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(54) **CALIBRATION APPARATUS AND METHOD FOR FLUORESCENT IMAGING**

KALIBRIERUNGSVORRICHTUNG UND -VERFAHREN ZUR FLUORESZENZABBILDUNG

APPAREIL D'ÉTALONNAGE ET PROCÉDÉ D'IMAGERIE FLUORESCENTE

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Description

Field of the Invention

[0001] The present invention relates to an apparatus and method for calibrating skin imaging systems, and more particularly, for calibrating skin imaging systems in which the skin is photographed under UV and/or blue light resulting in a fluorescent image.

Background of the Invention

[0002] Various imaging systems have been proposed that photographically capture images of a person's face for analysis of the health and aesthetic appearance of the skin. Different images, captured at different times or under different lighting conditions can be used and/or compared to one another to gain insight into the condition of the skin and its response to treatment. This was typically done by human operators inspecting the photographs to identify certain visual indicators of skin condition and to ascertain changes between photographs. When the skin is photographed under an illuminating light, such as a flash or strobe light, the light intensity and wavelength of the light can vary from one photograph to another. Environmental lighting conditions can also lead to variations in illuminating light. Variations in illuminating light can result in variations in the digital images captured which are not attributable to skin condition changes, thereby lessening the probative value of digital imaging analysis.

[0003] US 2003/0067545 discloses a device and method for acquiring an image of a portion of the human body. The device includes a calibration device comprising a fluorescent object. The calibration device can include at least 5 surfaces representing different optical properties; 3 corresponding to different grey levels and two to different shades. The surfaces can be adapted to allow calibration in non-visible light such as UV and IR. They can have known spectral reflectances (at least two being different). The calibration device can also be configured to detect fluorescence in a spectral band different to the spectral band of emission. For example, UVA light can be emitted which will result in red or orange visible light being observed.

Summary of the Invention

[0004] The problems and disadvantages associated with conventional apparatus used in digital skin imaging are overcome by the claimed fluorescence standard for identifying variations in illumination during imaging conducted at a plurality of times, which, inter-alia, includes a fluorescent object that fluoresces in response to light in the approximate wavelength range of 375nm to 430nm. The fluorescent object may have two areas with different fluorescent response. In accordance with a method of the present invention as claimed, variations in illumination during imaging with a camera are detected, inter-alia, by placing said fluorescent object, which fluoresces in response to light in the approximate wavelength range of 375nm to 430nm before the camera. A first image of the fluorescent object is captured with light in the approximate wavelength range of 375nm to 430nm. A second image of the fluorescent object is captured with light in the approximate wavelength range of 375nm to 430nm. The fluorescent response of the fluorescent object in the first image is then compared to the fluorescent response of the fluorescent object in the second image.

[0005] Other aspects, features and advantages of the present invention as defined by the claims will be apparent from the detailed description of the invention that follows.

Brief Description of the Drawings

[0006]

FIG. 1 is a diagrammatic view of a person having his skin photographed in a skin imaging station which incorporates the calibration apparatus of the present invention;

FIG. 2 is a perspective view of the calibration apparatus shown in FIG. 1, wherein the calibration apparatus is shown separate from the skin imaging system to facilitate consideration and discussion;

FIG. 3A is front view of a first photographic image of a subject and the calibration apparatus, as taken at time T1; and

FIG. 3B is front view of a second photographic image of a subject and the calibration apparatus, as taken at time T2.

Detailed Description of the Invention

[0007] The present invention includes an apparatus and method for calibration of a skin imaging station. The calibration apparatus includes a fluorescence standard with a first layer made of material having fluorescent properties similar to that of skin when exposed to UV and/or blue light. Additional layers made of translucent material that partially overlay the first layer attenuate the fluorescence intensity of the first layer producing a multi-step calibration standard.

[0008] In accordance with a method of the present invention, the calibration standard is positioned proximate the subject's face, is photographed with the subject and appears in the same photographic image. On taking a UV or blue fluorescence photograph, the different portions of the calibration standard having different numbers of layers absorb the UV and/or blue light and fluoresce at different, known levels, providing multiple fluorescence standards for calibration. A plurality of digital images are recorded for comparison to each other, each recording the fluorescence intensity for the subject's face and for the standard. The fluorescence values attributable to the standard are compared in subsequent digital images to determine if a variation in intensity has occurred, signaling a variation in illumination brightness. A software routine determines the location of the fluorescence standards in the image. If the light intensity of the illuminating light is determined to have varied, the image may be recaptured by taking another photograph. The illumination intensity may be adjusted prior to taking the replacement image or the photographer may correct environmental factors that led to the variation. Alternatively, the software may adjust the display intensity of the image by adjusting the pixel intensity values to compensate for the variation in illumination intensity.

[0009] FIG. 1 shows a skin imaging station 10 having the features and functionality described in applicants' co-pending United States Patent Application Serial No. 10/008,753, entitled, "Method of Taking Images of the Skin Using Blue Light and the Use Thereof", which was published as United States Application Publication No. US 2004/0146290 A1, United States Patent Application Serial No. 10/978,284 entitled "Apparatus for and Method of Taking and Viewing Images of the Skin," which was published as United States Patent Application Publication No. US 2005/0195316 A1 ("U.S. Publication No. 2005/0195316"), Application Serial No. 11/169,813 entitled "Skin Imaging System with Probe", which was published as United States Application Publication No. US 2006/0092315 A1 ("U.S. Publication No. 2006/0092315"), U.S. Publication Nos. 2005/0195316 and 2006/0092315 describe the use of alternative illuminating techniques to highlight and emphasize skin conditions, such as wrinkles or acne, wherein a flash unit which is capable of producing light of a particular wavelength is activated and an image captured with a camera. Various filters may also be employed in this process.

[0010] One technique described in the above referenced applications involves taking a blue fluorescence photograph of a subject's skin to illuminate and reveal skin conditions such as acne and "horns" (i.e., mixtures of sebaceous lipids, keratinocytes, and possibly sebocytes impacted in open comedones and blackheads on the skin) by producing bright images of the distribution of coproporphyrin, a substance associated with these conditions. By using substantially only blue light (i.e., light having a wavelength ranging from about 375 to about 430 nm), the fluorescence emission of coproporphyrin is maximized. Excitation in the blue region of the spectrum therefore yields bright fluorescence emission images of the distribution of horns.

[0011] Blue fluorescence photography typically uses filters having a very narrow bandwidth, and the resulting attenuation requires the use of high-intensity light sources (e.g., flashes). However, high intensity light sources are prone to fluctuations in intensity and color temperature, which may result in inconsistent images. These inconsistencies may also result from slight fluctuations of the power source or environmental factors, such as accidental light exposure from another source (e.g., outside light from opening the door of the room in which the subject is being imaged). Such inconsistencies may appear in successive photographs taken of the subject, if the light intensity of the flash varies between the taking two or more photographs. As a result, images of a subject's skin that are not taken under substantially identical lighting conditions may vary, which adversely affects the quality and/or consistency of the images obtained and compromises the information gleaned therefrom. Therefore, there is a need for a fluorescence standard to aid in interpreting each photograph, to compare light intensity levels of successively-taken photographs, to adjust for varying incident light intensity and to provide a standard reference for calibration.

[0012] As shall be apparent from the following, the present invention could be utilized to calibrate other imaging systems, but the referenced system may be used to illustrate the present invention. The skin imaging station 10 has a chin rest 14 for supporting a subject S's chin during the imaging process. A camera 16 is mounted in imaging station 10 across from the chin rest 14 and the subject S. The distance between chin rest 14 and the front end of the lens of camera 16 and the camera zoom setting is adjusted so that the subject S's face substantially fills the "frame" of camera 16, the chin rest 14 positioning the subject in a consistent orientation and distance from the camera 16. One or more blue flash units 18a (only one of which is shown, for the sake of clarity), which are used for blue fluorescent photography, are mounted in the imaging station 10 to illuminate the face of the subject S. A blue filter 18b is placed in front of each blue flash unit 18a. A power pack (not shown) is provided to power blue flash units 18a. Blue flash unit 18a is directed toward the center of the subject S's face. Other flash units, and their associated filters and power packs, may also be mounted in the imaging station 10 for standard and other types of photography (see U.S. Publication No. 2005/0195316).

[0013] Still referring to FIG. 1, skin imaging station 10 further includes a display monitor 20 operably connected to a computer (not shown) housed in imaging station 10. More particularly, the computer runs software programs that operate monitor 20, camera 16, flashes, e.g., 18a and a user interface. After the subject S has entered his or her relevant biographical and medical information using monitor 20 and is ready to be photographed, the operating software makes a function call to imaging acquisition and display software ("IDL software") (IDL Research Systems, Inc., Boulder, CO). The IDL software then triggers camera 16 to acquire blue fluorescence photographs (as well as other types of photographs, if desired). Flash unit 18a is triggered through the use of radio transceivers (see U.S. Publication No. 2005/0195316), a custom made flash sequencer, a programmable logic controller or "flash distributor". Prior to taking the blue fluorescence photographs, the IDL software moves long pass filter 24 (Kodak Wratten No. 8 or 12, Eastman Kodak, Rochester, NY) in front of the lens of camera 16. The blue fluorescence photographs are then taken. After the photographs are taken, the IDL software triggers the servo motor 22, solenoid or filter wheel to move long pass filter 24 away from the lens of camera 16.

[0014] Now referring to FIGS. 1 and 2, a calibration standard 26 is mounted on chin rest 14 (e.g., in a slot provided therein) in the present embodiment such that when the subject S positions their chin in the chin rest 14, the calibration standard 26 is positioned proximate to their face (see FIG. 1). The calibration standard 26 has two or more overlapping layers, and is shown in FIG. 2 as having three such layers 28, 30 and 32, respectively. The first layer 28 is fabricated from GG420 filter glass (Schott Glass Technologies PA, Duryea,) a material having fluorescence (excitation and emission) properties similar to that of skin when exposed to UV or blue light, i.e., light having a wavelength of about 375-430 nm. The second layer 30 has a smaller area than that of first layer 28, and partially overlays first layer 28 (see FIG. 2). The second layer 30 is fabricated from BG39 filter glass (Schott Glass Technologies PA, Duryea,) a translucent, non-fluorescent material that acts as an attenuating layer. The third layer 32 is similar to second layer 30 in that it is also fabricated from BG39 filter glass and also acts as an attenuating layer. The third layer 32 has a smaller area than that of first and second layers 28, 30, and partially overlays second layer 30 (see FIG. 2). The second and third layers 30, 32 progressively reduce the fluorescence intensity of first layer 28. The three layers 28, 30, 32 may be held together in a stacked configuration by a plastic housing (not shown). This layered assembly may be removeably attached to the imaging system 10 to allow removal for storage to protect the standard 26 from damage and contamination. Various standards 26 can be used with an imaging station 10 for different imaging sessions.

[0015] FIGS. 3A and 3B show images 34a and 34b, respectively, of the subject S and calibration standard 26, as shown on skin imaging station monitor 20. During the blue light imaging of the subject S, as fully described in U.S. Publication No. 2005/0195316, the three layers 28, 30 and 32 of calibration standard 26 receive blue light of the same intensity as that which illuminates the subject S's face. The portion of first layer 28 exposed to the blue light (i.e., the area not covered by second and third attenuating layers 30, 32), has a fluorescence response similar to skin. The second layer 30 has an attenuating effect on the fluorescence of first layer 28, reducing the amount of fluorescence produced in response to the blue light. The third layer 32, when combined with second layer 30, has a greater attenuating effect on the fluorescence of first layer 28, further reducing the amount of fluorescence produced in response to the blue light. By absorbing the blue light and fluorescing at different, consistent, known levels, the three layers 28, 30, 32 function as three fluorescence standards to provide multiple reference standards for calibration. A software routine may be used to determine the location of the fluorescence standards in images 34a and 34b, analyze the returning light intensity from the standards incorporated in apparatus 26, and calibrate the system based on this analysis, as described hereinbelow.

[0016] Both of the images 34a and 34b are formed by two-dimensional matrices of pixels. Every pixel occupies a unique (X,Y) location in a matrix and has an intensity value. In each of FIGS. 3A and 3B, the locations of three sample pixels are illustrated, viz., a pixel located in the area representative of third layer 32 of the standard 26 on the images 34a and 34b with location (X_1, Y_1), and two pixels at areas representative of the subject S's skin having locations (X_2,Y_2) and (X_3, Y_3). Image 34a is taken at a time T_1, while image 34b is taken at time T_2. The time each image was taken is denoted with the location coordinates in the images (e.g., (X_1, Y_1, T_1) in the image 34a and (X_1, Y_1, T_2) in the image 34b).

[0017] When a series of successive photographic images such as 34a and 34b is taken of a subject S, fluctuations in illumination (flash) light intensity described above may occur between the times T_1 and T_2, resulting in different light intensity values for the pixels in the areas representative of the standard 26, e.g., at (X_1, Y_1), as well as the subject S's skin, e.g., at (X_2, Y_2). Varying light intensity of pixels representative of the standard 26 is an indicator that the illumination light has varied. Accordingly, one of the aspects of the present invention is to identify the situation where the illumination light intensity has varied between at least two digital images taken in such varying illumination light. Without the use of the standard, it would not be possible to attribute the difference in light intensity values between one or more pixels, e.g., at (X_2, Y_2) in successive images of the skin (e.g., 34a and 34b) to such illuminating light fluctuations, or to varying skin conditions exhibited by the subject S at times T_1 and T_2.

[0018] In order to discern intensity variations in the image area corresponding to the standard 26, that area in the images, e.g., 34a, 34b must be identified/isolated so that the intensity values of the correct pixels can be identified. This may be done by assigning a pre-determined region of the image to the standard 26. More particularly, if the focus setting and orientation of the camera 16 remains fixed, then the standard 26 will appear in the same areas of each image taken, such that the image area corresponding to the standard 26 (and subparts 28, 30, 32) can be empirically determined and remains constant. Alternatively, the image can be scanned (entirely or a subset of pixels, e.g., one of every 50 pixels) to test for repeating intensity values in the form of a rectangle (having a rectangular shape). In the case of a multipart standard 26, like that shown in FIG. 2, the presence of more than one adjacent rectangle (here three) each with consistent intensity values, (progressively decreasing for each area 28, 30, 32) is a reliable indicia of locating the standard 26. Scanning for the standard 26 has the advantage that movement of the standard in the image, e.g., due to movement or focus change of the camera 16 will not result in erroneous readings for the standard.

[0019] Having located the pixels representing the standard 26 in the images 34a, 34b, the light intensity values of corresponding pixels, e.g., (X_1, Y_1, T_1) and (X_1, Y_1, T_2) can be compared. Subtracting one intensity value, e.g., at (X_1, Y_1, T_1) from the other, e.g., at (X_1, Y_1, T_2) yields a number representing the quantified difference in intensity between the pixels. Alternatively, more sophisticated analyses of the intensity differences between the images can be effected that are non-linear, e.g., gamma curves or conversion into alternate colorspaces, particularly for large differentials. In conducting numerical analysis of digital images, e.g., 34a, 34b, it is frequently beneficial to convert the image from RGB format to L*a*b* format in order to simplify the mathematics and gain greater insight into the color composition and brightness of the images.

[0020] Given the identification (and quantification) of illumination light variation between images taken at different times, as determined by the present invention, optional remedial steps maybe taken: (i) correct the environmental conditions of the imaging, e.g., instructing an operator to eliminate extraneous environmental lighting input, e.g., from an open door or shade, repositioning the subject, etc. (ii) adjust/correct the source of illumination, e.g., the light 18a, e.g., by repositioning it, replacing it with another or electronically adjusting its output, e.g., by adjusting the voltage input to the light; or (iii) normalizing the relevant image by adjusting the intensity values of all pixels in the image relative to the image selected as the reference image, e.g., globally adding or subtracting the quantified intensity difference identified by comparing the difference in intensity attributable to the portion of the images representing the standard 26 (and saving the normalized/corrected image for comparison). For example, if the image intensity of a second image is less than a first image by a value of "5" (due to a variation in illumination intensity as determined by the image intensity of the standard 26 appearing in each image) then the second image can be normalized to the first by adding "5" to the pixel intensity of all pixels in the second image. Alternatively, more sophisticated analyses of the intensity differences between the images can be effected that are non-linear, e.g., gamma curves or conversion into alternate colorspaces, particularly for large differentials. With respect to the first two options, i.e., adjusting the environment or the illuminating light, the image with variations is discounted and a new image is taken. With the third option of adjusting intensity values, the image need not be retaken.

[0021] It should be appreciated that the process of normalizing can be conducted with reference to the standard 26 image intensity values taken from any arbitrary image, e.g., 34a or 34b, since the process of adjustment is relative, and that the process of normalization can be conducted for any number of images ranging from 1 to any number N. The normalized image(s) may then be displayed or stored with other images in the computer memory or a file.

[0022] It should be understood that the embodiment of FIGS. 1-3B is merely exemplary, and that a person skilled in the art may make many variations and modifications without departing from the scope of the invention. as defined by the claims. For instance, more or fewer attenuating layers may be included in the calibration apparatus 26. While the present invention has been explained in the terms of adjusting for variations in blue illumination light, the present invention could also be utilized to identify and compensate for variations in illuminating light of other wavelengths.

Claims

1. A fluorescence standard (26) for identifying variations in illumination by a light source emitting light in the approximate wavelength range of 375nm to 430nm during imaging of the facial skin of a person with a camera conducted at a plurality of times, comprising:

   a holder for holding said standard in a substantially reproducible spacial relationship between said camera (16) said standard (26) and said facial skin,

   said fluorescence standard (26) **characterised by** further comprising:

   a fluorescent object, which fluoresces in response to light in the approximate wavelength range of 375nm to 430nm, said fluorescent object having three areas with different fluorescent response, wherein fluorescent response comprises an intensity of fluorescence;
   said fluorescent object having:

   a first layer (28) of material having a fluorescent response to light in the approximate wavelength range of 375nm to 430nm;
   a second layer (30) of material that attenuates the fluorescent response of said first layer (28), said second layer (30) only partially covering said first layer (28); and
   a third layer (32) of material partially covering said second layer (30), said third layer (32) further attenuating the fluorescence of the first layer (28) beyond that attenuation attributable to said second layer (30).

2. The standard of claim 1, wherein said first layer (28) is formed from filter glass of a first type and said second layer (30) is formed from filter glass of a second type.

3. The standard of claim 2, wherein said first type of

filter glass is GG420 filter glass and said second type of filter glass is BG39 filter glass.

4. The standard of claim 2, wherein said holder holds said layers in a stacked configuration.

5. The standard of claim 1, wherein said holder has a chin rest (14) for establishing the position of the subject (S) of imaging.

6. The standard of claim 5, wherein said standard (26) is mountable on said chin rest (14) proximate the subject (S).

7. A method for identifying variations in illumination by a light source emitting light in the approximate wavelength range of 375nm to 430nm during imaging of the facial skin of a person with a camera (16), comprising the steps of:

(A) placing a fluorescent object (26) as claimed in claim 1, which fluoresces in response to light in the approximate wavelength range of 375nm to 430nm before the camera and the light source;
(B) positioning the person's face before the camera and the light source and proximate to the fluorescent standard;
(C) capturing a first image of the person and the fluorescent object (26) by illuminating both simultaneously with light in the approximate wavelength range of 375nm to 430nm;
(D) using the holder (14) to position the person in a consistent orientation and distance from the camera;
(E) capturing a second image of the person and the fluorescent object (26) with light in the approximate wavelength range of 375nm to 430nm;
(F) identifying a portion of the first and second images representing the fluorescent response attributable to the fluorescent object (26) in the first and second images;
(G) comparing the fluorescent response of the fluorescent object (26) in the first image to the fluorescent response of the fluorescent object (26) in the second image; and
(H) in the event that there is a difference in fluorescent response ascertained in (G), correcting at least one of the first image and the second image to reduce the difference.

8. The method of claim 7, wherein said step (F) of identifying is by programmatically testing the first and second images for areas meeting criteria indicative of the fluorescent object (26).

9. The method of claim 8, wherein the criteria includes shape.

10. The method of claim 8, wherein the criteria includes size.

11. The method of claim 7, wherein said step of identifying is by manually ascertaining the location of the fluorescent object (26) in the first image and imaging in the approximate same manner for the second image, such that the fluorescent object (26) occupies substantially the same position in each of the first and second images.

12. The method of claim 7, further comprising the step of retaking at least the second image if a variation in illumination is noted to have occurred.

13. The method of claim 12, including remediating illumination conditions before said step of retaking, including at least one of adjusting an illuminating apparatus (18a, 18b), repairing the illuminating apparatus (18a, 18b), adjusting the camera (16), repairing the camera (16), and adjusting ambient lighting conditions.

14. The method of claim 12, wherein the first and second images are digital images, a variance of illumination has been noted as having occurred and wherein said step of correcting includes the step of normalizing the first and second images by digitally processing at least one of the images.

15. The method of claim 7, wherein the first and second images are digital images and further comprising the step of converting the first and second digital images from a first colorspace to another colorspace before said step of comparing.

16. The method of claim 15, wherein a variance of illumination has been noted as having occurred and wherein said step of correcting includes the step of normalizing the first and second images by digitally processing at least one of the images expressed in said another color space and then converting back to the first colorspace.

Patentansprüche

1. Fluoreszenzstandard (26) zum Identifizieren von Variationen bei der Beleuchtung durch eine Lichtquelle, die Licht im annähernden Wellenlängenbereich von 375 nm bis 430 nm während eines mehrmals ausgeführten Abbildens der Gesichtshaut einer Person mit einer Kamera emittiert, umfassend:

einen Halter zum Halten des Standards in einer im Wesentlichen reproduzierbaren räumlichen

Beziehung zwischen der Kamera (16), dem Standard (26) und der Gesichtshaut,
wobei der Fluoreszenzstandard (26) **dadurch gekennzeichnet ist, dass** er ferner Folgendes umfasst:

ein Fluoreszenzobjekt, das als Reaktion auf Licht in dem annähernden Wellenlängenbereich von 375 nm bis 430 nm fluoresziert, wobei das Fluoreszenzobjekt drei Bereiche mit unterschiedlichen Fluoreszenzreaktionen hat, wobei die Fluoreszenzreaktion eine Intensität der Fluoreszenz umfasst;
wobei das Fluoreszenzobjekt Folgendes hat:

eine erste Schicht (28) von Material, das eine Fluoreszenzreaktion auf Licht im annähernden Wellenlängenbereich von 375 nm bis 430 nm hat;
eine zweite Schicht (30) von Material, das die Fluoreszenzreaktion der ersten Schicht (28) dämpft, wobei die zweite Schicht (30) die erste Schicht (28) nur teilweise bedeckt; und
eine dritte Schicht (32) von Material, die teilweise die zweite Schicht (30) bedeckt, wobei die dritte Schicht (32) die Fluoreszenz der ersten Schicht (28) über die Dämpfung hinaus dämpft, die der zweiten Schicht (30) zuzuordnen ist.

2. Standard nach Anspruch 1, wobei die erste Schicht (28) aus Filterglas einer ersten Art gebildet ist und die zweite Schicht (30) aus Filterglas einer zweiten Art gebildet ist.

3. Standard nach Anspruch 2, wobei die erste Art von Filterglas GG420-Filterglas ist und die zweite Art von Filterglas BG39-Filterglas ist.

4. Standard nach Anspruch 2, wobei der Halter die Schichten in einer gestapelten Konfiguration hält.

5. Standard nach Anspruch 1, wobei der Halter eine Kinnstütze (14) zum Herstellen der Position der Person (S) bei der Abbildung hat.

6. Standard nach Anspruch 5, wobei der Standard (26) auf der Kinnstütze (14) dicht bei der Person (S) befestigt werden kann.

7. Verfahren zum Identifizieren von Variationen bei der Beleuchtung durch eine Lichtquelle, die Licht im annähernden Wellenlängenbereich von 375 nm bis 430 nm während des Abbildens der Gesichtshaut einer Person mit einer Kamera (16) emittiert, das die folgenden Schritte umfasst:

(A) Platzieren eines Fluoreszenzobjektes (26) nach Anspruch 1, welches als Reaktion auf Licht im annähernden Wellenlängenbereich von 375 nm bis 430 nm vor der Kamera und der Lichtquelle fluoresziert;
(B) Positionieren des Gesichtes der Person vor der Kamera und der Lichtquelle und dicht bei dem Fluoreszenzstandard;
(C) Erfassen eines ersten Bildes der Person und des Fluoreszenzobjektes (26) durch gleichzeitiges Beleuchten beider mit Licht im annähernden Wellenlängenbereich von 375 nm bis 430 nm;
(D) Verwenden des Halters (14) zum Positionieren der Person in einer gleichbleibenden Ausrichtung und Distanz von der Kamera;
(E) Erfassen eines zweiten Bildes der Person und des Fluoreszenzobjektes (26) mit Licht im annähernden Wellenlängenbereich von 375 nm bis 430 nm;
(F) Identifizieren eines Teils des ersten und zweiten Bildes, der die fluoreszente Reaktion darstellt, die dem Fluoreszenzobjekt (26) im ersten und zweiten Bild zugeordnet werden kann;
(G) Vergleichen der fluoreszenten Reaktion des Fluoreszenzobjektes (26) im ersten Bild mit der fluoreszenten Reaktion des Fluoreszenzobjektes (26) im zweiten Bild; und
(H) in dem Fall, dass es einen Unterschied in der fluoreszenten Reaktion, die in (G) ermittelt wurde, gibt, Korrigieren von mindestens einem des ersten und zweiten Bildes, um die Differenz zu reduzieren.

8. Verfahren nach Anspruch 7, wobei der Schritt (F) des Identifizierens durch programmatisches Testen des ersten und zweiten Bildes auf Bereiche erfolgt, die Kriterien erfüllen, welche auf das Fluoreszenzobjekt (26) hinweisen.

9. Verfahren nach Anspruch 8, wobei die Kriterien die Form einschließen.

10. Verfahren nach Anspruch 8, wobei die Kriterien die Größe einschließen.

11. Verfahren nach Anspruch 7, wobei der Schritt des Identifizierens durch manuelles Ermitteln des Ortes des Fluoreszenzobjektes (26) im ersten Bild und Abbilden in etwa derselben Weise für das zweite Bild derart ausgeführt wird, dass das Fluoreszenzobjekt (26) im Wesentlichen dieselbe Position in jedem des ersten und zweiten Bildes einnimmt.

12. Verfahren nach Anspruch 7, das ferner den Schritt des Neuaufnehmens zumindest des zweiten Bildes umfasst, wenn bemerkt wird, dass eine Änderung in der Beleuchtung aufgetreten ist.

13. Verfahren nach Anspruch 12, das das Beseitigen von Beleuchtungsbedingungen vor dem Schritt des Neuaufnehmens umfasst, einschließlich zumindest von einem Element aus Einstellen einer Beleuchtungsvorrichtung (18a, 18b), Reparieren der Beleuchtungsvorrichtung (18a, 18b), Einstellen der Kamera (16), Reparieren der Kamera (16) und Einstellen der Beleuchtungsbedingungen in der Umgebung.

14. Verfahren nach Anspruch 12, wobei das erste und zweite Bild digitale Bilder sind, eine Veränderung der Beleuchtung als aufgetreten bemerkt wird und wobei der Schritt des Korrigierens den Schritt des Normalisierens des ersten und zweiten Bildes durch digitale Verarbeitung von mindestens einem der Bilder umfasst.

15. Verfahren nach Anspruch 7, wobei das erste und zweite Bild digitale Bilder sind und das ferner den Schritt des Umwandelns des ersten und zweiten digitalen Bildes aus einem ersten Farbraum in einen anderen Farbraum vor dem Schritt des Vergleichens umfasst.

16. Verfahren nach Anspruch 15, wobei eine Veränderung der Beleuchtung als aufgetreten bemerkt wird und wobei der Schritt des Korrigierens den Schritt des Normalisierens des ersten und zweiten Bildes durch digitale Verarbeitung von mindestens einem der Bilder umfasst, das in dem anderen Farbraum ausgedrückt ist, und dann Rückkonvertieren zum ersten Farbraum.

Revendications

1. Étalon de fluorescence (26) servant à identifier des variations dans l'éclairage d'une source de lumière émettant une lumière dans la gamme de longueurs d'onde approximative de 375 nm à 430 nm pendant l'imagerie de la peau du visage d'une personne avec une caméra conduite à une pluralité de moments, comprenant :

un support servant à supporter ledit étalon dans une relation spatiale sensiblement reproductible entre ladite caméra (16), ledit étalon (26) et ladite peau du visage, ledit étalon de fluorescence (26) étant **caractérisé en ce qu'**il comprend en outre :

un objet fluorescent, qui fluoresce en réponse à une lumière dans la gamme de longueurs d'onde approximative de 375 nm à 430 nm, ledit objet fluorescent ayant trois zones avec une réponse fluorescente différente, la réponse fluorescente comprenant une intensité de fluorescence ;
ledit objet fluorescent ayant :

une première couche (28) de matériau ayant une réponse fluorescente à la lumière dans la gamme de longueurs d'onde approximative de 375 nm à 430 nm ;
une deuxième couche (30) de matériau qui atténue la réponse fluorescente de ladite première couche (28), ladite deuxième couche (30) ne recouvrant que partiellement ladite première couche (28) ; et
une troisième couche (32) de matériau recouvrant partiellement ladite deuxième couche (30), ladite troisième couche (32) atténuant davantage la fluorescence de la première couche (28) au-delà de l'atténuation imputable à ladite deuxième couche (30).

2. Étalon de la revendication 1, dans lequel ladite première couche (28) est formée à partir de verre filtrant d'un premier type et ladite deuxième couche (30) est formée à partir de verre filtrant d'un deuxième type.

3. Étalon de la revendication 2, dans lequel ledit premier type de verre filtrant est le verre filtrant GG420 et ledit deuxième type de verre filtrant est le verre filtrant BG39.

4. Étalon de la revendication 2, dans lequel ledit support supporte lesdites couches dans une configuration empilée.

5. Étalon de la revendication 1, dans lequel ledit support a une mentonnière (14) pour établir la position du sujet (S) d'imagerie.

6. Étalon de la revendication 5, ledit étalon (26) étant installable sur ladite mentonnière (14) à proximité du sujet (S).

7. Procédé d'identification de variations dans l'éclairage d'une source de lumière émettant une lumière dans la gamme de longueurs d'onde approximative de 375 nm à 430 nm pendant l'imagerie de la peau du visage d'une personne avec une caméra (16), comprenant les étapes consistant à :

(A) placer un objet fluorescent (26) selon la revendication 1, qui fluoresce en réponse à une lumière dans la gamme de longueurs d'onde approximative de 375 nm à 430 nm avant la caméra et la source de lumière ;

(B) positionner le visage de la personne avant la caméra et la source de lumière et à proximité de l'étalon fluorescent ;
(C) capturer une première image de la personne et de l'objet fluorescent (26) en éclairant les deux simultanément avec la lumière dans la gamme de longueurs d'onde approximative de 375 nm à 430 nm ;
(D) utiliser le support (14) pour positionner la personne dans une orientation et une distance constantes par rapport à la caméra ;
(E) capturer une deuxième image de la personne et de l'objet fluorescent (26) avec la lumière dans la gamme de longueurs d'onde approximative de 375 nm à 430 nm ;
(F) identifier une partie des première et deuxième images représentant la réponse fluorescente imputable à l'objet fluorescent (26) dans les première et deuxième images ;
(G) comparer la réponse fluorescente de l'objet fluorescent (26) dans la première image à la réponse fluorescente de l'objet fluorescent (26) dans la deuxième image ; et
(H) au cas où il y aurait une différence de réponse fluorescente établie en (G), corriger la première image et/ou la deuxième image pour réduire la différence.

8. Procédé selon la revendication 7, dans lequel ladite étape (F) d'identification se fait en testant avec un programme les première et deuxième images pour des zones respectant des critères révélateurs de l'objet fluorescent (26).

9. Procédé selon la revendication 8, dans lequel les critères comportent une forme.

10. Procédé selon la revendication 8, dans lequel les critères comportent une taille.

11. Procédé selon la revendication 7, dans lequel ladite étape d'identification se fait en établissant manuellement l'emplacement de l'objet fluorescent (26) dans la première image et en imageant de la même manière approximative pour la deuxième image, de telle sorte que l'objet fluorescent (26) occupe sensiblement la même position dans chacune des première et deuxième images.

12. Procédé selon la revendication 7, comprenant en outre l'étape de reprise au moins de la deuxième image s'il a été constaté qu'une variation d'éclairage s'est produite.

13. Procédé selon la revendication 12, comportant la correction des conditions d'éclairage avant ladite étape de reprise, comportant au moins une opération parmi le réglage d'un appareil d'éclairage (18a, 18b), la réparation de l'appareil d'éclairage (18a, 18b), le réglage de la caméra (16), la réparation de la caméra (16), et le réglage des conditions d'éclairage ambiant.

14. Procédé selon la revendication 12, dans lequel les première et deuxième images sont des images numériques, il a été constaté qu'une différence d'éclairage est apparue, et dans lequel ladite étape de correction comporte l'étape de normalisation des première et deuxième images par traitement numérique d'au moins une des images.

15. Procédé selon la revendication 7, dans lequel les première et deuxième images sont des images numériques, et comprenant en outre l'étape de conversion des première et deuxième images numériques d'un premier espace de couleur à un autre espace de couleur avant ladite étape de comparaison.

16. Procédé selon la revendication 15, dans lequel il a été constaté qu'une différence d'éclairage est apparue et dans lequel ladite étape de correction comporte l'étape de normalisation des première et deuxième images par traitement numérique d'au moins une des images exprimées dans ledit autre espace de couleur puis conversion inverse dans le premier espace de couleur.

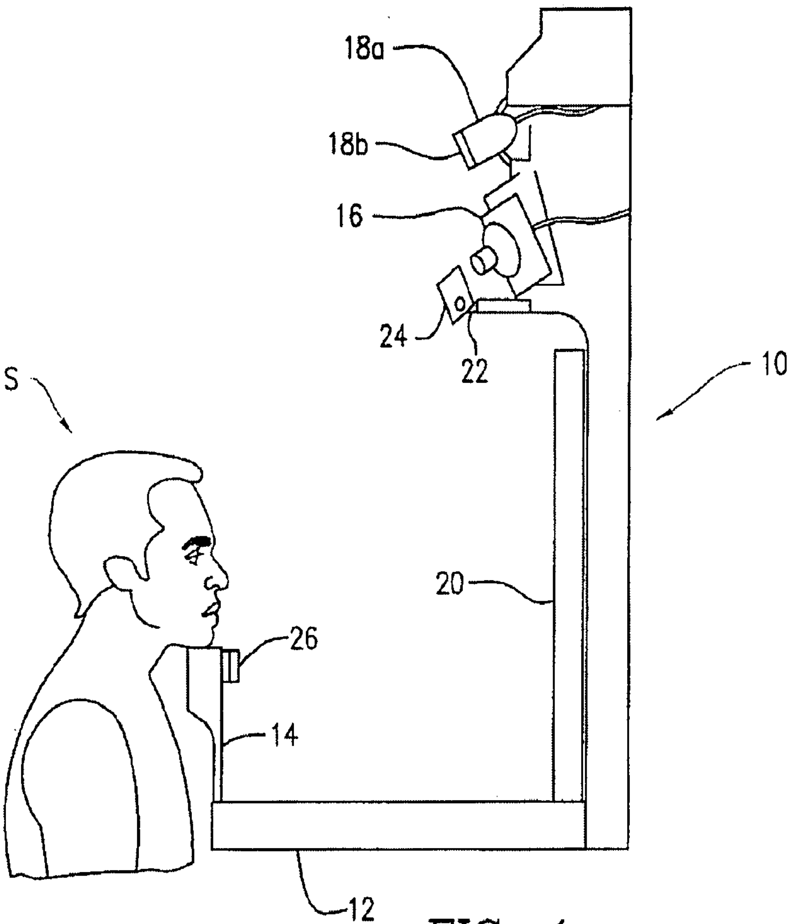

FIG. 1

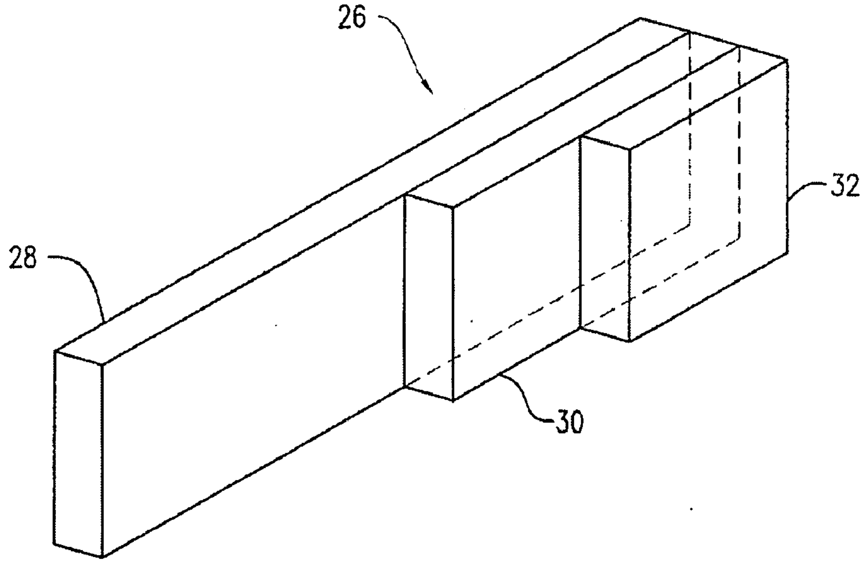

FIG. 2

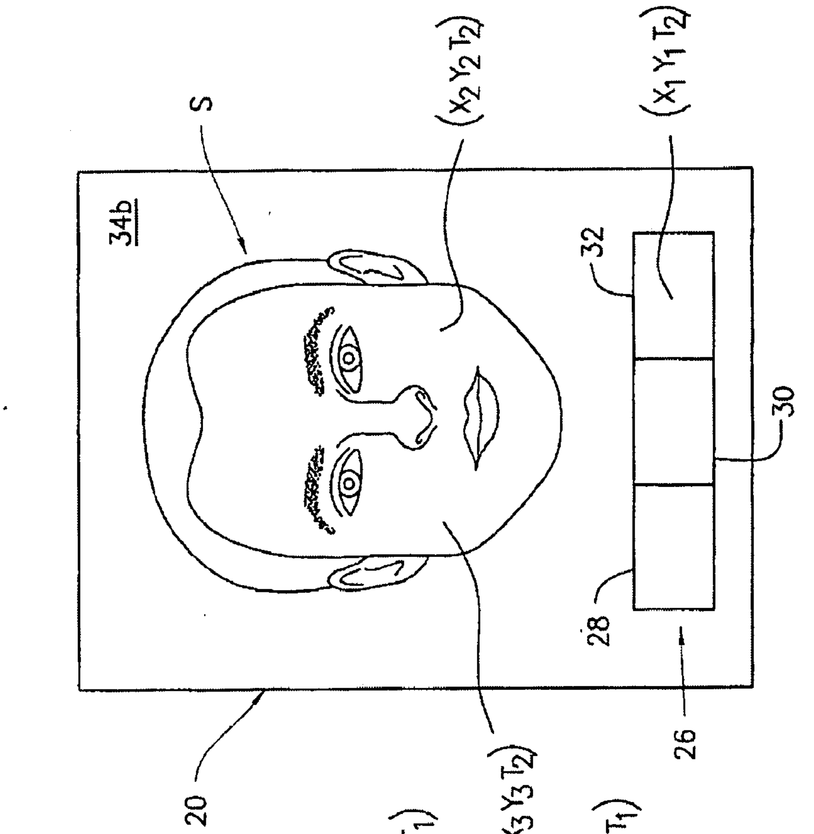
S
34b
$(X_2 Y_2 T_2)$
$(X_1 Y_1 T_2)$
32
30
28
26
20
$(X_3 Y_3 T_2)$

FIG. 3B

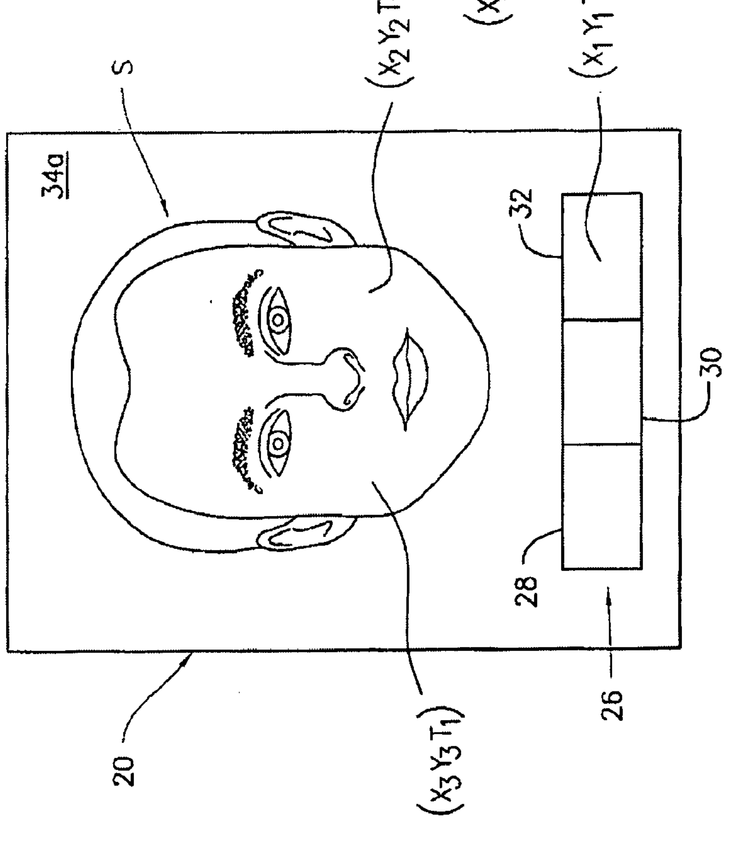
S
34a
$(X_2 Y_2 T_1)$
$(X_1 Y_1 T_1)$
32
30
28
26
20
$(X_3 Y_3 T_1)$

FIG. 3A

REFERENCES CITED IN THE DESCRIPTION

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专利名称(译)	用于荧光成像的校准设备和方法		
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当前申请(专利权)人(译)	娇生INC.		
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优先权	11/863345 2007-09-28 US 60/848707 2006-10-02 US		
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外部链接	Espacenet		

摘要(译)

用于识别成像期间照明变化的荧光标准具有复合荧光层状结构，其响应于近似波长的光而发荧光。荧光物体具有至少两个具有不同荧光响应的区域，例如，第一个由强烈发光的材料制成，例如对荧光响应具有衰减作用的GG420滤光玻璃。通过在成像期间将标准放置在相机之前来检测在使用相机成像期间的照明变化。每个捕获的图像可以包含不同图像中标准的荧光响应，并且可以比较以识别由于照明变化引起的任何响应变化。然后可以通过调节照明源，照相机或环境照明来补救照明的变化。可以通过数字图像处理对图像进行归一化。

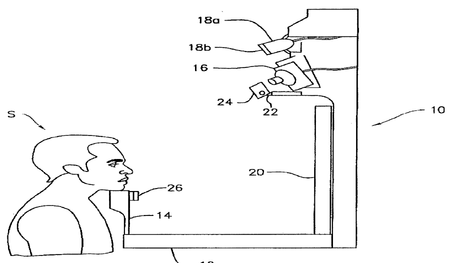

FIG. 1

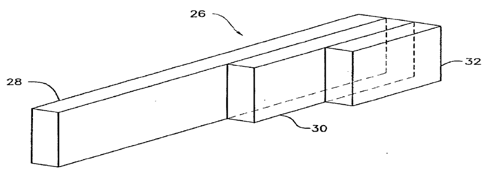

FIG. 2