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(54) APPARATUS FOR SKIN IMAGING, SYSTEM FOR SKIN ANALYSIS

VORRICHTUNG ZUR HAUTABBILDUNG UND SYSTEM ZUR HAUTANALYSE

APPAREIL D'IMAGERIE DE PEAU, SYSTEME D'ANALYSE DE PEAU

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Description

FIELD OF THE INVENTION

[0001] The invention relates to an apparatus for skin imaging, a system for skin analysis and a method for skin analysis.

BACKGROUND OF THE INVENTION

[0002] Melanoma is the most aggressive and the deadliest form of skin cancer. The annual occurrence and death are 60,000 and 7000 cases, respectively in the US only. When detected at an early stage, melanoma can be treated effectively at a relatively low cost of $ 1.8K, which results in high survival rate of 95%.

[0003] In contrast, progression of the disease in the late stage is associated with poor survival rate of less than 13% and dramatically increasing treatment costs of $ 60K per patient or higher. As a result, 88% of the total annual melanoma treatment costs is due to 18% of late stage cases.

[0004] At this moment, however, no official melanoma screening program exists. Currently, melanoma diagnosis is performed by general practitioner based on visual criteria. However, visual screening is very dependent on the skill and experience of the physician, and is generally prone to errors and overlooking of signals that may not be obvious at the early stages of the skin disease.

[0005] Available dermatological tools, e.g. a dermascope, are only useful in the hands of experienced dermatologists, who followed a dedicated training. Yet, there is a large spread in acquired data due to not reproducible data acquisition.

[0006] Thus, there is a long-felt need for improved skin analysis tools, providing easy and unambiguous analysis of the skin, allowing for reliable early detection of melanoma, as well as other skin cancer types and other skin diseases. Such a tool would provide easy and timely diagnosis, increasing survival rate and decreasing treatment costs.

[0007] It is an object of the invention to provide a diagnosis tool for the early detection of skin diseases, in particular skin cancer, more in particular melanoma.

[0008] WO 2007/119202 A discloses an apparatus for skin imaging with the features of the preamble of present claim 1.

SUMMARY OF THE INVENTION

[0009] The invention provides an apparatus for skin imaging, comprising a housing provided with a viewing window for positioning on a skin, at least one lighting means for lighting the viewing window from inside the housing, at least one near field image capturing means directed at the viewing window, at least one far field image capturing means directed at a reflector located adjacent to the viewing window, wherein the reflector is adapted for directing scattered diffuse light from the skin under the viewing window towards the far field image capturing means. With such an apparatus, it is possible to make reliable scans of skin that may be compared with reference data in order to detect changes and/or anomalies in specific locations of the skin. The housing is essentially light-free when the viewing window is placed on top of a skin area to be monitored. Preferably, the inner surface of the housing is provided with a coating with controlled optical properties that govern absorption, colour, scattering etc. The near field imaging means as well as the far field imaging means are preferably digital cameras. The near-field and far-field scattering are typically of different intensities. Therefore these cameras may operate under different optimal conditions. The reflector may comprise a single mirror or multiple mirrors. The viewing window may have various shapes, for instance circular or square.

[0010] Preferably, the near field imaging means are directed at the viewing windows essentially perpendicular to the skin surface. Thus, the near-field image is essentially a two-dimensional image with a maximum surface area exposed to the near-field camera.

[0011] In a preferred embodiment, the lighting means are directed at the skin surface under an oblique angle. An oblique angle is an angle that is not a multiple of 90 degrees; this implies that the incident angle with the skin surface is smaller than 90°.

[0012] The advantage of using multiple oblique angles is further elaborated in what follows. Using variable angles of incidence has two advantages. First, by varying the illumination angle, the position of the far-field scattering pattern on the inner surface of the housing is changed. This shift depends on tissue scattering coefficient, which is higher for malignant tissue. Analysing the change in the far-field images as a function of angle can provide information if the lesion is benign or malignant (cancer).

[0013] Second, using oblique incident angles has an impact on the penetration depth of the illuminating light. As a result, a selection can be made as to the depth to which, e.g., a tissue sample is probed, by adjusting the orientation of the optode(s). Therefore, information from different depth of the lesion can be obtained. This is especially important to a) detect skin cancer at an early stage, when its position is limited to the epidermal layer

[0014] (approximately 70 to 100 micrometers below the skin surface) and b) to detect the depth of a cancer lesion at a late stage, where there is a high risk of metastases if a lesion reaches a blood-rich dermal layer of the skin.

[0015] It is advantageous if the lighting means are suitable for varying the incident angle. Thus, the near field and far field images may be recorded under different angles, which yield more information, and increases the sensitivity of the method. Some differences, changes or anomalies in the skin will not be as apparent under a single lighting angle: increasing the number of angles at

which recordings are collected increases the chance of detecting anomalies.

[0016] Preferably, the lighting means are adapted to project a light pattern on the skin. Using an illumination pattern has the following advantages. First, it assists in obtaining 3-dimentional information about the shape of the object under investigation, i.e., a skin lesion. Malignant skin lesions may form a dome on top of the skin surface, which can be detected using 3-dimentional spatial information. Secondly, using an illumination pattern assists in obtaining information about light attenuation along an extended area. An illumination pattern may be achieved by providing the illumination means with a way to adjust the shape or pattern of the illuminated area within or near the field of view. The lighting means may comprise a single spot scanning an area of the skin in a predetermined pattern, or multiple combined spots at a given location, or multiple spots arranged in a predetermined a ring shape, or other appropriate shapes.

[0017] In a preferred embodiment, the lighting means are displaceable to vary the incident angle. This is a very reliable way of varying the incident angle of the light on the skin surface. Various mechanical displacement means are available to vary the angle in a reliable and reproducible way, for instance a motorized light source on tracks. A disadvantage is that it takes time to move the lighting source to a new location in between measurements, and moving parts are prone to defects.

[0018] In another preferred embodiment, the lighting means comprise multiple independently powered light sources positioned under different incident angles. These light sources may be addressed sequentially in order to vary the lighting angle. As the lighting angles are fixed, the reproducibility is very good. A disadvantage is that multiple light sources are needed that may be expensive.

[0019] In a preferred embodiment, the incident angles comprise at least one oblique angle.

[0020] Particularly useful oblique angles are from 20° to 75°, most preferably approximately 55°, as this is the approximate Brewster angle for human skin.

[0021] Preferably, the incident angles also comprise an angle of approximately 0°. The difference between the effect of light scattering on parameters of the near-field and far-field images at 0° and an oblique angle is often large, and thus the combination yields a lot of information.

[0022] It is advantageous if the lighting means comprise a polarized light source, preferably a laser or an unpolarised light source provided with a polarizing means. A polarized light source yield a more specific scattering pattern than non-polarized light.

[0023] In a preferred embodiment, the spectral composition emitted by the light source can be varied. Thus, measurements can further optimized, and carried out at various wavelengths, which further optimises the sensitivity of the measurement. Preferably but not necessarily, each measurement is done at a single wavelength.

[0024] It is preferred if the reflector is a convex surface of a predetermined shape, protruding from the housing. Such a reflector captures a wide area of scattered diffuse light, and thus provides a high density of information for the far field imaging means.

[0025] The invention also provides a system for skin analysis, comprising an apparatus according to any of the preceding claims, controlling means for controlling the lighting means and the imaging means, data processing means for processing images captured by the near field and far field image capturing means, and display means for displaying images and/or processed data. With such a system, it is relatively easy for a skilled person to gain insight in the current state of the skin of a person, and to notice changes in a skin when comparing analyzed images to images taken at an earlier stage, for instance weeks, months or years earlier. The analysis system according to the invention helps to indicate changes indicative of for instance skin diseases at an early change, typically earlier than possible even by experienced physicians. Upon the detection of possibly malign changes in the skin, the physician may decide to initiate further tests, for instance histological or microbiologic testing, that may lead to an early diagnosis of a skin disease. Early diagnosis of potentially lethal skin diseases such as melanoma improves the chances of survival for the patient.

[0026] The invention also provides a method for skin analysis, comprising the steps of positioning the viewing window of an apparatus according to the invention, as described above, on a skin area to be analysed, lighting at least part of the skin area by the lighting means under an incident angle, capturing at least one image of the lighted skin by the near field image capturing means, capturing at least one image as reflected by the reflector from the illuminated skin by the near field image capturing means, and comparing the captured images with reference images. Such a combination of near field and far field images under different lighting angles provides reliable and sensitive information, and developing changes in the analyzed skin are likely to be noticed. In contrast, if only a near field or a far field would be taken, some changes are less likely to be noticed at an early stage. Also, the angle or the pattern of the lighting has a great influence on the image created, and may increase the chance skin lesions are noticeable. The obtained images may be further subjected to images segmentation and pattern recognition analysis and classifying lesions, preferably on an automated system. Illumination of the skin can be done with a light source partially outside the dome shaped screen from a distance or in proximity from the edge of the skin aperture.

[0027] The method may further include the positioning of the viewing window of an apparatus according to the invention on a skin area to be analysed.

[0028] The method may further include the acquiring of far-field images of the skin distant from a suspicious lesion, preferably at 0° and at various oblique angles.

The images taken at a distance from the suspicious lesion may then be used as a standard, which is particularly if no historical data is available.

[0029] Advantageously, it is possible to determine a "center-of-gravity" for each image and shift in the "center-of-gravity" depending on the angle. It is then possible to acquire far-field images of the suspicious lesion (possibly malignant) at 0° and an oblique angle, and estimate a "center-of-gravity" for each image and shift in the "center-of-gravity" depending on the angle. For comparison, it is also useful to acquire far-field images of a mole (a non-malignant lesion) at 0° and an oblique angle, estimating a "center-of-gravity" for each image and shift in the "center-of-gravity" depending on the angle. This then enables the comparison of the difference in the shifts in the "center-of-gravity" in the images of the skin, moles, and suspicious lesion, which makes it relatively easy for a skilled person to assess if the suspicious lesion is indeed malignant.

[0030] Preferably, a plurality of images is taken under varying incident angles of lighting. This increases the chance of detecting skin lesions. Preferably, a plurality of images is taken under varying incident angles ranging from 0° to at least 75°. By using high incident angles, more superficial layers of the skin can be assessed. This is beneficial for detecting a cancer lesion at an early stage, since it is known that is starts from the epidermal layer, which is approximately 70 to 100 micrometers deep in the skin.

[0031] Most preferably, the plurality of images comprises images taken at least a first angle between 15° and 25°, and a second angle between 55° and 65°. It is preferred if the incident angles comprise at least 0° and at least one oblique angle, and preferably the angles include the Brewster angle of fully polarised reflection

BRIEF DESCRIPTION OF THE DRAWINGS

[0032] Fig. 1 shows an apparatus according to the invention.

DETAILED DESCRIPTION OF EMBODIMENTS

[0033] Fig. 1 shows an apparatus 1, comprising a light-free housing 2 that can comprise a whole or part of a hemisphere. A bottom plate 3 of the housing 1 is provided with a window opening 4, which is placed on top of a skin area 5 to be examined. The skin 5 forms an approximately flat surface in the window location. A device may include additional means to control pressure or force exerted on the skin. This is to minimize skin deformation, skin fluid displacement and the related effects, which may affect the measurements. The window 4 may be open, but can also be provided with an essentially flat, sufficiently transparent material layer, preferably a glass plate, most preferably a reflection-free glass plate. When no glass plate is used, it is preferred if the monitored part of the skin 5 is as flat as possible. This may be achieved by keeping the scanned area sufficiently small, or by using skin stretching means. Immersion fluid (known from microscopy) may be applied on the skin between the skin and the exit window of the device. This minimizes the specular reflectance from the skin surface, increases light penetration in the skin, and maximizes light collection efficacy. Perpendicular to the skin surface 5, a first, near-field imaging camera 6 is positioned above the window opening 4. Under an angle A, a light source 7 is directed at the exposed skin area 4. Part of the light 8 is absorbed by the skin 5, another part is reflected and yet another part is scattered. When a glass plate is used in the window 4, the maximum angle that can be used is typically 75° (depending on the type of glass), as at higher angles typically no useful data can be obtained due to total internal reflection. The reflected light 9 may be captured by a light trap 10, in order to prevent further scattering within the housing. Part of the scattered light 11 is recorded directly by the first camera 6. The first camera records near-field scattered light, which is scattered under angles smaller than 90° with respect to the incident beam 8, and has a relatively high intensity. Another part of the scattered light 11 is reflected towards a second, far-field, imaging camera 12, through a suitably curved mirror 13 located adjacent to the opening 4. The indirectly reflected far-field scattering is scattered under angles greater than 90° with respect to the incident beam 8, and has a relatively low intensity. As the far-field camera 12 is separated from the near-field image camera 6, each camera can be easily optimised with respect to the intensity as recorded, for an optimal signal-to-noise ratio.

[0034] The angle A under which the light source 7 lights the skin 5 can be varied, either through mechanical movement of the laser, or through adjustable optics such as mirrors, or by using an optical fiber to deliver light from a remote light source, which position and angle can be displaced with respect to the skin. Alternatively, a number of additional lasers 14, 15 (or other light sources) can be positioned under fixed angles A, an operated sequentially in order to achieve the same illumination conditions that could be achieved by moving a single laser 7.

[0035] By recording both the near-field image 6 and the far-field image 12 under different incident laser angles A. Images at numerous angles could be measured, however, this would lead to enormous amounts of data. In practice, it is preferred to record under a limited amount of angles, preferably from 3 to 10 angles per skin position. A particularly useful data set could for instance be obtained by measuring at angles of approximately 0°, 20°, 40°, 55° and 75°. The apparatus can then be moved towards different locations on the skin in both the X and Y directions, preferably by automated means. Thus, a specific part of the skin can be scanned at a desired resolution, and the data can be processed. The scanning of a specific skin area may be done relatively fast.

[0036] The processed combination of near-field and far-field images under different angles yields a skin profile. The recorded images may be compared with refer-

ence images, for instance images that were recorded at an earlier time, or a recording of a healthy part of the skin. This method yields a reliable and easy way of indicating anomalies and/or changes in the skin, which can be a great help in diagnosing for instance skin cancer. As the method is very sensitive, such skin diseases are more likely to be detected at an earlier stage than known methods. Early detection is in particular of importance in the case of skin cancers. Combined with automated data processing system and decision support this provides a basis for easy-to-access tool for skin cancer screening.

[0037] The apparatus 1 can be operated by a person who does not need a full medical education, nor experience. The collected image data and/or analysis data may be sent to a skilled person, or there may be a pre-selection of potentially harmful developments by a relatively un-skilled person that need to be looked at by a higher qualified expert. Once an alarming difference in images is noted, the examined person can be forwarded to clinicians, who may carry out a full diagnosis in order to confirm the development of a certain disease such as melanoma. Thus, the limited time available to skilled professionals can be used more effectively, while at the same time, a larger amount of persons can be monitored for potentially hazardous skin diseases.

[0038] Although the application for early detection of skin diseases is considered to be the most important application of the apparatus 1 according to the invention, it may also be used for other applications, for instance cosmetic applications such as measurement of skin type, monitoring of pigment disorders, e.g., age spots and vitiligo.

Claims

1. Apparatus (1) for skin imaging, comprising:

- a housing (2) provided with a viewing window (4) for positioning on a skin surface (5),
- at least one lighting means (7, 14, 15) for lighting the viewing window from inside the housing and providing incident light beams (8) under different oblique angles (A) with respect to the viewing window (4),
- at least one near field imaging camera (6) directed at the viewing window and adapted for directly recording near field scattered light scattered from the skin under the viewing window under angles smaller than 90° with respect to the incident light beam (8), **characterised by**
- at least one far field imaging camera (12), which is separated from the at least one near field imaging camera (6), directed at a reflector (13) located adjacent to the viewing window,

wherein the reflector is adapted for directing scattered diffuse light scattered from the skin under the viewing window under angles greater than 90° with respect to the incident light beam (8) towards the far field imaging camera for each of the different oblique angles of the incident light beam (8).

2. Apparatus according to claim 1, **characterised in that** the near field imaging camera is directed essentially perpendicular to the viewing window (4).

3. Apparatus according to claim 1, **characterised in that** the lighting means are displaceable to vary the incident angle.

4. Apparatus according to claim 1, **characterised in that** the lighting means comprise multiple independently powered light sources (7, 14, 15) positioned under different incident angles.

5. Apparatus according to any of the preceding claims, wherein the lighting means are adapted to project a light pattern on the skin.

6. Apparatus according to any of the preceding claims, **characterised in that** the incident angle comprises at least one oblique angle (A).

7. Apparatus according to claim 6, wherein the oblique angle (A) is from 20° to 75°.

8. Apparatus according to claim 5 or 6, wherein the incident angles comprise an oblique angle as well as an angle of approximately 0°.

9. Apparatus according to any of the preceding claims, **characterised in that** the wave length emitted by the light source can be varied.

10. Apparatus according to any of the preceding claims, **characterised in that** the reflector (13) is a convex mirror of a predetermined shape, protruding from the housing.

11. System for skin analysis, comprising an apparatus (1) according to any of the preceding claims, controlling means for controlling the lighting means and the imaging means, data processing means for processing images captured by the near field and far field imaging camera, and display means for displaying images and/or processed data.

12. Method for skin analysis, comprising the steps of:

- positioning the viewing window (4) of an apparatus according to any of the claims 1-10 on a skin area (5) to be analysed,
- lighting at least part of the skin area by the lighting means (7, 14, 15) providing the incident light beam (8) under different oblique angles (A)

with respect to the viewing window (4)"
- capturing at least one image for each of the different oblique angles (A) of the lighted skin area by the near field imaging camera (6) by recording near field scattered light scattered from the skin under the viewing window under angles smaller than 90° with respect to the incident light beam (8),
- capturing at least one image for each of the different oblique angles (A) as reflected by the reflector (11) under angles greater than 90° with respect to the incident light beam (8) from the lighted skin area by the far field imaging camera (12), and
- comparing the captured images with reference images.

13. Method for skin analysis according to claim 12, wherein a center-of-gravity is determined for each image and a shift in the center-of-gravity depending on the angle.

14. Method according to claim 12, **characterised in that** the incident angles comprise at least 0° and at least one oblique angle (A).

Patentansprüche

1. Vorrichtung (1) zur Hautabbildung, die Folgendes umfasst:

- ein Gehäuse (2) mit einem Sichtfenster (4) zur Positionierung auf einer Hautoberfläche (5),
- zumindest ein Beleuchtungsmittel (7, 14, 15) zur Beleuchtung des Sichtfensters vom Gehäuseinnern aus und zum Erzeugen einfallender Lichtbündel (8) unter unterschiedlichen schiefen Winkeln (A) bezogen auf das Sichtfenster (4),
- zumindest eine Nahfeld-Bildkamera (6), die auf das Sichtfenster gerichtet ist und für die direkte Aufnahme von Nahfeld-Streulicht ausgelegt ist, das von der Haut unter dem Sichtfenster unter Winkeln von weniger als 90° bezogen auf das einfallende Lichtbündel (8) gestreut wird,

gekennzeichnet durch

- zumindest eine Fernfeld-Bildkamera (12), die von der zumindest einen Nahfeld-Bildkamera (6) getrennt und auf einen Reflektor (13) gerichtet ist, der an das Sichtfenster angrenzend angeordnet ist,

wobei der Reflektor für jeden der verschiedenen schiefen Winkel des einfallenden Lichtbündels (8) für die Lenkung von gestreutem diffusem Licht, das von der Haut unter dem Sichtfenster unter Winkeln von mehr als 90° bezogen auf das einfallende Lichtbündel (8) gestreut wird, hin zu der Fernfeld-Bildkamera ausgelegt ist.

2. Vorrichtung nach Anspruch 1, **dadurch gekennzeichnet, dass** die Nahfeld-Bildkamera im Wesentlichen senkrecht zum Sichtfenster (4) ausgerichtet ist.

3. Vorrichtung nach Anspruch 1, **dadurch gekennzeichnet, dass** die Beleuchtungsmittel zur Veränderung des Einfallswinkels verschiebbar sind.

4. Vorrichtung nach Anspruch 1, **dadurch gekennzeichnet, dass** die Beleuchtungsmittel mehrere unabhängig voneinander mit Energie versorgte Lichtquellen (7, 14, 15) umfassen, die unter verschiedenen Einfallswinkeln positioniert sind.

5. Vorrichtung nach einem der vorhergehenden Ansprüche, wobei die Beleuchtungsmittel für die Projektion eines Lichtmusters auf die Haut ausgelegt sind.

6. Vorrichtung nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** der Einfallswinkel zumindest einen schiefen Winkel (A) umfasst.

7. Vorrichtung nach Anspruch 6, wobei der schiefe Winkel (A) von 20° bis 75° beträgt.

8. Vorrichtung nach Anspruch 5 oder 6, wobei die Einfallswinkel einen schiefen Winkel sowie einen Winkel von ungefähr 0° umfassen.

9. Vorrichtung nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** die von der Lichtquelle ausgesendete Wellenlänge verändert werden kann.

10. Vorrichtung nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** der Reflektor (13) ein konvexer Spiegel mit einer vorbestimmten Form ist, der aus dem Gehäuse vorragt.

11. System zur Hautanalyse, das eine Vorrichtung (1) nach einem der vorhergehenden Ansprüche, Steuermittel zur Steuerung der Beleuchtungsmittel und der Abbildungsmittel, Datenverarbeitungsmittel zur Verarbeitung der von der Nahfeld- und der Fernfeld-Bildkamera erfassten Bilder und Anzeigemittel zur Anzeige von Bildern und/oder verarbeiteten Daten umfasst.

12. Verfahren zur Hautanalyse, das die folgenden Schritte umfasst:

- Positionierung des Sichtfensters (4) einer Vorrichtung nach einem der Ansprüche 1-10 auf ei-

nem zu analysierenden Hautbereich (5),
- Beleuchtung zumindest eines Teils des Hautbereichs durch die Beleuchtungsmittel (7, 14, 15), die das einfallende Lichtbündel (8) unter verschiedenen schiefen Winkeln (A) bezogen auf das Sichtfenster (4) erzeugen,
- Erfassung zumindest eines Bildes für jeden der verschiedenen schiefen Winkel (A) des beleuchteten Hautbereichs durch die Nahfeld-Bildkamera (6) durch die Aufnahme von Nahfeld-Streulicht, das von der Haut unter dem Sichtfenster unter Winkeln von weniger als 90° bezogen auf das einfallende Lichtbündel (8) gestreut wird,
- Erfassung zumindest eines Bildes für jeden der verschiedenen schiefen Winkel (A), das vom Reflektor (11) unter Winkeln von über 90° bezogen auf das einfallende Lichtbündel (8) von dem beleuchteten Hautbereich reflektiert wird, durch die Fernfeld-Bildkamera (12) und
- Vergleich der erfassten Bilder mit Referenzbildern.

13. Verfahren zur Hautanalyse nach Anspruch 12, wobei für jedes Bild ein Schwerpunkt und eine Verschiebung des Schwerpunkts in Abhängigkeit von dem Winkel ermittelt werden.

14. Verfahren zur Hautanalyse nach Anspruch 12, **dadurch gekennzeichnet, dass** die Einfallswinkel zumindest 0° und zumindest einen schiefen Winkel (A) umfassen.

Revendications

1. Appareil (1) d'imagerie de la peau, comprenant :

- un logement (2) pourvu d'une fenêtre de visualisation (4) à positionner sur une surface de peau (5) ;
- au moins un moyen d'éclairage (7, 14, 15) pour éclairer la fenêtre de visualisation depuis l'intérieur du logement et fournir des faisceaux de lumière incidents (8) à des angles obliques différents (A) par rapport à la fenêtre de visualisation (4) ;
- au moins une caméra d'imagerie en champ proche (6) dirigée vers la fenêtre de visualisation et apte à enregistrer directement une lumière diffusée en champ propre à partir de la peau sous la fenêtre de visualisation à des angles inférieurs à 90° par rapport au faisceau de lumière incident (8) ;

caractérisé par

- au moins une caméra d'imagerie en champ lointain (12), qui est séparée de l'au moins une caméra d'imagerie en champ proche (6), dirigée vers un réflecteur (13) situé adjacent à la fenêtre de visualisation ;

dans lequel le réflecteur est apte à diriger une lumière diffuse diffusée à partir de la peau sous la fenêtre de visualisation à des angles supérieurs à 90° par rapport au faisceau de lumière incident (8) vers la caméra d'imagerie en champ lointain pour chacun des différents angles obliques du faisceau de lumière incident (8).

2. Appareil selon la revendication 1, **caractérisé en ce que** la caméra d'imagerie en champ proche est dirigée essentiellement perpendiculairement à la fenêtre de visualisation (4).

3. Appareil selon la revendication 1, **caractérisé en ce que** le moyen d'éclairage peut être déplacé pour varier l'angle incident.

4. Appareil selon la revendication 1, **caractérisé en ce que** le moyen d'éclairage comprend plusieurs sources de lumière alimentées indépendamment (7, 14, 15) positionnées à des angles incidents différents.

5. Appareil selon l'une quelconque des revendications précédentes, dans lequel le moyen d'éclairage est apte à projeter un motif de lumière sur la peau.

6. Appareil selon l'une quelconque des revendications précédentes, **caractérisé en ce que** l'angle incident comprend au moins un angle oblique (A).

7. Appareil selon la revendication 6, dans lequel l'angle oblique (A) est de 20° à 75°.

8. Appareil selon la revendication 5 ou 6, dans lequel les angles incidents comprennent un angle oblique ainsi qu'un angle d'environ 0°.

9. Appareil selon l'une quelconque des revendications précédentes, **caractérisé en ce que** la longueur d'onde émise par la source de lumière peut être variée.

10. Appareil selon l'une quelconque des revendications précédentes, **caractérisé en ce que** le réflecteur (13) est un miroir convexe d'une forme prédéterminée, faisant saillie à partir du logement.

11. Système d'analyse de peau, comprenant un appareil (1) selon l'une quelconque des revendications précédentes, un moyen de commande pour commander le moyen d'éclairage et le moyen d'imagerie, un moyen de traitement de données pour traiter des images capturées par la caméra d'imagerie en champ proche et en champ lointain, et un moyen d'affichage pour afficher des images et/ou des données traitées.

12. Procédé d'analyse de peau, comprenant les étapes :

- du positionnement de la fenêtre de visualisation (4) d'un appareil selon l'une quelconque des revendications 1 à 10 sur une zone de peau (5) à analyser,
- de l'éclairage d'au moins une partie de la zone de peau par le moyen d'éclairage (7, 14, 15) fournissant le faisceau de lumière incident (8) à des angles obliques différents (A) par rapport à la fenêtre de visualisation (4),
- de la capture d'au moins une image pour chacun des différents angles obliques (A) de la zone de peau éclairée par la caméra d'imagerie en champ proche (6) en enregistrant une lumière diffusée en champ proche qui est diffusée à partir de la peau sous la fenêtre de visualisation à des angles inférieurs à 90° par rapport au faisceau de lumière incident (8),
- de la capture d'au moins une image pour chacun des différents angles obliques (A) telle qu'elle est reflétée par le réflecteur (11) à des angles supérieurs à 90° par rapport au faisceau de lumière incident (8) à partir de la zone de peau éclairée par la caméra d'imagerie en champ lointain (12), et
- de la comparaison des images acquises à des images de référence.

13. Procédé d'analyse de peau selon la revendication 12, dans lequel un centre de gravité est déterminé pour chaque image, un décalage du centre de gravité dépendant de l'angle.

14. Procédé selon la revendication 12, **caractérisé en ce que** les angles incidents comprennent au moins 0° et au moins un angle oblique (A).

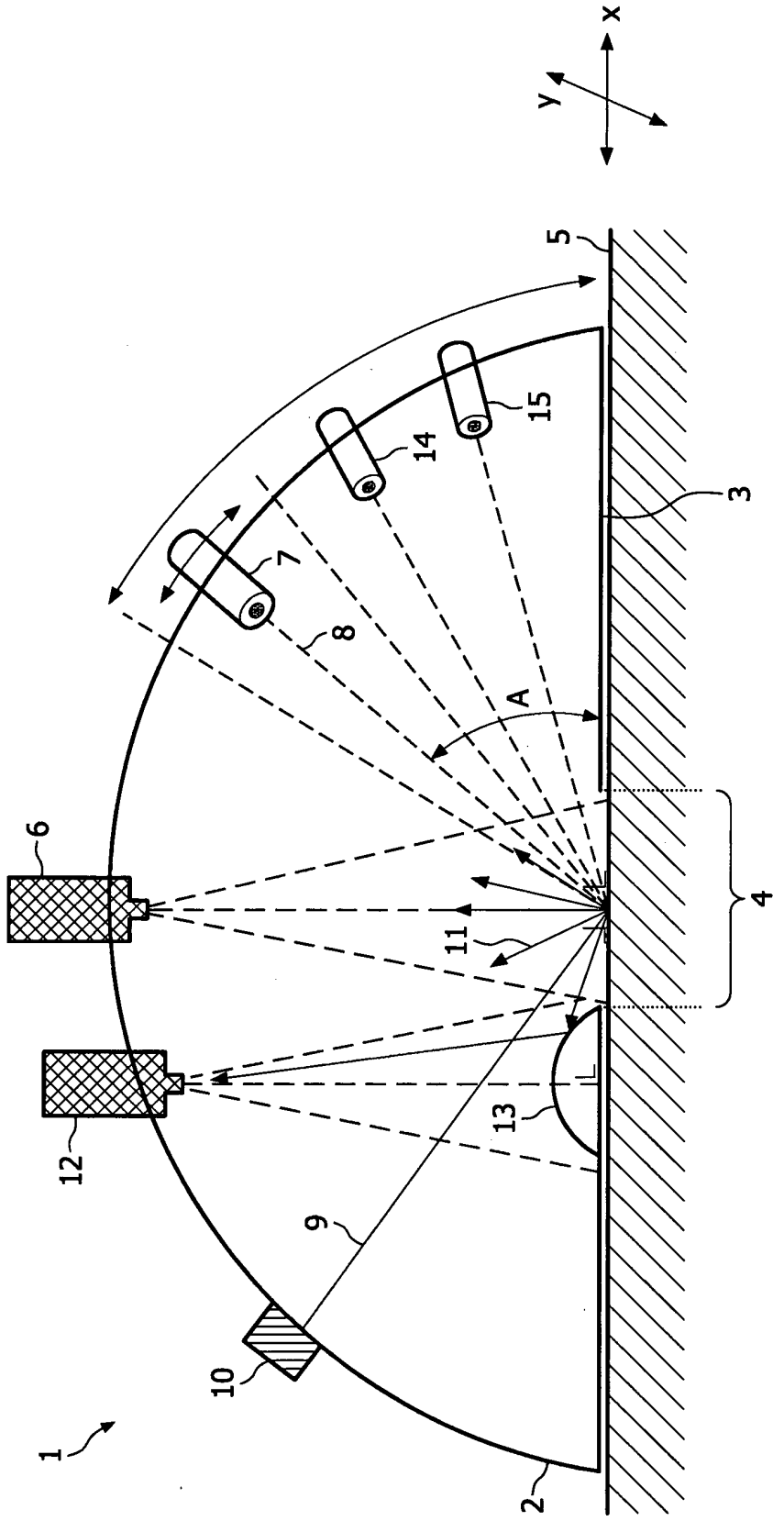

FIG. 1

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- WO 2007119202 A **[0008]**

专利名称(译)	用于皮肤成像的装置，用于皮肤分析的系统		
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摘要(译)

本发明涉及一种用于皮肤成像的装置，一种用于皮肤分析的系统和一种用于皮肤分析的方法，其使用在不同照射角度下的近场和远场皮肤图像的组合。该装置提供了一种工具，该工具可用于快速筛查皮肤以寻找可能指示皮肤疾病的病变，特别是皮肤癌，例如黑素瘤。

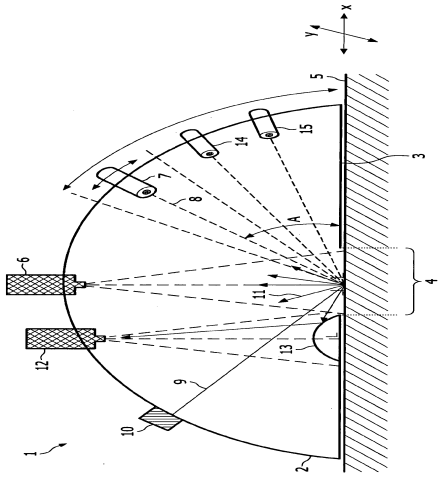

FIG. 1