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(54) **SYSTEM FOR INTEGRATED WOUND ANALYSIS**

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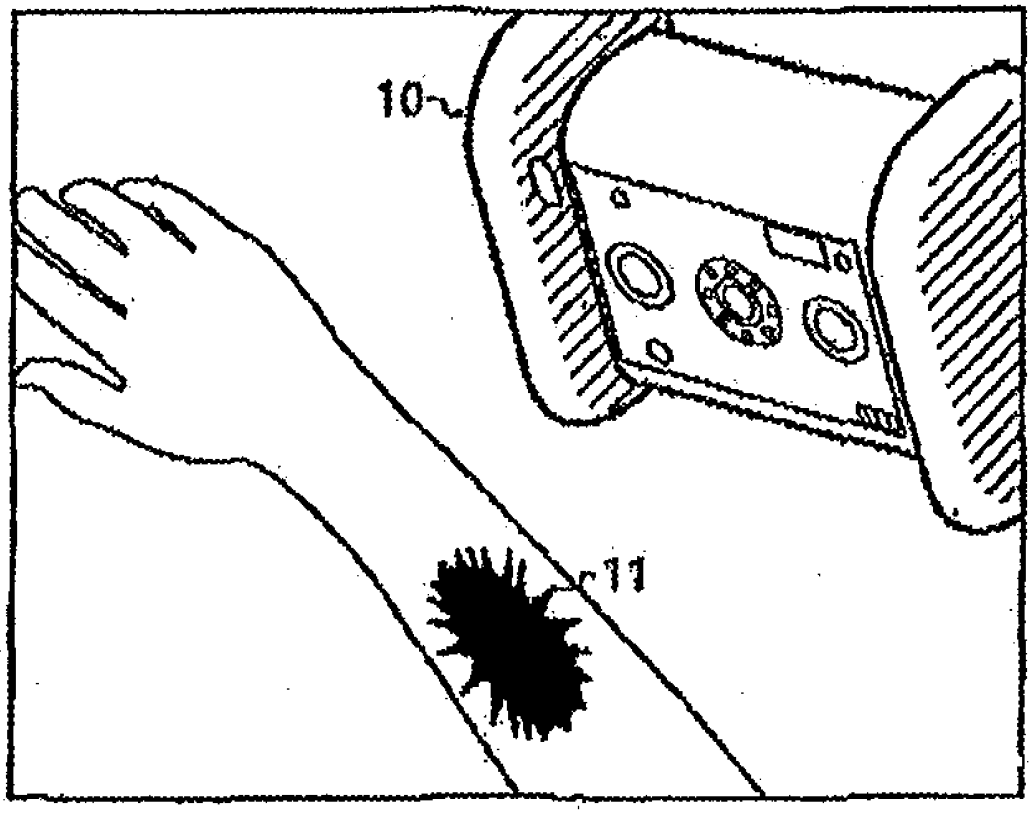
(57) **ABSTRACT**

A system for integrated wound analysis; said system including sensing and image recording elements; sensed data and images of at least a first recording session stored for analysis; said system including a reference system whereby sensing and image recording of any subsequent said recording session substantially repeats sensing and recording of parameters of said first recording session.



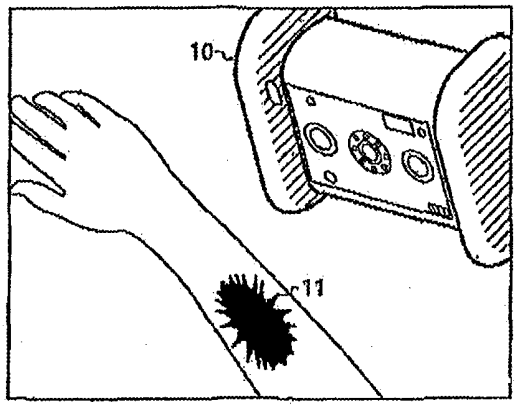
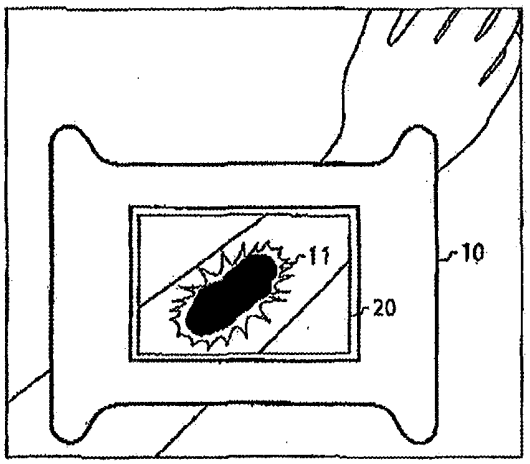


Figure 1



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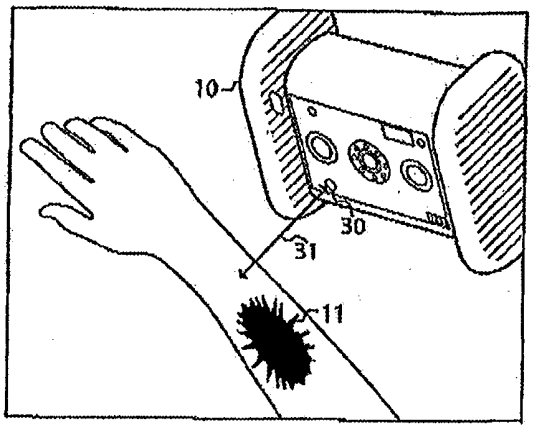
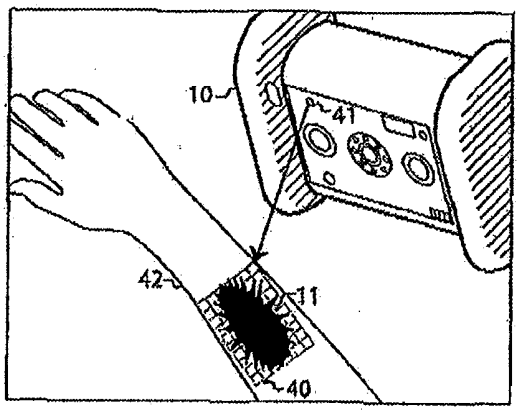


Figure 3



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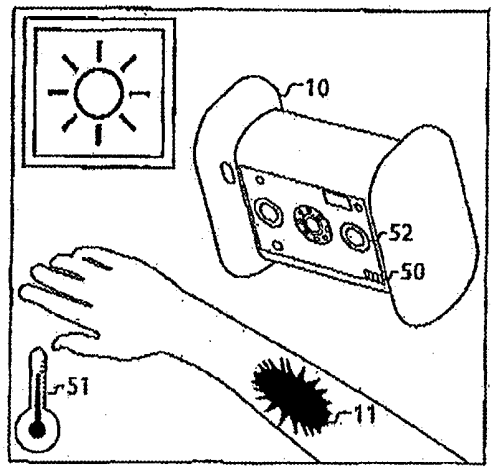
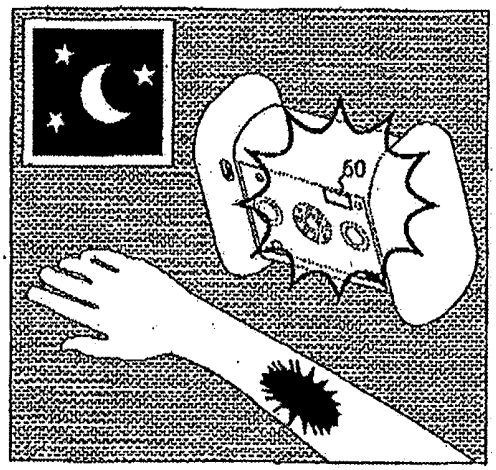


Figure 5



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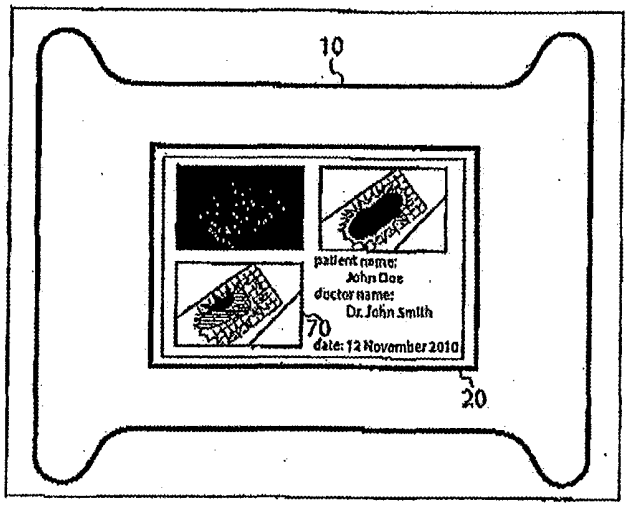


Figure 7

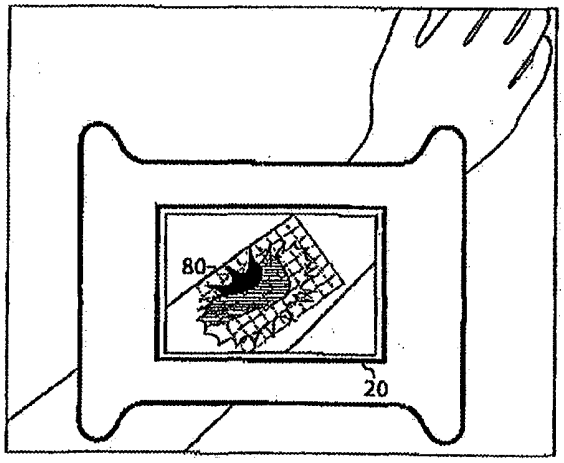


Figure 8

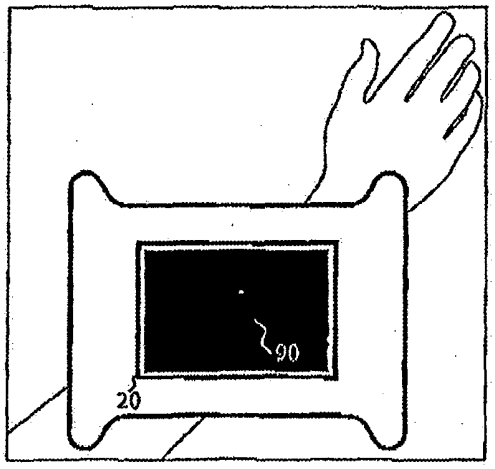


Figure 9

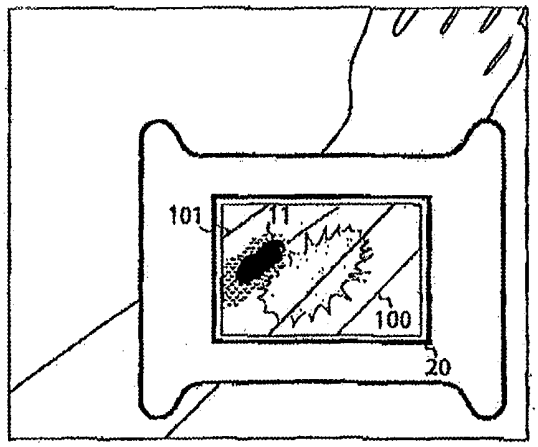


Figure 10

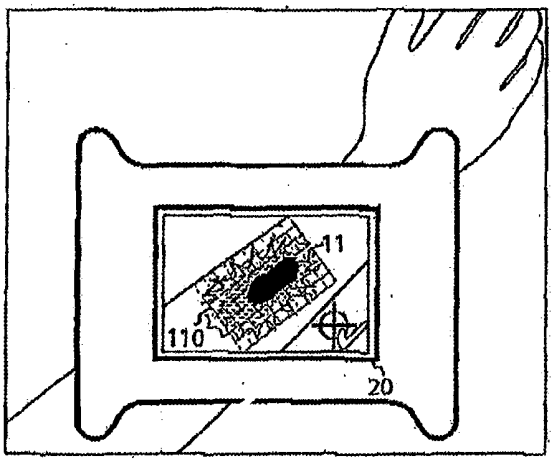


Figure 11

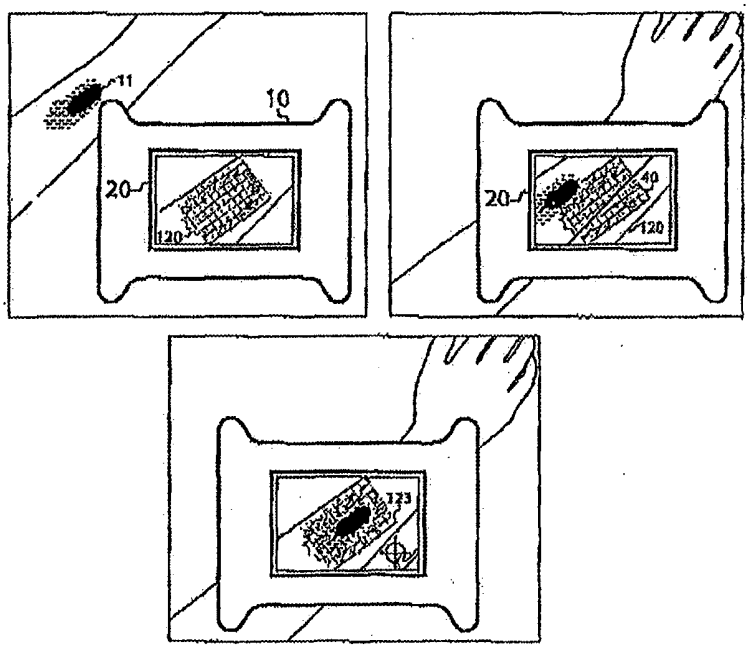
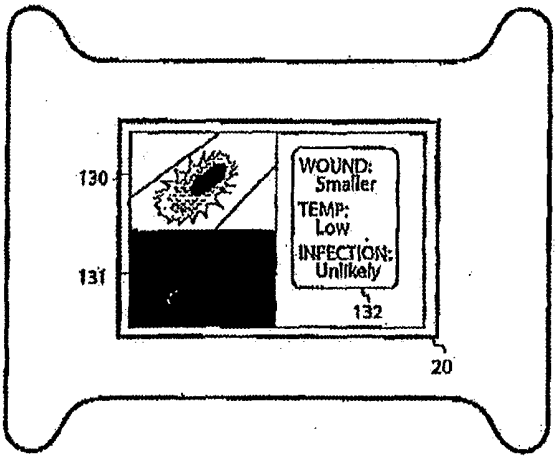


Figure 12



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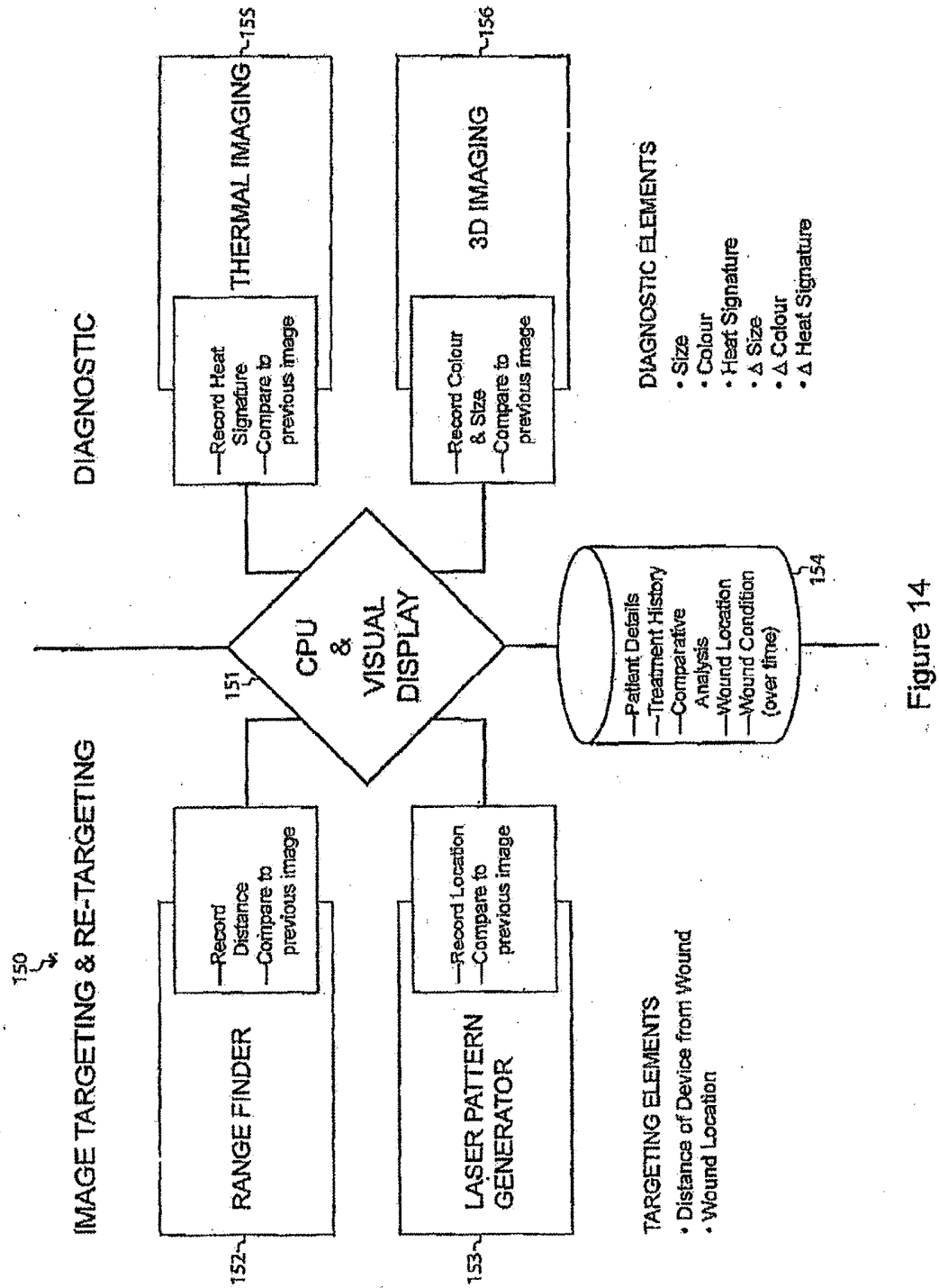
IMAGE TARGETING & RE-TARGETING
150
DIAGNOSTIC
CPU & VISUAL DISPLAY
151
RANGE FINDER
152
—Record Distance
—Compare to previous image
LASER PATTERN GENERATOR
153
—Record Location
—Compare to previous image
THERMAL IMAGING
155
—Record Heat Signature
—Compare to previous image
3D IMAGING
156
—Record Colour & Size
—Compare to previous image
—Patient Details
—Treatment History
—Comparative Analysis
—Wound Location
—Wound Condition (over time)
154
TARGETING ELEMENTS
• Distance of Device from Wound
• Wound Location
DIAGNOSTIC ELEMENTS
• Size
• Colour
• Heat Signature
• Δ Size
• Δ Colour
• Δ Heat Signature

Figure 14

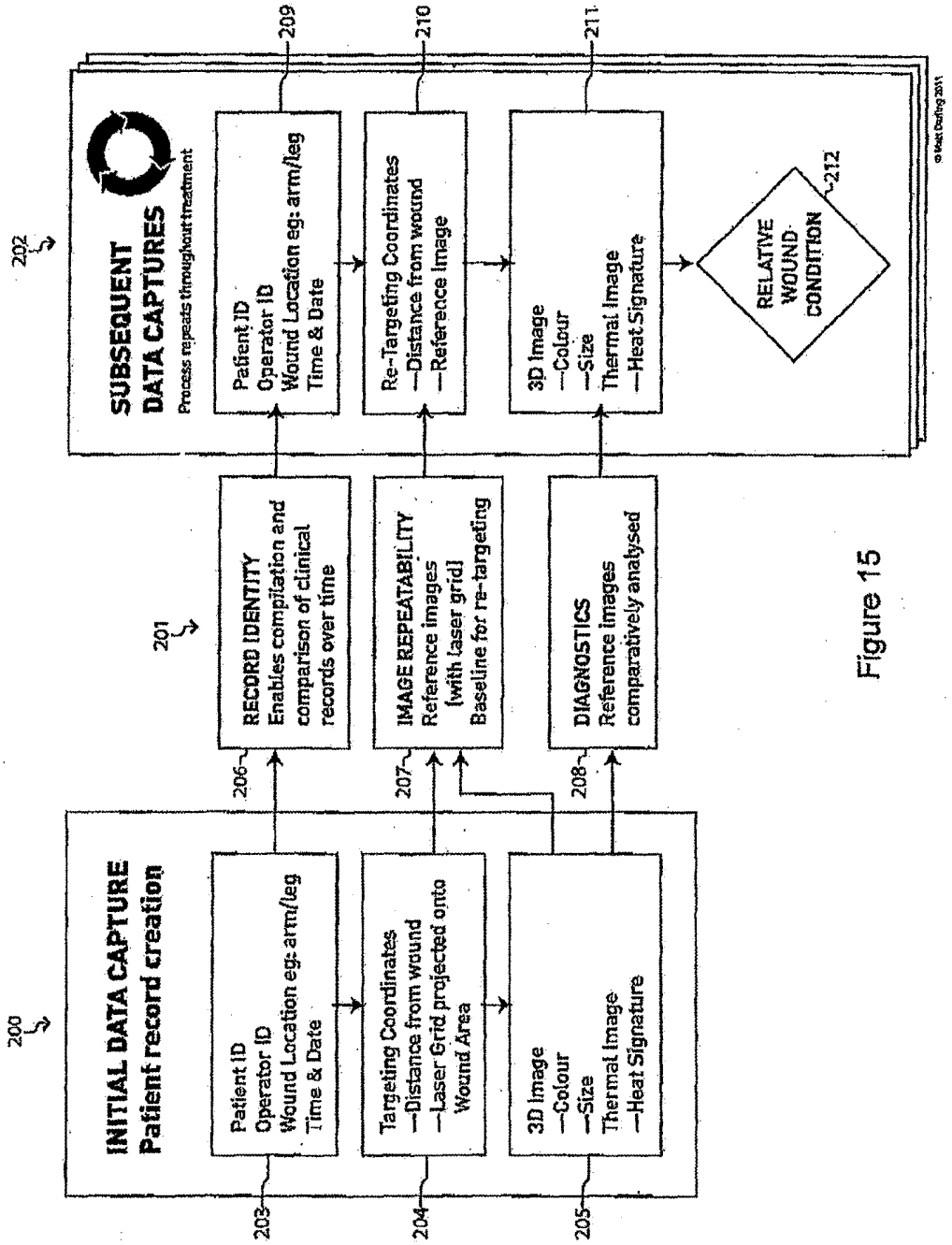
200
INITIAL DATA CAPTURE
Patient record creation
Patient ID
Operator ID
Wound Location eg: arm/leg
Time & Date
203
Targeting Coordinates
—Distance from wound
—Laser Grid projected onto Wound Area
204
3D Image
—Colour
—Size
Thermal Image
—Heat Signature
205
201
206
RECORD IDENTITY
Enables compilation and comparison of clinical records over time
207
IMAGE REPEATABILITY
Reference images
(with laser grid)
Baseline for re-targeting
208
DIAGNOSTICS
Reference images
comparatively analysed
202
SUBSEQUENT DATA CAPTURES
Process repeats throughout treatment
209
Patient ID
Operator ID
Wound Location eg: arm/leg
Time & Date
210
Re-Targeting Coordinates
—Distance from wound
—Reference Image
211
3D Image
—Colour
—Size
Thermal Image
—Heat Signature
212
RELATIVE WOUND CONDITION

Figure 15

SYSTEM FOR INTEGRATED WOUND ANALYSIS

TECHNICAL FIELD

[0001] The present invention relates to the treatment of wounds to the bodies of human and other animals and, more particularly, to the monitoring of changes in selected wound parameters.

BACKGROUND

[0002] Observations of temperature, colour changes, size and surface contours of a wound exists in the art. Traditionally management and assessment of wounds is done manually by health care professionals.

[0003] This involves visual inspection and the taking of notes. Some tools are known in the art to aid in evaluation. These include transparent media onto which the perimeters of wounds are traced. The media are then scanned and compared in series to detect growth or contraction in the wound area. This approach is variable and hard to repeat exactly due to the lack of a visual record. It also interferes with the wound and entails infection risk.

[0004] Increasingly, digital cameras are used in the art to keep record of wounds over time. Digital cameras record only a two dimensional image and are subject to variability in ambient light; adversely affecting colour rendition and consistency.

[0005] Colour is one of the principle means by which infection is recognised in the art. Specially designed cameras seek to achieve scale consistency in image capture through the use of sonar or similar range finding techniques, however there is no means of assuring consistent viewing angle or detecting swelling within the wound perimeter. In some devices lasers are also used to measure distance from the camera and changes in the surface depth or surface contour of the item being photographed.

[0006] Devices to record high-resolution images of changes in surface temperature and surface contours also exist in the art, but this technology has been focused on satellite surveillance and has not been adapted to small scale use.

[0007] In the hospital environment wound infection is a major problem. There remains a need to provide an efficient, reliable apparatus and process to monitor wounds in order to detect in a timely fashion the occurrence and progress of infection in a wound.

[0008] It is an object of the present invention to address or ameliorate some of the above disadvantages.

Notes

[0009] The term "comprising" (and grammatical variations thereof) is used in this specification in the inclusive sense of "having" or "including", and not in the exclusive sense of "consisting only of".

[0010] The above discussion of the prior art in the Background of the invention, is not an admission that any information discussed therein is citable prior art or part of the common general knowledge of persons skilled in the art in any country.

SUMMARY OF INVENTION

[0011] In one broad form of the invention there is provided a system for integrated wound analysis; said system including sensing and image recording elements; sensed data and images of at least a first recording session stored for analysis; said system including a reference system whereby sensing and image recording of any subsequent said recording session substantially repeats sensing and recording of parameters of said first recording session.

[0012] Preferably said recording parameters of said first recording session include location and disposition of said sensing and image recording elements relative a subject wound.

[0013] Preferably said recording parameters further include ambient lighting and temperature of the recording environment.

[0014] Preferably said sensing elements include a distance sensor; said distance sensor establishing a distance parameter of said sensing and image recording elements for a said recording session.

[0015] Preferably said reference system includes a laser projected reference mark for projection onto a body portion adjacent said wound; image of said projected reference mark stored for comparison with a projected reference mark of any said subsequent recording session.

[0016] Preferably wherein a projected image of said reference mark in a said subsequent recording session sensed by said imaging element is analysed by said system; said system indicating to a user when said projected image corresponds substantially with an image of said reference mark recorded in said first recording session.

[0017] Preferably said sensing elements include temperature and ambient light sensors; said temperature and ambient light sensors establishing baseline parameters of said first recording session for comparison and adjustment of said parameters in any said subsequent recording session.

[0018] Preferably said system further includes a flash emitting light source; said light source providing a compensating lighting of a said wound in any said subsequent recording session to adjust lighting to said base line parameter.

[0019] Preferably said image recording elements include a digital camera.

[0020] Preferably said digital camera is provided with a thermal imaging capability; said thermal imaging recording temperatures of said wound corrected according to variations from said base line parameter of ambient temperature.

[0021] Preferably said system includes a view finder/display screen; said view finder/display screen acting in a first instance to display a subject wound sensed through a lens system of said digital camera; said display acting in a second instance to display simultaneously as a semi transparent overlay a previously recorded image of said subject of interest and said subject of interest sensed through said lens system.

[0022] Preferably recorded sensed and image data is analysed by said system; analysis of said recorded data providing an output of progress of said subject wound displayed on said view finder/display screen.

[0023] Preferably said view finder/display screen is further adapted to the display of recorded textual data relating to treatment of said wound.

[0024] Preferably said sensing and said imaging elements and said view finder/display screen are incorporated in a single monitoring device.

[0025] Preferably said sensing elements, said imaging elements and said view finder/display screen are separate devices; said separate devices connected to a central data processing unit.

[0026] In a further broad form of the invention there is provided a method of monitoring a wound; said method including the steps of establishing base line parameters of conditions under which parameters of said wound are recorded in a first sensing and image recording session; recording sensing and image data of said wound in subsequent sensing and image recording sessions; analysing differences between sensed and image data of a said subsequent sensing and image recording session with sensing and image data recorded in said first sensing and image recording session to derive an output of progress of said wound.

[0027] Preferably said analysis is based on recorded temperature, colour and thermal imaging differences between said first recording session and said subsequent recording sessions.

[0028] Preferably wherein analysis and comparison of said sensing and image recordings of said first and subsequent recording sessions is provided by repeatability of parameters under which said sensing and image recording is conducted.

[0029] Preferably wherein repeatability of orientation and disposition parameters of sensing elements and imaging elements is provided by comparison of an image of a projected reference mark with an image of said reference mark recorded in said first recording session.

[0030] Preferably wherein repeatability of sensing and imaging conditions of ambient light and temperature is provided by comparison of ambient light and temperature in a said subsequent recording session with corresponding ambient light and temperature recorded in said first recording session; said ambient light and temperature recorded in a said subsequent recording session compensated to correspond to said ambient light and temperature of said first recording session.

[0031] In yet another broad form of the invention there is provided a method of collecting an initial data set relating to a wound by use of a monitoring device; said method including the steps of: positioning said recording device over a wound to be monitored; using a view finder/display screen of said monitoring device to ensure said wound is within frame of said screen; said monitoring device measuring a distance between said device and a reference mark projected by said device onto a surface adjacent said wound; recording a digital visual three dimensional image and a thermal image of said wound.

[0032] In a further broad form of the invention there Is provided a method of monitoring and analysing a wound over time; said method including the steps of: establishing a base line of wound parameters in an initial sensing and image recording session; repeating said sensing and image recording in subsequent sensing and recording sessions at predetermined intervals; analysing changes in status of said wound by comparison of said subsequent sensing and recording sessions with said base line wound parameters and preceding sensing and recording sessions.

[0033] Preferably said monitoring is by means of a sensing and image recording device; said device including at least a digital camera for recording visual three-dimensional and thermal images of said wound.

[0034] Preferably said device further includes a laser source projector; said laser source projector projecting a reference mark onto a surface adjacent said wound.

[0035] Preferably said laser source projector is configured for cauterising infected portions of said wound.

[0036] Preferably wherein analysis of said wound includes monitoring changes in topography of a surface of said wound over a monitoring period.

[0037] In yet another broad form of the invention there is provided a system for integrated site analysis; said system including sensing and image recording elements; sensed data and images of at least a first recording session stored for analysis; said system including a reference system whereby sensing and image recording of any subsequent said recording session substantially repeats sensing and recording of parameters of said first recording session.

[0038] Preferably said recording parameters of said first recording session include location and disposition of said sensing and image recording elements relative a subject site.

[0039] Preferably said recording parameters further include ambient lighting and temperature of the recording environment.

[0040] Preferably said sensing elements include a distance sensor; said distance sensor establishing a distance parameter of said sensing and image recording elements for a said recording session.

[0041] Preferably said reference system includes a laser projected reference mark for projection onto a body portion adjacent said site; image of said projected reference mark stored for comparison with a projected reference mark of any said subsequent recording session.

[0042] In a further broad form of the invention there is provided a method of monitoring a site; said method including the steps of: establishing base line parameters of conditions under which parameters of said site are recorded in a first sensing and image recording session; recording sensing and image data of said site in subsequent sensing and image recording sessions; analysing differences between sensed and image data of a said subsequent sensing and image recording session with sensing and image data recorded in said first sensing and image recording session to derive an output of progress of said site.

[0043] In a further broad form of the invention there is provided a method of collecting an initial data set relating to a site by use of a monitoring device; said method including the steps of: positioning said recording device over a site to be monitored; using a view finder/display screen of said monitoring device to ensure said site is within frame of said screen; said monitoring device measuring a distance between said device and a reference mark projected by said device onto a surface adjacent said site; recording a digital visual three dimensional image and a thermal image of said site.

[0044] In yet a further broad form of the invention there is provided a method of monitoring and analysing a site over time; said method including the steps of: establishing a base line of site parameters in an initial sensing and image recording session; repeating said sensing and image recording in subsequent sensing and recording sessions at predetermined intervals; analysing changes in status of said site by comparison of said subsequent sensing and recording sessions with said base line site parameters and preceding sensing and recording sessions.

BRIEF DESCRIPTION OP DRAWINGS

[0045] Embodiments of the present invention will now be described with reference to the accompanying drawings wherein:

[0046] FIG. **1** is a view of a wound sustained to an arm with a preferred embodiment of a monitoring device of the system for wound monitoring and analysis according to the invention;

[0047] FIG. **2** is a view of a view finder/display screen of the monitoring device of FIG. **1** in a recording mode;

[0048] FIG. **3** is a further view of the monitoring device of FIGS. **1** and **2** indicating a distance sensing function of the device;

[0049] FIG. **4** is a further view of the monitoring device of FIGS. **1** and **2** indicating a grid projection function of the device;

[0050] FIG. **5** is a further view of the monitoring device of FIGS. **1** and **2** indicating ambient temperature and lighting level sensing functions of the device;

[0051] FIG. **6** is a further view of the monitoring device of FIGS. **1** and **2** indicating a light emitting and ambient light compensating function of the device;

[0052] FIG. **7** is a further view of the view finder/display screen of the device showing an example of a display of recorded wound data;

[0053] FIG. **8** is a further view of the view finder/display screen showing a colour image capture by a digital imaging element of the monitoring device;

[0054] FIG. **9** is a further view of the view finder/display screen showing a thermal image capture by the digital imaging element of the monitoring device;

[0055] FIG. **10** is a further view of the view finder/display screen showing an overlay of a prior recorded image with a current image of the wounded arm of FIG. **1**;

[0056] FIGS. **11** and **12** illustrate how the initial monitoring position of the monitoring device may be re-established for subsequent monitoring sessions by means of the overlay of initial recorded position and the current view of the subject area;

[0057] FIG. **13** is a view of the view finder/display screen indicating an output of monitored wound parameters;

[0058] FIG. **14** is a block diagram of the hardware components and their interconnection in accordance with an implementation of the device of the above referenced Figures;

[0059] FIG. **15** is a block diagram showing a flow chart of the steps in capture, recordal and analysis of relevant information.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

First Preferred Embodiment

[0060] With reference to FIG. **1**, a monitoring device **10**, according to a preferred embodiment of the invention, is placed in position to commence analysis over the wound **11**. The device has to be placed close enough to the target wound to ensure clear high resolution imagery is available and also to maximize the effectiveness of other wound analysis components in the device. In this example the wound **11** is on a patient's right forearm.

[0061] FIG. **2** shows a viewfinder/display screen **20** at the rear of the monitoring device **10**, with the device positioned to give the operator a clear image of the wound **11**. The viewfinder/display screen **20** is used to verify that the wound **11** is in the frame of the view finder/display screen **20** and can be easily captured and analyzed by the device **10**.

[0062] A sensor **30** located in the device **10** as shown in FIG. **3**, is designed to measure the distance **31** from the wound **11** thereby establishing a base line distance parameter upon which other variables can be calculated such as changes in surface contours and topography. This sensor **30** is also used to provide three dimensional imaging of the wound **11** detecting swelling and providing an assessment of the wound's **11** relative size.

[0063] FIG. **4** shows a reference grid **40** being visually projected by a laser source projector **41** onto the arm **42**. This reference grid **40** can be visually seen and measured by the device **10**. The grid can be used to determine if the laser source projector **41**, and hence the device **10**, is at a different angle or distance from the subject wound **11** to that of the previous, base line analysis session. The reference grid system provides for repeatability of sensing and image recording between the first base line recording session and subsequent recording sessions.

[0064] The size of this reference grid **40** combined with the Measurement of distance **31** between the device **10** and wound **11** as described above and shown in FIG. **3**, allows for an accurate calculation of variables such as distance and angle of the device **10** relative to the wound **11**, and eliminates erroneous diagnosis due to a difference between measurements taken at various times during the treatment process.

[0065] The laser source projector **41** could additionally be configured to act as a cauterizing laser source. By this means small pockets of infection on some wounds could be cauterized as part of a sensing and image recording session.

[0066] FIG. **5** shows a thermal imaging temperature sensor **50** of device **10**, measuring the ambient temperature **51** of the environment in which monitoring of the wound **11** takes place. This is used to establish a baseline for other measurements which rely on temperature readings related to the wound and surrounding body surface.

[0067] At the same time an optical sensor **52** measures the light level and hue of the environment, allowing these variables to be taken into account when diagnosing skin discoloration in and around the wound **11**.

[0068] Device **10** may further incorporate a self-adjusting flash **60** as shown in FIG. **6**, which utilizes the light level measurement taken as described above and shown in FIG. **5** to ensure an optimal and consistent light balance for color evaluation across all data collected relative to a single wound.

[0069] FIG. **7** shows a first set of images **70** being displayed after capture. The device **10** displays the results on the view finder/display screen **20** and saves the image-set together with a patient identifier, time, date, distance and ambient temperature as measured. This grouped information is used collectively to compare with results from other sessions of grouped data taken at other times and used to analyse what is happening to the wound.

[0070] FIG. **8** shows how wound colours **80** are recorded in the set of images and displayed on the view finder/display screen **20**. One example of how wound colour is used in wound management is to determine the progress of a bruise where discolouration is clearly a sign of the progress or decay of the wound.

[0071] FIG. **9** illustrates a thermal image **90** of the wound being displayed on the screen **20**. Wound temperatures are measured by the sensor **50** as described above and shown in FIG. **5**. The measured temperatures are recorded in an image set. Small variations in temperature in the wound **11** are recorded and help in the assessment of many wound conditions including, but not limited to, signs of tissue death, known in the art as necrosis, and infection.

[0072] FIG. **10** shows an example of how the set of images **100** can be compiled and presented on the view finder/display screen **20** as a semi transparent layer **100** on top of real-time imagery **101** of the wound **11** and can be analyzed by the device.

[0073] FIG. **11** shows the analysis and compiled images **110** being displayed on the view finder/display screen **20** as a semi transparent layer which then allows the operator to make clinical treatment decisions based on the comparison of the previous data and image set with the current condition of the wound **11**.

[0074] As shown in FIG. **12**, when subsequent images are taken at later dates for diagnosis of the healing progress, the device **10** can be used to monitor this progress. The device retrieves data from the previous patient assessment, displaying this on the semi transparent layer on view finder/display screen **20**. The same distance and aspect from the wound are achieved using the saved distance measurement and projected grid as described above and shown in FIGS. **1** to **4**.

[0075] The user is guided by a semi-transparent version of the previous images **120** to adjust the position of the device over the wound **11**. When the grid **40** in the saved image **120** is aligned with the marker shown in current diagnosis **123**, the steps described above and shown in FIGS. **5** to **10** are repeated for a comparative diagnosis.

[0076] FIG. **13** shows that the device has analyzed changes in color, temperature and relative size of the wound **11**. Analytical data is then displayed **130**, **131** on the screen **20** to assist the operator. In this example, analysis **132** has determined that the wound is smaller and that the surface temperature of the wound has reduced and deduced that the chance of infection is unlikely. All data is saved with patient identification for records, analysis and ongoing treatment.

In Use

[0077] The system of the invention provides the ability to monitor and record wounds over time. It also enables systematic multi-sensing assessment of a wound, supporting the early detection of pathologies to improve patient outcomes.

[0078] It is anticipated that the frequency of use will depend on the pathology of individual patients, with some wounds requiring monitoring every shift (8 hrs) in a hospital setting.

[0079] The following sets out a method of use in a typical wound monitoring process.

First Use on a Patient

[0080] 1—Clinical Records Integration

[0081] The user's ID is input.

[0082] The patient's ID and the location of the wound or wounds are input. Each wound has a record specific to it.

[0083] Time and date are appended to the record automatically.

[0084] 2—Data Collection

[0085] The user positions the device over the wound to be measured, recorded and analysed.

[0086] By using the screen as reference, the user ensures that the wound is in-frame.

[0087] The device measures the distance from the wound and projects a grid onto the wound.

[0088] The device focuses and records a visual image in 3D and a thermal image.

[0089] The images are stored separately, and can be viewed individually or as composite.

[0090] A combination of image collection setting and distance from the wound can be used to calculate the surface area of the wound.

[0091] 3—Analysis

[0092] If thermal readings or colour analysis suggest the likelihood of infection, the device signifies the risk.

Subsequent Uses on a Patient

[0093] 1—Clinical Records Integration

[0094] The user's ID is input.

[0095] The patients ID and the location of the wound or wounds are selected from a list.

[0096] Time and date are appended to the record automatically.

[0097] 2—Data Collection

[0098] The user positions the device over the wound to be measured, recorded and analysed.

[0099] By using a composite of the:

[0100] Previous image and live input from the screen, and;

[0101] Previous measurement of distance of the device from specific locations on the patient's body, using the projected grid and the patient as reference the user ensures that the device is positioned similarly to the initial image capture.

[0102] This creates a series of images to enable slight corrections within the device CPU, such that an accurate comparison of wound size, colour and temperature is possible.

[0103] 3—Analysis

[0104] Changes in wound size, colour and/or temperature may signal the likelihood of pathologies or healing. Initially, the device will alert the user to these changes. In time, clinical trials and ongoing analysis will inform a diagnostic capability in the device. Changes will also be aligned to treatment records enabling improvements in wound care more broadly. High definition, high sensitivity thermal analysis will also enable the detection of early-stage infection and early treatment thereby ameliorating or preventing progress of the wound to a serious and/or chronic infection.

Implementation

[0105] With reference to FIG. **14** there is illustrated in block diagram form the main components and their interconnection of a data acquisition device **150** suited to implement the system described above.

[0106] In this instance the data acquisition device **150** includes a digital processor and display **151** in communication with a memory **154** which stores data corresponding to patient details, treatment history, comparative analysis,

wound location and wound condition (monitored progressively and repeatedly over time at predetermined time intervals).

[0107] A number of primary sensing components are also in communication with the processor and display **151** including a range finder **152** which acquires and transmits data corresponding to distance to a target location (in this instance a wound). Again, distance data is sent at predetermined intervals on a repeated basis thereby to build a time referenced profile of conditions at the target site.

[0108] A suitable range finder device particularly suited to wound data acquisition at close range (that is under 1 m in range but at high resolution) as contemplated in embodiments described above.

[0109] Also in communication with the processor and display **151** is laser pattern generator **153** which, in the preferred instances described above, projects a grid pattern onto the target site at the range determined by the rangefinder **152**. In a preferred form the grid is a rectilinear array of squares having sides having lengths in the range 0 to 5 mm depending on specific application thereby to provide a clear point of reference for an observer.

[0110] The range finder **152** and laser pattern generator **153** collectively provide data feeds to processor and display **151** as what may be broadly described as targeting data including distance of the data acquisition device **150** from its target site and the relative location of the target site, in this instance a wound, in three-dimensional space.

[0111] Also in communication with the processor and display **151** is thermal imaging device **155**. This device fundamentally records heat signature at the target site at the designated range on a repeated basis at predetermined intervals. In a preferred form the thermal imaging device comprises a heat sensor with a macro lens which permits focus onto the target site and acquisition of thermal imaging data in the under 1 m range including more preferably the 0 to 20 cm range.

[0112] Also in communication with the processor and display **151** is 3-D imaging device **156** which records colour data and size data at the target site with reference to the data provided by the targeting elements **152**, **153**. Again these recordings are made at predetermined intervals on a repeated basis thereby to provide time sequence data and as a consequence change data (first derivative).

[0113] The thermal imaging device **155** and 3-D imaging device **156** comprise diagnostic elements which provide data relating to size, colour, heat signature and change in size, colour and heat signature which processor **151** references against the targeting element data from rangefinder **152** and laser pattern generator **153** thereby to build a time referenced profile of data concerning the target site, in this instance of the wound.

[0114] With reference to FIG. **15** there is illustrated a flow chart sequence **200** which can be programmed into the processor and display **151** of FIG. **14** whereby initial data capture **203** includes patient identification, operator identification, wound location and time and date data for providing core reference date for a capture sequence. This data is input into processor **151** (see FIG. **14**) either via a touch sensitive display or other keypad input.

[0115] Data is then progressively acquired from the devices described with reference to FIG. **14** including targeting coordinates **204** and detailed diagnostic data **205**.

[0116] This data acquisition enables a reference framework **201** to be built by processor **151** in the form of record identity **206**, image repeatability (particularly with reference to the grid pattern provided by the laser) **207** and diagnostic element data **208**.

[0117] The sequence is repeated **202** as a series of subsequent data captures **202** at predetermined intervals on a repeated basis. In a preferred form the intervals are equal. In an alternative form the intervals may not be equal but extrapolation algorithms may then be used to normalise the data for example so as to map it to what would be expected for equal time interval data acquisition.

[0118] Thus, at predetermined intervals, the data captures repeat the patient ID acquisition **209**, the targeting coordinates data **210** and the 3-D image and related detailed data **211** thereby to present a relative wound condition summary **212** over time.

Further Embodiments

[0119] In the first preferred embodiment described above all the components for analysis are in the one device. An alternative embodiment could have these components separated but connected to one central data processing unit. For example multiple analysis devices of the same type could be used at different times but the results could be coordinated to achieve the same synchronized diagnosis.

[0120] In the first preferred embodiment described above all the measurements required for diagnosis are taken in one session. In alternative embodiments measurements could be taken continuously or at intervals of any length.

[0121] In the first preferred embodiment described above images are taken at high definition quality commonly used in digital cameras. An alternative embodiment could use much higher resolution, allowing diagnosis even up to microscopic levels.

[0122] In the first preferred embodiment described above the projected reference marker shown in FIG. **4** is a grid. In an alternative embodiment a different size or shape projection than that used in the drawings could be used with the intent of being able to determine changes in size and angle.

[0123] The first preferred embodiment described above uses changes in color, heat, size and contour of the wound to make an analysis. An alternative embodiment could use just three of these to perform an analysis.

[0124] The first preferred embodiment described above is a single, purpose designed module that can be cleaned to minimize infection risk. An alternative embodiment could see the functionality separated out into separate modules. While this may be harder to sanitize it may also deliver advantages in terms of ease of replacement with component failure.

[0125] The first preferred embodiment described above takes temperature measurements and three dimensional images simultaneously, allowing multiple evaluations to be conducted to enable an accurate clinical appraisal. An alternative embodiment could collect measurements from approximately the same time, using multiple devices and still deliver relatively usable analysis.

[0126] The above describes only some embodiments of the present invention and modifications, obvious to those

skilled in the art, can be made thereto without departing from the scope and spirit of the present invention.

1.-34. (canceled)

35. A wound monitoring device for integrated wound analysis; said device including sensing and image recording elements; sensed data and images of at least a first recording session stored for analysis; said device including a reference system whereby sensing and image recording of any subsequent said recording session substantially repeats sensing and recording of parameters of said first recording session; said sensing and image recording elements including a distance sensor; said distance sensor determining a distance between said device and a reference mark projected by said device onto a surface adjacent said wound.

36. The device of claim **35**, wherein said recording parameters of said first recording session include location and disposition of said sensing and image recording elements relative a subject wound.

37. The device of claim **35**, wherein said recording parameters further include ambient lighting and temperature of the recording environment.

38. The device of claim **35**, wherein said distance sensor establishes a distance parameter of said sensing and image recording elements for a said recording session.

39. The device of claim **35**, wherein said reference system includes said reference mark; said reference mark being laser projected onto a body portion adjacent said wound; an image of said projected reference mark stored for comparison with a projected reference mark of any said subsequent recording session.

40. The device of claim **39**, wherein a projected image of said reference mark in a said subsequent recording session sensed by said imaging element is analysed by said system; said system indicating to a user when said projected image corresponds substantially with an image of said reference mark recorded in said first recording session.

41. The device of claim **35**, wherein said sensing elements include temperature and ambient light sensors; said temperature and ambient light sensors establishing baseline parameters of said first recording session for comparison and adjustment of said parameters in any said subsequent recording session.

42. The device of claim **35**, wherein said system compensates for ambient light conditions.

43. The device of claim **35**, wherein said image recording elements include a digital camera.

44. The device of claim **43**, wherein said digital camera is provided with a thermal imaging capability; said thermal imaging recording temperatures of said wound corrected according to variations from said base line parameter of ambient temperature.

45. The device of claim **35**, wherein said system includes a view finder/display screen; said view finder/display screen acting in a first instance to display a subject wound sensed through a lens system of said digital camera; said display acting in a second instance to display simultaneously as a semi transparent overlay a previously recorded image of said subject wound and said subject wound sensed through said lens system.

46. The device of claim **36**, wherein recorded sensed and image data is analysed by said system; analysis of said recorded data providing an output of progress of a said subject wound displayed on said view finder/display screen.

47. The device of claim **45**, wherein said view finder/display screen is further adapted to the display of recorded textual data relating to treatment of a said wound.

48. The device of claim **45**, wherein said sensing and said imaging elements and said view finder/display screen are incorporated in a single monitoring device.

49. The device of claim **45**, wherein said sensing elements, said imaging elements and said view finder/display screen are separate devices; said separate devices connected to a central data processing unit.

50. A method of monitoring a wound; said method including the steps of

(a) projecting a reference mark onto a surface area adjacent said wound,

(b) determining a distance between a sensing and recording device and said reference mark,

(c) establishing base line parameters of conditions under which parameters of said wound are recorded in a first sensing and image recording session,

(d) recording sensing and image data of said wound in subsequent sensing and image recording sessions,

(e) analysing differences between sensed and image data of a said subsequent sensing and image recording session with sensing and image data recorded in said first sensing and image recording session to derive an output of progress of said wound.

51. The method of claim **50**, wherein said analysis is based on recorded temperature, colour and thermal imaging differences between said first recording session and said subsequent recording sessions.

52. The method of claim **50**, wherein analysis and comparison of said sensing and image recordings of said first and subsequent recording sessions is provided by repeatability of parameters under which said sensing and image recording is conducted.

53. The method of claim **50**, wherein repeatability of orientation and disposition parameters of sensing elements and imaging elements is provided by comparison of an image of a said projected reference mark with an image of said reference mark recorded in said first recording session.

54. The method of claims **50**, wherein repeatability of sensing and imaging conditions of ambient light and temperature is provided by comparison of ambient light and temperature in a said subsequent recording session with corresponding ambient light and temperature recorded in said first recording session; said ambient light and temperature recorded in a said subsequent recording session compensated to correspond to said ambient light and temperature of said first recording session.

55. The device of claim **35**, wherein said device further includes a laser source projector.

56. The device of claim **55**, wherein the laser source projector is configured to act as a cauterizing laser source.

57. The device of claim **55**, wherein the laser source projector is configured to cauterize small pockets of infection on wounds as part of a sensing and image recording session.

* * * * *

专利名称(译)	集成伤口分析系统		
公开(公告)号	US20170079575A1	公开(公告)日	2017-03-23
申请号	US15/276381	申请日	2016-09-26
[标]申请(专利权)人(译)	DARLING MATTHEW ROSS		
申请(专利权)人(译)	亲爱的，马修罗斯		
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[标]发明人	DARLING MATTHEW ROSS		
发明人	DARLING, MATTHEW ROSS		
IPC分类号	A61B5/00 G06T7/00 A61B18/20		
CPC分类号	A61B5/445 A61B5/0077 A61B5/742 A61B5/004 A61B18/203 G06T2207/30088 A61B2018/00595 A61B2018/0047 A61B2018/00982 G06T2207/10024 G06T7/0016 A61B5/01 G06F19/321 G06T2200/24 G06T2207/10048		
优先权	PCT/AU2011/001637 2011-12-19 WO 61/424644 2010-12-19 US		
外部链接	Espacenet USPTO		

摘要(译)

一种综合伤口分析系统;所述系统包括传感和图像记录元件;检测至少存储用于分析的第一记录会话的数据和图像;所述系统包括参考系统，其中任何后续所述记录会话的感测和图像记录基本上重复所述第一记录会话的参数的感测和记录。