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(54) Title: APPARATUS TO IMAGE BLOOD VESSEL

(57) Abstract: An apparatus is provided to map blood vessels of a patient by infra-red illumination and further reproduction of the blood vessels on the body part of the patient. The apparatus comprises a flexible base having two parallel faces. The first face comprises a first matrix of infra-red light sources interleaved with a second matrix of infra-red light detectors adapted to detect the infra-red light reflected by the body from the infra-red light sources. The second face comprises a third matrix of visible light sources, each of said sources being back to back with an associated infra-red detector of the first face. The light of each visible light source is modulated by the quantity of the infra-red light detected by the associated infra-red detector.

APPARATUS TO IMAGE BLOOD VESSELS

Field of the invention

The invention relates to the field of medical imaging apparatus, and more specifically to an apparatus to image blood vessels.

Background of the invention

Veins and arteries in many patients are hard to find. When, for instance, dehydrated patients or young patients are treated, finding the veins and arteries is a classical medical problem involving pain, stress and distress. Further, unskilled technicians have grave difficulty in locating many subcutaneous structures in even normal patients. Thus, an aid in locating such structures is needed.

The patent application US 2006/0122515 discloses a system which is able to locate subcutaneous veins and project real-time images of their location onto the surface of the skin. Therefore, clinicians have the ability to visualize the location of the target area and observe any movement of the vasculature regardless of a patient's age, body type or skin tone.

This system includes an infrared light source for generating infrared light and a structure for diffusing the infrared light to an object. The system further includes a video imaging device for receiving the infrared light reflected from the object and for generating a video image of the buried structure based on the reflected infrared light. A calibration procedure is also described as well as embodiments for ensuring that the object is maintained in focus at the correct distance.

Problem with such a system is its complexity in term of manufacturing and usage. It is complex to manufacture and therefore costly as it integrates a lot of technologies with moving parts to adapt and focus the system to the object to analyze. It is complex to use as it is necessary to focus the optical subsystems to the object to analyse. Therefore, for instance, the ability of the object to move during operation is reduced.

Summary of the invention

It would advantageous to achieve an apparatus to image blood vessels which is easy to use. It would be also desirable to reduce the manufacturing cost of such an apparatus.

To better address one or more concerns, in a first aspect of the invention an apparatus to image blood vessels is presented that comprises a flexible base having two parallel faces. A first one of these faces comprises a first matrix of infra-red light sources. The first matrix is

interleaved with a second matrix of infra-red light detectors. These detectors are able to detect the infra-red light reflected by the body of a person when it is illuminated by the infra-red light sources. The second face of the flexible base comprises a third matrix of visible light sources, each light source being back to back with an associated infrared detector of the second matrix. And the light of each visible light source is modulated by the quantity of infra-red light detected by the associated infra-red detector.

The apparatus is advantageously applied on the surface of the examined tissue, so that the matrix of visible light sources presents to the operator a picture of scale 1:1 of the blood vessels underneath the examined tissue surface. The apparatus works as a “look through screen” enhancing the visibility of blood vessels.

In a particular embodiment, the flexible base comprises a hole or an extra slit to allow the access of the tissue surface by some medical tool.

Brief Description of the Drawings

These and other aspects of the invention will be apparent from and elucidated with reference to the embodiment described hereafter where:

- Figure 1 is a bottom view of an apparatus according to an embodiment of the invention;
- Figure 2 is a sectional view along axis A-A of the apparatus of Figure 1;
- Figure 3 is a schematic of the operation of the apparatus of Figure 1; and
- Figure 4 is a schematic view of another embodiment of the invention.

Detailed Description

In reference to Figures 1 and 2, an apparatus 1 comprises a flexible base 2. The flexible base 2 has two substantially parallel faces 3, 4.

On one 3 of these faces, a first matrix of infrared light sources 5 is disposed.

On figure 1, the infrared light sources are symbolized by small circles. The distance between sources is chosen to obtain a substantially constant infrared illumination at few millimetres of the face 3.

On the same face 3, a second matrix of infrared detectors 6 is interleaved with the first matrix. The density of detectors 6 is advantageously higher than the density of infrared light sources 5 as the area illuminated by one source can be detected by a plurality of detectors.

On the second face 4, a third matrix of visible light sources 7 is disposed.

Each visible light source 7 is back to back with an associated infrared detector 6. Therefore, the density of visible light sources 7 per surface unit is the same as the density of infrared detectors 6.

The visible light sources 7 are controlled by modulators 8 so that the visible light emitted by each source 7 is modulated by the quantity of infrared light received by the associated infrared detector 6.

The operation of the apparatus 1 is described in relation to Figure 3. The flexible base 2 is placed on the skin 10 of a patient, the face 3 having the infrared sources 5 and detectors 6 directed towards the skin.

The tissue is illuminated by the infrared light sources 5 and reflects partly the infra-red light. Depending on the type of tissue and on the chosen wavelength, the infrared light is more or less reflected. As it is known by a person skilled in the art, a near infra-red wavelength is particularly advantageous to distinguish blood vessels from surrounding tissues.

The infrared detectors 6 detect the reflected infrared light, creating an infrared picture of the area where the apparatus 1 is placed.

The matrix of visible light sources 7, on the other side of the base 2, provides a visualisation of this infrared picture.

As there is a one to one association between detectors 6 and visible light sources 7, the visualisation of the infrared picture is done at a 1:1 scale.

Therefore, each element seen by the operator through the matrix of visible light sources 7 is situated exactly underneath its image. The apparatus works as a "look through screen".

The definition of the picture is set by the density per surface unit of the detectors 6/visible light sources 7.

In the case that an invasive medical procedure is required, for instance the insertion of a needle into a blood vessel, the insertion point at which the needle must penetrate the skin may be located at the edge of the apparatus. The insertion direction of the needle can be such

that the path of the needle and insertion point into the vessel is located under the apparatus. Depending on the application, an extra slit or an hole 11 may be present in the flexible base 2 to allow access of the tissue surface by some medical tool.

Depending on the type of embodiment, the modulators 8 may be decentralized, i.e. to each couple of detector/source is associated a modulator, or the control of the visible sources 8 may be centralized, Figure 4, into a central controller 20.

While the invention has been illustrated and described in details in the drawings and foregoing description, such illustration and description are to be considered illustrative or exemplary and not restrictive; the invention is not limited to the disclosed embodiment.

For instance, the matrix of infrared detectors may be a CCD (Charge Coupled Device) matrix connected to a microcontroller and the matrix of visible light sources may be a LCD (Liquid Crystal Display) screen or an electronic ink device controlled by the microcontroller. In this case, the microcontroller is programmed to geometrically calibrate the image on the LCD to obtain the relationship between each visible light source and its associated detector.

In another embodiment, each visible light source may be composed of a plurality of pixels.

Other variations to the disclosed embodiments can be understood and effected by those skilled on the art in practising the claimed invention, from a study of the drawings, the disclosure and the appended claims. In the claims, the word "comprising" does not exclude other elements and the indefinite article "a" or "an" does not exclude a plurality.

Claims

1. Apparatus (1) to image blood vessels on the body of a person comprising a flexible base (2) having two parallel faces (3, 4),
the first face (3) comprising a first matrix of infra-red light sources (5) interleaved with a second matrix of infra-red light detectors (6) adapted to detect the infra-red light reflected by the body from the infra-red light sources,
the second face (4) comprising a third matrix of visible light sources (7), each of said sources being back to back with an associated infra-red detector of the first face, the light of each visible light source being modulated by the quantity of the infra-red light detected by the associated infra-red detector.
2. Apparatus according to claim 1, wherein at least a hole (11) is present in the flexible base, said hole being adapted to the insertion of a needle.
3. Apparatus according to claim 1, wherein the modulation of visible light of the matrix of visible light sources is controlled by a unique controller (20) receiving as input the quantity of the infra-red light detected by each associated infra-red detector.
4. Apparatus according to claim 1, wherein the modulation of visible light of each visible light source is controlled by a modulator (8) receiving as input the quantity of the infra-red light detected by the associated infra-red detector.

1/2

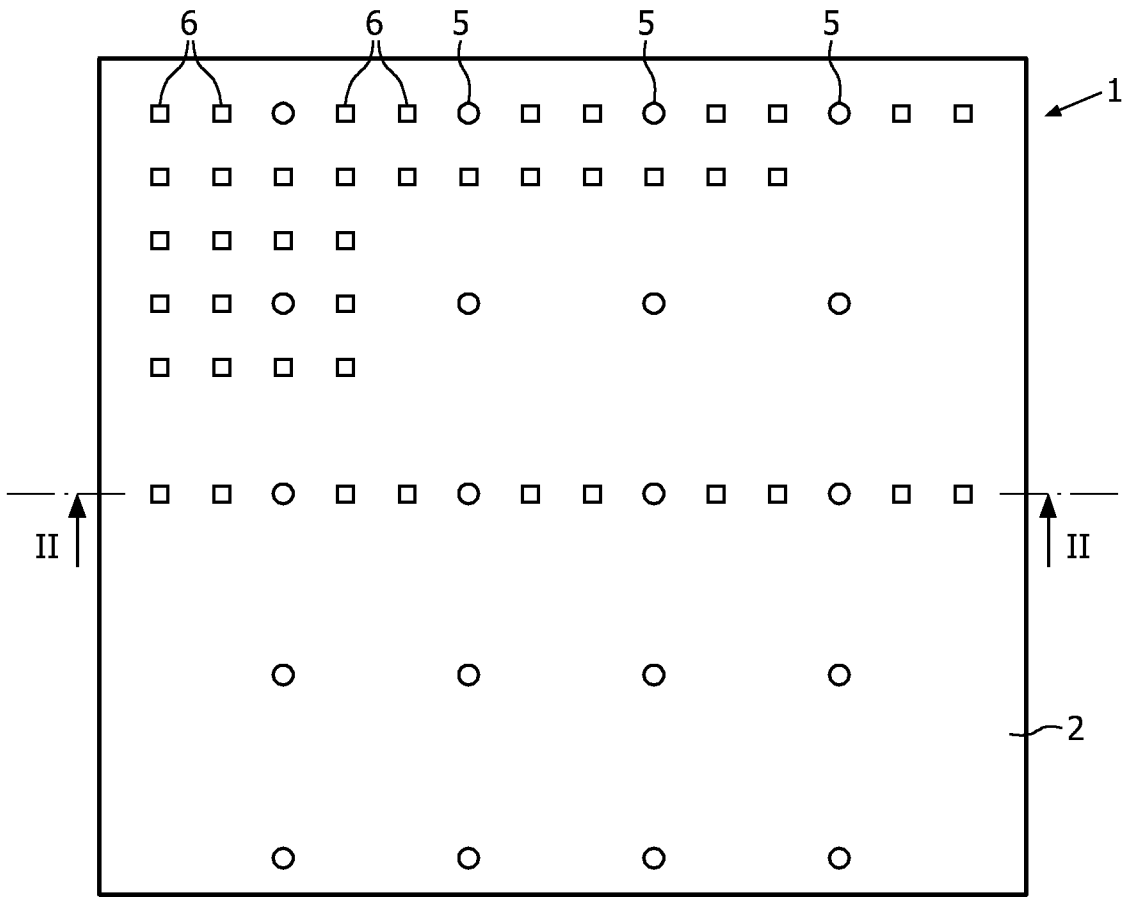


FIG. 1

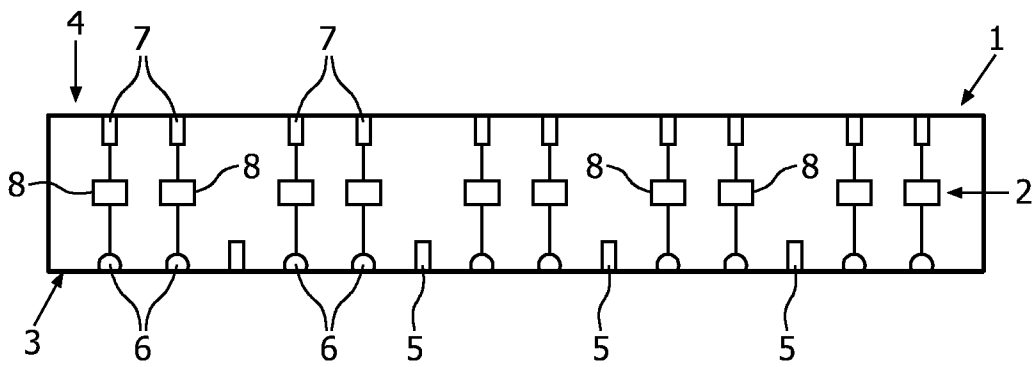


FIG. 2

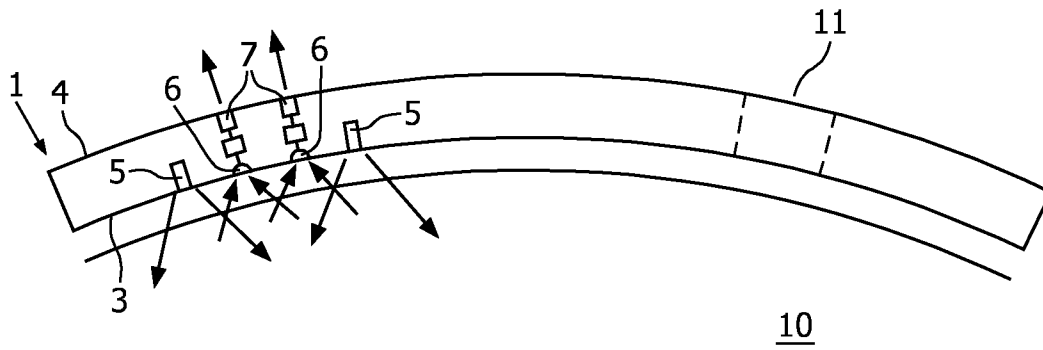


FIG. 3

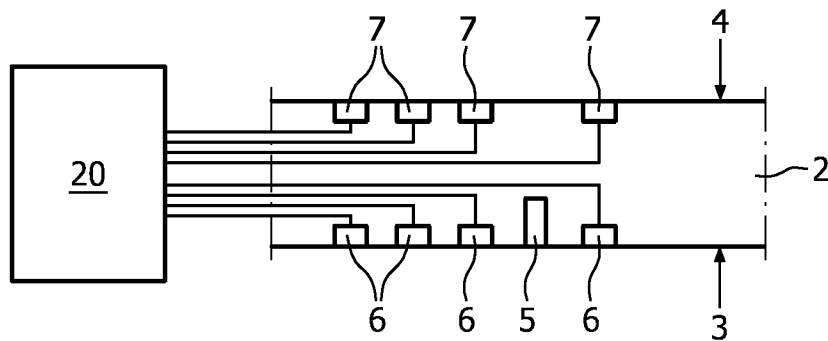


FIG. 4