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SYSTEM FOR THE CONTACTLESS RECOGNITION  
OF HAND AND FINGER LINES

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The invention relates to a process and a device for optically reproducing hand and finger lines without skin contact for the identification of persons, and, furthermore, concerns a recognition algorithm.

The pattern of the papillary ridges of the fingers, which has been employed in the field of criminology since a long time in the form of fingerprints on objects or on paper, or used by illiterate persons as their signature, has gained significance more recently as an authorization control code for access to safes, safe-deposit rooms of banks, computers and other secured objects.

However, filing of a permanent color or fat imprint would not be practicable in this connection because a computer evaluation must rapidly take place immediately, and it is pre-supposed that the same applicator is in each case used frequently.

Therefore, methods were developed first which make the picture of the imprint briefly visible on a glass surface through optical reproduction , exploiting impeded total or partial reflection on a refractive interface.

Patterns of the lines in the palm are suitable for the identification of persons as well. The method of imprinting such patterns on a glass surface is feasible in this connection as well; however, this method failed to gain wide acceptance if only because the equipment would have to be substantially larger and more complicated. Therefore, the development of evaluation algorithms for this method has not yet reached an advanced stage.

If an access control system operating based on a skin line imprint method is used possibly by a large number of persons unobserved and anonymously, such use is adversely affected by the following factors:

(1) Soiling is caused on the measuring or contact pressure surface that is no longer tolerated by the evaluation algorithm. Dirt, of course, could be removed by simply wiping it off, if necessary with care agents. However, the drawback is then that this requires cooperation and care on part of the

participating people, which cannot be always expected, or the user operating the system has to carry out the care and maintenance work, which is both cost- and labor-intensive.

(2) The contact surface of the sensor is a part of the path of the measuring rays that has to be always freely accessible, so that important components of the system may be damaged in the event of vandalism or sabotage.

(3) Contact is made via the contact pressure surface of the applicator with a great number of persons, which, under aspects of hygiene, should be avoided. This applies in particular to areas in hospitals as well as medical and biological safety areas.

(4) The contact pressure surface of the applicator may transmit chemical or radioactive contamination.

(5) Methods requiring skin contact are less accepted than other methods for psychological reasons, for example because of their association with a data file on "criminals", fear of infection, or aversion to skin contact, which, for example, may be ethnically conditioned in the latter case.

(6) The outermost surface of the skin is reproduced by most known optical imprinting methods as an interference with the reflection on a surface of glass. This has a negative effect inasmuch as inhomogeneities of the skin disposed at deeper levels of the skin, as well as blood circulation patterns, which contain individual information as well, are not accessible in this way. This limits the clarity and definition of such methods.

(7) Many known methods of skin pattern detection are designed to determine the genuine surface structure of the skin (i.e., the relief of the skin). The drawback here is that a relief can be easily reproduced by plastic reproduction methods, which consequently creates possibilities for fraud.

(8) With all methods requiring skin contact, a hardly visible imprint, i.e., the classical imprint of a finger or hand line, remains on the surface of the apparatus. The drawback here is that such an imprint can be made visible and can be misused with means employed for detecting and securing traces, and that such imprints would have to be eliminated, for example by wiping them off in cases where high safety requirements need to be satisfied.

(9) The simple conventional method, of course, needs to be mentioned here as well, which is to reproduce skin lines with a camera without contact with the object. Since the skin is always slightly translucent under conventional illumination, and the light scatters diffused to a certain extent, and since the uppermost layer of the papillary ridges is reflected at the same time in a more or less shiny way, the camera, like the human eye, normally "sees" an undefined superpositioning of the images of the epidermis and hypodermis.

It is basically possible with illumination aimed at an angle, i.e., slanted, to increase the contrast of the papillary ridges and furrows of the skin. The drawback here is that this method does not uniformly work throughout the entire field of vision, but is dependent upon the direction of the line pattern relative to the illumination (shadow effects), as well as upon the waviness of the surface of the object (gloss effects). Inclined illumination from all sides, or diffused illumination does in fact compensate waviness optically, but deteriorates the contrast of the ridges because the component of diffused reflection increases.

A relatively strong gloss and contrast effect is obtained with inclined illumination and inclined recording direction (according to the law on reflection) particularly with large

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angles of incidence or recording. The drawback here is that when the object is set at an angle, or inclined, correction of distortion is required, for example according to SCHEIMPFLUG, which is costly in terms of equipment requirements; and that the waviness of the skin has a very disturbing effect (image distortions).

The drawbacks of known methods as described above are reduced or eliminated according to the invention in that the process as defined by the invention works without skin contact.

The operating mode can be enhanced in this connection by employing polarized light. Such light, on the one hand, (a) substantially increases the contrast of the papillary ridges through preferred reproduction of the glossy or shiny structures, but the papillary ridges (b) can be made visible as well by filtering out the shiny structures, on the other, so that the pattern of the hypodermis becomes visible. In particular, by using polarized light in the path of the illuminating rays and in the path of the reproducing light rays it is possible to select in a defined way the pattern of the epidermis and the pattern of the hypodermis. Possible are an accentuated representation of the shiny epidermis alone, an accentuated representation of the diffusely reflecting

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hypodermis alone, or a representation of both skin patterns in combination, for example one briefly after the other. The pattern of the hypodermis is predominantly supplied by the structures disposed at deeper levels, in particular by the structures of the adjacent layers of the skin that are already supplied with blood. In the case of linearly polarized light, the pattern of the epidermis is reproduced if the polarizing devices are set in parallel in the paths of the illuminating and reproducing rays, and the pattern of the hypodermis is reproduced when said polarizing devices are adjusted vertically.

In the case of circularly polarized light, the pattern of the epidermis is reproduced when the rotation of polarization in the paths of the illuminating and reproducing rays is adjusted not in the same sense, and the pattern of the hypodermis is reproduced when it is adjusted in the same sense, whereby the direction of rotation (right or left rotation) is defined here as the direction of rotation of the E-vector, looking in the direction of propagation of the light.

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The benefits offered by the invention can be described in detail as follows:

(1) The sensor system is protected against soiling or contamination by the user because it is not touched, which makes frequent care and control superfluous.

(2) The system can be completely accommodated behind a protecting wall, for example made of bulletproof glass, so that it is protected against vandalism or sabotage.

(3) The devices can be designed in such a way that indirect contact with other persons is excluded for securing hygiene.

(4) The devices can be designed in such a way that no chemical or radioactive contamination is transmitted.

(5) Psychological reasons such as association with a "file on criminals", fear of infection or fear of skin contact are eliminated because the device operates without requiring contact.

(6) As opposed to a number of optical contact methods, structures of the hypodermis with additional information content are made accessible in connection with the present invention.

(7) The safety against fraud is enhanced because structures of the hypodermis, as with a watermark, cannot be copied or counterfeited easily, and because it is particularly not easy to successfully combine the two different types of contrast for fraudulent purposes.

(8) No finger of skin line imprint is produced on the apparatus that could be fraudulently used, for example for producing a skin duplicate, for example made from rubber.

(9) As opposed to conventional reproduction with a camera, the present invention permits separation of the images of the epidermis and hypodermis and their separate evaluation.

~~(10)~~ In the field of the face, the process as defined by the invention permits a uniform effect and independence of the direction of the lines and waviness of the surface. No inclined positioning of the object is required for exploiting the gloss angle condition, and the rectification connected therewith is therefore not needed.

Details of the invention are described in the following with the help of exemplified embodiments in connection with the associated drawings, in which:

FIG. 1 is a side view of a first device for recognizing finger lines without contact.

FIGS. 2 and 3 show the path of the illuminating beam of light rays of the device shown in FIG. 1, by a top and, respectively, front view.

FIGS. 4 to 6 show exemplified embodiments of a sensor system for recognizing skin lines of the epidermis and hypodermis; and

FIG. 7 shows a position pattern model for a hand.

A device for reproducing finger lines is described by way of example in FIGS. 1 to 3, said device being designed as a table model. It is adjusted in a fixed way for reproducing the epidermis. Finger 1 is placed on the support 2, so that it is present in object plane 3 or its zone of sharp focus, and so that it can be photographed with camera 10 via an interference light filter 4, carrier plate 5 (e.g. acrylic glass), reversing prism 6 and polarization filter 7. Camera 10 contains the lens 8 and an image receiver (for example a CCD-chip) in image plane 9, and, furthermore, may contain components (not shown) for image processing.

Components 4, 5, 6 and 7 are optically cemented with each other for constructional reasons, whereby retaining plate 5 is joined with housing pot 11 in a fixed way. Cover plate 12, which has to absorb and dissipate certain forces engaging the support 2, is joined on the edge with housing pot 11 as well (and not with retaining plate 5). Housing pot 11 has a borehole 13 for light to exit from. Housing pot 11 and camera 10 are solidly connected with each other via base plate 14.

FIGS. 2 and 3 show the path of the illuminating beam of rays. The light sources 15, which are mounted in two groups each comprising three light sources are mounted laterally of prism 6 (not visible in FIG. 1 in the plane of the section), are designed, for example in the form of light-emitting diodes with focusing lenses, and aligned with their directional (or aiming) lobes with object 1, aiming at the latter. The scatter disks 16 with forward characteristic and the polarization filter 17 are interconnected in each case. For the exit of light from housing pot 11, provision is made for two slots 18 in cover plate 12, as well as for corresponding slots in carrier plate 5. Instead of using individual polarization filters 17 it is possible also to employ 2 through-extending polarization foils each covering 3 light sources.

For adjusting the sensor for the separate reproduction of the pattern of the epidermis, all pole filters 17 and pole filter 7 in the path of the reproducing rays have to be adjusted in the same direction if light with linear polarization is used. The best effect for the selection of the epidermis is achieved if the common direction of polarization (E-vector) is disposed parallel with the drawing plane of FIGS. 1 and 2, or perpendicular to the drawing plane of FIG. 3. The latter plane is the plane of reflection in which the skin, with slanted illumination and adherence to the reflection condition (for example the Brewster angle), shows a polarizing effect. With approximately vertical illumination, the common direction of polarization may be any direction. If light with circular polarization is employed, filters 17 and 7 do not have to be adjusted with respect to the position of rotation.

FIGS. 4 to 6 describe exemplified embodiments for a sensor system for recognizing skin lines of the epidermis and hypodermis. Said devices may be advantageously designed as wall installation units. The system is accommodated in a housing 25, which has a bulletproof glass window 20 on one side. According to the invention, the housing with the sensor system can be mounted also in front of an existing, larger bulletproof glass wall.

Polarization and interference light filters are arranged in FIG. 4 as camera filters 7 and 4 in front of lens 8. Camera 10 is aimed at object plane 3, which is located in the outer space approximately 4 cm in front of glass panel 20. The lighting consists of 4 lamps 15, of which 2 lamps are shown in the drawing. which are designed in the form of directional lamps, e.g. small halogen spotlights aimed at object plane 3. A scatter disk 16, which, however, may not be needed depending on which type of lamp is used, and a polarization filter 17 are connected in front of each of said lamps.

When light with linear polarization is employed, the polarization filters are adjusted in such a way that the pair of lamps shown in the drawing plane is polarized perpendicular to the plane of the drawing. If camera filter 7 is adjusted perpendicular to the plane of the drawing as well, the image of the epidermis is obtained with this arrangement (as in the preceding example shown in FIG. 1).

For representing the image of the hypodermis, camera filter 7 can be turned by 90 degrees with an electric drive providing for 2 locking points. More robust, however, is an arrangement which dispenses with mechanical movements. For this purpose, an additional pair of lamps of the same type

is required, in association with a stationary filter 7.

Said additional pair of lamps, including the adjusted filters, is turned by 90 degrees on the optical axis versus the pair of lamps shown in FIG. 4. The two pairs of lamps are switched on and off one briefly after the other for recording the pictures of the epidermis and hypodermis.

The same procedure is used when light with circular polarization is employed, however, no filter adjustment is needed in this case, and the polarization rotation of filters 7, 17 and the turned arrangement 17 have to be taken into account according to the preceding explanations.

The user is required to insert his or her hand into sharp focusing zone 3 with the palm in the forward direction without touching the pane. A model 27 shown in FIG. 7, which is located on the glass pane, serves as a positioning aid. The contours of a hand with spread fingers are shown on the model, for example in a simplified or stylized form. The hand line pattern always should be recorded with the fingers spread because fewer picture distortions will then appear, such distortions being caused by the fall of the wrinkles of the skin. The user is to be incited by the picture of the model to also spread the fingers because it

is known from experience that instructions to this extent in a user manual are not always followed.

The path of the light rays may be bent by a mirror or a prism in order to obtain a more compact unit (not shown).

FIG. 5 is a variation of the preceding exemplified embodiment, whereby the object plane 3 is spaced with some distance from the wall. The distance may come to a few meters as well. Such a design is of interest in a case where the access and the control do not take place in the same location, the sensor system is located in the protected area (behind the bulletproof glass pane), and a sight connection exists with said system. The illuminating elements 15, 16, 17 are located in this connection near camera 10, which makes the volume of housing 25 relatively small. In this case, the positioning aid is designed in the form of a frame 22 which, on the inside, has the simplified or stylized contours of a hand with spread fingers, such frame being mounted on a wall mounting device or, with a larger spacing, on a freestanding column or pillar, or in some other location. The user is required to insert his or her hand in the frame and to align the hand with the model, fully covering the latter. The dimensions of the interior of the frame are selected in

such a way that touching can be avoided without difficulties.

FIG. 6 shows a further variation, where the positioning plate 23 is mounted on a wall in an inclined position. This permits a more comfortable holding of the hand as well as a more compact structure in that the path of the light rays is bent on mirror 24. The slanted passage of the light rays through bulletproof glass pane 20 causes a certain amount of image distortion which, however, is only minor and can be corrected later. According to a further variation not shown here, provision is made that the housing with the camera and the illumination is mounted, for example on the ceiling at a reachable level of height, and with the sight window aimed downwardly; and that a frame of the type of frame 22 or 23 is used as positioning aid, such frame, however, being mounted horizontally. The hand is inserted in such a frame with the palm facing up. Such a frame may be wholly or partially made of plastic, whereby an antenna may be integrated in said frame as well, if need be.

A further positioning aid for the arrangement described last is an "aerial" picture projected from the top into or onto the object plane of the camera. According to the invention, such an aerial picture is a double image, which is produced by 2 projectors - which are arranged next to one another - in

such a way that both part pictures or images exactly coincide only in the object plane of the camera and, with correct positioning of the hand, appear coinciding in said plane.

Also holographically produced aerial pictures, for example of marks, hand contour lines or hands can be considered as aids for positioning the hand. In this connection, the hologram plate is preferably mounted on the inside in front of the bulletproof glass pane. A small hole in the hologram may serve for the camera to "look through".

With the design arrangements described last, where aerial images are employed as positioning aids, even accidental touching of any components of the installation can be excluded.

In order to prevent ambient light, in particular daylight from interfering with the measurements, and if simple measures such as elimination of interference sources, covering with a screening etc. are not adequate, the device can be made more insensitive to interfering light as follows:

(1) Cover plate 12 and finger support 2 in the first exemplified embodiment should be designed dark, in the best way black, and the surface should be roughed up, so that only

little foreign light is reflected.

(2) Narrow-banded light should be employed, for example with the help of narrow-banded filters or by using colored light-emitting diodes or lasers on the illumination side, and corresponding filters with narrow-banded passages on the reproduction side.

(3) Pulsed illumination such a flashlight, pulsed light-emitting diodes (LED's) or pulses laser diodes have to be combined with an adapted short shutter time of the recording camera.

Finally, it has to be noted that space is also available in cover plate 12, finger support 2, model 21 as well as frames 22 and 23 for the antenna of a contactless (electromagnetic) ID card reader (proximity reader), so that a combination with this method of ID-reading is feasible.

#### Software Algorithm1 for Handline Recognition

The comparison of two handline patterns with the goal of making a decision on the identity is, in the ideal case, formally a correlation of the complete patterns. With conformity, and assuming that the quality of the reproduction is

good, the coefficient of correlation is then practically 100%.

If the image of the person to be identified has to be compared in this way with a great number of stored complete images, however, the image processing expenditure and in particular the computing time would be too high and long. More favorable are the storage and the comparison of characteristic identification data, or characteristics, containing the features required for a decision. Therefore, image data compression and coding are required. Such compression and coding should be adaptable in a simple manner to the desired conditions, in particular to the "sharpness" of the decision. The strategy of image processing selected in the present case is shown in the diagram and explained in the following. In the text, reference is made to the different blocks of the diagram by underlining.

Apart from any suppression of very high and relatively low room or space frequencies that may be required by filtering (not shown here), the first processing step is segmentation of the epidermis and hypodermis images. This is a division in subunits, for example small boxes, which takes place in such a way that the number of image segments

is reduced as much as possible versus the number of pixels of the initial or starting image in the sense of data compression; however, with the detail resolution in the segment image still being adequate for the task here on hand.

In the following line analysis, the segment contents are examined according to line elements having different intensities "s" and directions "r", with approximately 2 to 3 values for "s" and up to about 8 values at the most for "r". Several vectors of the same type (parallel line segments of the same intensity) in one segment are added up. Each segment thus can be described by a number of different types of vector. When only one type of vector is viewed at a time, i.e., a combination of "r" and "s", vector images are obtained as a result for the various types of vector. It may be advantageous within the framework of optimization of the algorithm to additively combine images of different types of vector, for example in order to avoid excessively low numerical values.

The further data compression takes place through projection of the vector images, i.e., addition of the pixel values in different directions. This corresponds with the recording of a sectional plane according to the process of computer

tomography, whereby the object, in this case, is an already digitized image field with integral pixel values lower than about 5, and the value zero can be found relatively frequently.

It is known that it is possible with a sufficiently large number of projections to reconstruct by means of the CT-algorithm the layer of an object because the totality of the projections contains the complete object information.

The image reconstruction (back projection) is not carried out here. However, the information of the projection functions is used for characterizing the image of the hand lines. The number of projections depends on the desired accuracy of image characterization. It is one advantage of the process that the required and adequate accuracy can be adjusted by a simple rule, namely the selection of the number of projections. Only a few projections are required in this connection as compared to the known computer tomography.

First of all, the overall frequencies result in a simple way from the projection functions for each type of vector. The overall frequencies or their conditions are already suitable for roughly characterizing the line pattern.

The next step is the determination of the main direction of projection. For this purpose, we look at the picture of the sum of all vector images with the highest line intensity "s" without taking into account the direction "r", and at the projections of said summation image. The pair of projections with directions at about plus or minus 45 degrees relative to the longitudinal axis of the hand is a preferred pair in this connection because the three most strongly pronounced main lines, which are the furrow or groove of the thumb, the five-finger furrow and the three-finger furrow, regardless whether of the right or left hand, appear as maxima with a large amplitude. The well-identifiable maximum, for example of the five-finger furrow can be used for defining an object-related zero point of the scale. With the other projections, said maximum may serve for fixing the zero point of the scale as well if a very clear maximum is recognizable. Otherwise the zero point is fixed randomly for example on the left edge of the image.

The main direction of projection is searched for with the help of the "printout" of the maxima within the range of plus or minus 45 degrees of the program. It then serves also as the reference direction for the other directions. In this way, a certain rotation invariance of the measuring method is produced as well.

For further data compression, the projection functions are subjected to a frequency analysis, whereby the shortest form, the amplitude and, if need be, the phase are selected for representing the frequency components. Characterizing of all projections in the main direction can take place through amplitude and phase values. With the other projections, phase data are object-related only in some cases and generally not directly suitable for the characterization.

A possibility is to be mentioned here also as to how the not object-related phase information can be used for pattern identification: the projection functions can be reconstructed from the amplitudes and phases filed in the answerback code storage and a comparison of the shapes of the curves can be carried out by means of correlation. This possibility is not shown in the diagram.

The numerical identification based on the image of the epidermis and hypodermis contains conditions of overall frequencies of types of vectors, sets of amplitudes of the frequency components of the projections, as well as phases relating to the amplitudes of the main projections. It has to be determined empirically how many projections or amplitude/phase sets are generated. This type of characterization of handline patterns is translation-invariant with respect to the hand.

The features can be set up in the numerical identification file in a type of ranking order, which starts with global statements and ends with highly resolved patterns, i.e., at amplitudes and phases of the frequency components for the high space (room) frequencies. The process of feature comparison begins with the overall frequencies and is discontinued in case of nonconformity. The quality of the conformity of handline images is the higher the farther one advances in the ranking order without receiving a negative message.

The analysis of the image of the hypodermis, which is not as strongly structured as the image of the epidermis (but in a different way), takes place in the same manner, whereby the zero points of the scale for the main projections are taken over from the associated images of the epidermis. The number of line intensities "s" may be lower with the hypodermis.

Once an identification has been computed, it is received and included in the data base when a person is registered for the first time. When a comparison of handline patterns is to be carried out, the features of the identification to be checked are compared with the identification data stored in the data base, following the ranking order, so that a positive

or negative decision can be made as shown in the diagram at the bottom.

As opposed to the algorithms of finger imprint recognition which determine the number or arrangement of minutiae, which are peculiarities or special features in the pattern of the papillary ridges, (sinusoidal) distribution patterns of "normal" line elements are detected in the handline recognition process proposed herein. In the present case, the information content lies less in the three main lines specified above, which individually do not vary very strongly, but more in the network of the slightly thinner secondary lines.

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CLAIMS

1. A process for the identification of persons with the help of hand and/or finger lines, characterized in that said lines are optically detected without contact, and that a numerical identification is computed by means of digital image processing, such numeral identification permitting comparison with stored data of the same type.
2. The process for the identification of persons with the help of hand and/or finger lines according to claim 1, characterized in that patterns of the lines of the epidermis and/or hypodermis are detected and evaluated.
3. The process for the identification of persons according to claim 1 and/or 2, characterized in that for the selective representation of the patterns of the epidermis and/or hypodermis, use is made of polarized light in the visible or near infrared range in the path of the illuminating and reproducing light rays.
4. The process for the identification of persons according to claim 2 and/or 3, characterized in that the process is carried out with both linearly and circularly polarized light for the selective representation of the hypodermis and epidermis.

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5. The process for the identification of persons according to claim 4, characterized in that the selection of the pattern of the epidermis is carried out with the rotation of polarization adjusted in opposite senses in the path of the illuminating light and the path of the reproducing light, and the selection of the pattern of the hypodermis with polarization rotation adjusted in the same sense, whereby the direction of rotation (right or left rotation) is defined in this connection as the direction of rotation of the E-vector viewed in the direction of propagation of the light.

6. The process for the identification of persons according to claim 3, characterized in that the selection of the pattern of the epidermis takes place with parallel adjusted directions of polarization in the paths of the illuminating and reproducing light rays, and the selection of the pattern of the hypodermis with vertically adjusted directions of polarization.

7. The process for the identification of persons according to claim 6, characterized in that both patterns are recorded with the same coordinates with a camera one briefly after the other.

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8. The process for the identification of persons according to claim 6, characterized in that each pattern is recorded with one camera employed in each case.

9. The process for the identification of persons according to at least one of claims 4 to 8, characterized in that the information content of both skin patterns available with the same coordinates is combined for said purpose.

10. The process for the identification of persons according to least one of claims 1 to 10, characterized in that the hand and/or finger lines are detected from a greater distance.

11. The process for the identification of persons according to at least one of claims 1 to 10, characterized in that for recognizing fingerlines by means of a recognition algorithm, the relative position of the minutiae is determined and evaluated in the direction of an identification (e.g. Henry Code).

12. The process for the identification of persons according to at least one of claims 1 to 10, characterized in that for recognizing the finger line of the pattern of the epidermis by means of a recognition algorithm, the frequency of orthogonal features is determined and evaluated in the direction of an identification.

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13. The process for the identification of persons according to at least one of claims 1 to 10, characterized in that for recognizing hand lines, the starting image is divided in segments and line sections having different intensities and directions are determined in such segments.

14. The process for the identification of persons according to claim 13, characterized in that in the segment image, the line sections (vectors) are added up to frequency distributions in the way of a computertomographic sectional image recording, as pixel values in different directions (projections).

15. The process for the identification of persons according to claim 12, characterized in that the projections are characterized by the amplitudes and, if need be, also by the phases of the components of their frequency approximation (e.g. according to HARTLEY), and that the amplitudes with or without phase data are used for the numeral characterization of the pattern.

16. A device for carrying out the process according to at least one of claims 1 to 15, characterized by a camera (10) with an image receiver (9), the lens (8) of said camera being

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sharply focused on the plane (3) of the object.

17. The device according to claim 16, characterized in that the image receiver (9) is a CCD-chip.

18. The device according to claim 16, characterized in that provision is made for at least one light source (15) for illuminating the object (1).

19. The device according to claim 18, characterized in that the light source (15) is a diode laser.

20. The device according to claim 18, characterized in that the light source (15) is a lamp with glowing metal surfaces viewed at an inclined angle of observation.

21. The device according to claims 16 to 20, characterized in that a polarization filter (17) is associated with at least one light source (15).

22. The device according to claims 18 to 20, characterized in that a differently (linear or circular) designed polarization filter (17) is associated with at least two light sources (15).

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23. The device according to at least one of claims 1 to 22, characterized in that linear polarization filters (17 and 7) are arranged in the path of the illuminating light and, respectively, in the path of the reproducing light, said filters being crossed by 90 degrees.

24. The device according to at least one of claims 1 to 22, characterized in that provision is made in the paths of the illuminating and the reproducing light for circularly polarized filters (17, 7), said filters having properties suitable for representing the image of the epidermis or hypodermis.

25. The device according to at least one of the preceding claims, characterized in that the light sources (15) can be switched on and off depending on the direction of polarization of the polarization filters (17) associated with said light sources.

26. The device according to at least one of the preceding claims, characterized in that with equally polarized light sources (15), provision is made in the path of the reproducing light rays for two polarization filters with directions extending vertically one on top of the other, said filters





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being individually selectively movable into said path.

27. The device according to claims 22 to 26, characterized in that the camera (10), the illuminating system (15, 16, 17) as well as additional optical devices such as a reversing prism, a range finder and hologram lighting, if needed, are accomodated in a mechanically closed housing (11, 12) and optically accessible only via a glass pane (20), for example made of bulletproof glass.

28. The device according to claim 27, characterized in that the identification device is designed as a wall installation unit.

29. The device according to at least one of the preceding claims, characterized in that the hand and/or the fingers can be positions by means of a model (21) of a frame (22; 23) in the field of vision and in the range of focus of the camera (10).

30. The device according to claim 29, characterized in that the inner contour of the model (21) of the frame (22; 23) has the outline of a hand with spread fingers in the way of positioning model 27.

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31. The device according to claim 29 and/or claim 30, characterized in that the frame (22; 23) is provided in the form of a holographically produced aerial picture.

32. The device according to claim 29, characterized in that the frame (22; 23) partly or wholly consists of metal, and that in terms of high frequency, said frame is designed and adapted in such a way that it has the antenna function of a contactless operating ID card reader (proximity reader).

33. The device according to at least one of claims 29 to 32, characterized in that an optical range finder adjusted to a fixed distance is associated with the frame (22; 23), said range finder being capable of controlling the recording of the image.

34. The device according to claim 33, characterized in that the range finder is optically operating according to the triangulation principle.

35. The device according to at least one of the preceding claims, characterized in that once the hand is correctly positioned in the positioning frame, switch-on of the device to the ready-state and/or triggering of the measuring process

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take place through making of a capacitive connection with the ground or floor on which the user is standing, via the body of the user or through capacitive mistuning of the positioning frame operating as an HF-antenna, or via an antenna integrated in the frame.

36. The device according to at least one of the preceding claims, characterized in that the antenna of a contactless operating ID card reader is integrated in the finger support (2) or in the cover plate (12).

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