherein the first input and the second input comprises at least one of a touch input, key input, gesture input and voice input.

10 7. The system according to claim 1, wherein the device is operable to generate 3D reconstructed information using 3D information acquired by at least one 3D imaging sensor, and display the 3D reconstructed information with at least one of the injury image, an anatomy image and the interactive information.

15 8. The system according to claim 1, wherein the device is operable to toggle at least one of the interactive information and the injury image, based on the users' input.

9. The system according to claim 8, wherein the device is operable to display the interactive information overlaying on the injury image in a mixed reality format.

20

10. The system according to claim 8, wherein the device is operable to display the interactive information beside the injury image.

11. The system according to claim 8, wherein the device is operable to display a
25 historical trend of the injury.

12. The system according to claim 11, wherein a previous injury image is overlapped with a current injury image.

5

13. The system according to claim 1, wherein the suggestions include description of the injury and information of medical supplies for the injury.

14. The system according to claim 1, wherein the information system comprises at least one of a local database and a remote database.

15. The system according to claim 1, wherein the information stored on the information system comprises at least one of the following information: injury information, patient information, environment information, medication product information and algorithms for machine intelligence.

16. The system according to claim 1, wherein the sensor is installed in the device.

17. The system according to claim 1, wherein the device comprises a first device and a second device,

the sensor is installed in the first device,

the first device is operable to control the sensor using the information relating to the injury, and

the second device is operable to obtain the sensing data from the first device, display the data associated with the injury based on the sensing data, generate the

interactive information of the injury using the information relating to the injury and the sensing data, and display the interactive information with the data associated with the injury.

5 18. A method for obtaining data associated with an injury comprising:

storing information relating to the injury in an information system;

sensing, by at least one sensor, the injury;

controlling, by a device, the sensor;

obtaining, at the device, sensing data from the sensor; and

10 displaying, on the device, the data associated with the injury based on the sensing data, the data including at least one of an injury image, information such as size, colour, location and temperature, and clinical information associated with the injury;

generating, by the device, interactive information of the injury using the information relating to the injury and the sensing data; and

15 displaying, on the device, the interactive information with the injury image;

wherein the interactive information comprises machine intelligence generated suggestions; and

wherein the information relating to the injury is used for controlling the sensor to obtain the sensing data of a characteristic of the injury.

20

19. The method according to claim 18 further comprises a step of:

setting, by the device, a sensing parameter using the information relating to the injury to operate the sensor.

25

20. The method according to claim 18 further comprises steps of:

receiving, by the device, a first input on the injury image or the interactive information from a first user; and

5 modifying or adding, by the device, the interactive information based on the first input.

21. The method according to claim 20 further comprises steps of:

receiving, by a remote device, the modified or added interactive information;

10 receiving, by the remote device, a second input on the injury image or the received interactive information from a second user; and

modifying or adding, by the remote device, the received interactive information based on the second input.

15 22. The method according to claim 21, wherein the modified or added interactive information based on the second input is stored on the information system for future use.

23. The method according to claim 21, wherein the first input and the second input comprises at least one of a touch input, key input, gesture input and voice input.

20

24. The method according to claim 18, wherein the device is operable to generate 3D reconstructed information using 3D information acquired by at least one 3D imaging sensor, and display the 3D reconstructed information with at least one of the injury image, an anatomy image and the interactive information.

25

25. The method according to claim 18, wherein the device is operable to toggle at least one of the interactive information and the injury image, based on the users' input.

26. The method according to claim 25, wherein the device is operable to display the
5 interactive information overlaying on the injury image in a mixed reality format.

27. The method according to claim 25, wherein the device is operable to display the interactive information beside the injury image.

10 28. The method according to claim 25, wherein the device is operable to display a historical trend of the injury.

29. The method according to claim 28, wherein a previous injury image is overlapped with a current injury image.

15

30. The method according to claim 18, wherein the suggestions include description of the injury and information of medical supplies for the injury.

31. The method according to claim 18, wherein the information system comprises at
20 least one of a local database and a remote database.

32. The method according to claim 18, wherein the information stored on the information system comprises at least one of the following information: injury information, patient information, environment information, medication product information and
25 algorithms for machine intelligence.

33. The method according to claim 18, wherein the sensor is installed in the device.

34. The method according to claim 18, wherein the device comprises a first device and
5 a second device,

the sensor is installed in the first device,

the first device is operable to control the sensor using the information relating to
the injury, and

the second device is operable to obtain the sensing data from the first device,
10 display the data associated with the injury based on the sensing data, generate the
interactive information of the injury using the information relating to the injury and the
sensing data, and display the interactive information with the data associated with the
injury.