(54) Titre : PROCEDE POUR EVALUER LA QUALITE D'UNE IMAGE, PROCEDE DE CREATION D'UN DOCUMENT, PRODUIT-PROGRAMME INFORMATIQUE, INTERFACE UTILISATEUR, FICHER ET APPAREIL ELECTRONIQUE

(54) Title: METHOD FOR EVALUATING THE QUALITY OF AN IMAGE, METHOD FOR PRODUCING A DOCUMENT, COMPUTER PROGRAM PRODUCT, USER INTERFACE, DATA FILE AND ELECTRONIC DEVICE

(57) Abrégé/Abstract:
The invention relates to a method for evaluating the quality of an image according to the following steps: an evaluation data file (132, 134) which contains an evaluation plan is accessed, image analysis results are evaluated using the evaluation plan and the evaluation is produced.
Summary


The invention relates to a method for the evaluation of the quality of an image with the following steps:

- access to an evaluation data file (132, 134), which contains an evaluation scheme,

- evaluation of image analysis results by using an evaluation scheme,

- output of the evaluation.

(Fig. 2)

Description

The invention relates to a method for the evaluation of the quality of an image, a method for generation of a document, particularly of a value or security document, particularly an identification document, a computer program product, a user interface, a data file, as well as an electronic device, such as, for instance, a computer system, a digital camera system, or similar.
The issuance of an identification document such as, for instance, a personal identification card or a passport, is generally done in the state of the art in a way that the applying citizen has a picture taken of himself and then applies with this picture for the issuance of the desired identification document at the responsible passport and identification card issuance office. The application is then processed by the responsible person at the passport and identification card office, the responsible person verifying the quality of the picture.

The verification of the quality is done based on a so-called photo sample table such as is issued, for instance, by Bundesdruckerei (http://www.bundesdruckerei.de/de/support/download/Fotomustertafel_2005_72dpi.pdf) and the International Civil Aviation Organization (ICAO) (http://www.icao.int/mrted/download/documents/Annex%20Photograph%20Guidelines.pdf).

This evaluation of the picture quality by the responsible person is done without further technical means and therefore is largely characterized by the subjective quality judgment by the responsible person. If, in the opinion of the responsible person, the quality of the picture is sufficient, a corresponding order of the identification document, for instance, at the Bundesdruckerei is triggered, which then produces the identification document and delivers it to the passport and identification card office. The identification document is then handed over by the responsible person to the applying citizen. Of special disadvantage here is that the verification of the picture does not include an objective verification of the image for biometry capability, i.e., the capability of the image for use of biometrical processes.

From EP 1 208 539 B1, a method and a fixture are known for the biometrical authentication of a person. For this, a parameter is determined based on individual characteristics of persons that influence the acquisition of biometrical data, particularly of fingerprints, by means of sensors. This parameter is used for a subsequent biometrical verification. Similar methods have also become known

Methods for verification of pictures taken from persons are also known from EP 1 413 972 A1 and US 2005/0058369 A1.

In contrast, this invention is based on the task to generate an improved method for the evaluation of the quality of an image. Additionally, the invention is based on the task to create a corresponding method for the generation of a document, particularly of a value or security document such as, e.g., an identification document, a computer program product, a user interface, a data file, and an electronic device.

The tasks that are the basis for the invention are each solved by the features of the independent Claims. Preferred embodiments of the invention are defined in dependent Claims.

According to the invention, a method for the evaluation of the quality of an image is created with the following steps: access to an evaluation data file that contains an evaluation scheme, evaluation of image analysis results by using the evaluation scheme, and output of the evaluation.

The method according to the invention may generally be used for the quality evaluation of any type of images, particularly of images that are also foreseen for use in biometric processes. The method according to the invention can be used, for instance, for the evaluation of the quality of the picture of a person, for instance, the picture of a face. The method according to the invention may also be used for other types of images, for instance, for the quality evaluation of fingerprint images, images of the iris, or similar.
The basis of the quality evaluation of an image is an evaluation data file that contains an evaluation scheme. The evaluation scheme may be established based on defined criteria that an image must and/or shall fulfill for a certain purpose.

5 Preferably, a predefined criteria catalogue is formulated as an evaluation scheme. For instance, each criterion of the criteria catalogue is defined as a characteristic of the image to be verified with a threshold attributed to the characteristic. For face images, for instance, as criterion for use in passports, the criterion may be defined that the distance between the eyes in the face image must be at least 90 pixels. For translation into the evaluation scheme, the characteristic “eye distance” is defined in it with the attributed threshold value of “90 Pixels.”

As a function of the intended purpose of use of the image, different evaluation schemes may be defined for this, which implement the more or less complex criteria catalogues.

For the quality evaluation of an image, those characteristics of the image that are defined in the evaluation scheme as to be verified are accessed. These characteristics may either already be known, be entered manually, or, if necessary, be determined entirely or partially by image analysis as part of the method according to the invention. In one embodiment of the method according to the invention, for instance, first the relevant characteristics of the image to be assessed are detected according to the evaluation scheme, and then corresponding measurement values are determined for these characteristics. As an example, a measurement value of 70 pixels may be determined for the characteristic “eye distance.”

The determined measurement values are compared to the corresponding thresholds of the evaluation scheme. The quality of the image is determined on this basis.

In an embodiment of the method according to the invention, all characteristics of the evaluation scheme are mandatory criteria, meaning that the quality of the image is
assessed only then as sufficient if the corresponding thresholds relative to all characteristics of the evaluation scheme are fulfilled.

According to an additional embodiment of the invention, the evaluation scheme also contains optional criteria next to the mandatory criteria. This is particularly advantageous if the criteria catalogue implemented in the evaluation scheme contains criteria of different importance. The essential criteria that are, for instance, absolutely necessary for the biometric capability of the image, will then be formulated as mandatory criteria, and other criteria of the criteria catalogue as optional criteria. This, then, makes it possible to determine the degree of similarity of an image with the requirements of the criteria catalogue instead of allowing only a binary usable/unusable decision. In this way, one is able to receive a differentiated quality statement about whether an image just barely fulfills or even surpasses the mandatory criteria.

According to an embodiment of the invention, the fulfillment of different criteria, particularly of mandatory and optional criteria, may be weighted in the evaluation scheme. For this purpose, different point values can be attributed to the corresponding characteristics. For instance, a point value of 100 points can be attributed to characteristic A of the test criterion A, while a point value of 200 points may be attributed to another characteristic B for verification of the test criterion B. If an image to be assessed fulfills a certain characteristic, the points attributed to this characteristic will be attributed and added up so that one receives a total point value that contains an objective quality statement.

According to an embodiment of the invention, previously known measurement values of relevant characteristics of the image are transferred to an image analysis function that uses the measurement values provided from the outside for the evaluation of the quality of an image. In this case, the determination of measurement values can be omitted entirely or partially. For instance, the eye positions can be entered "manually" by the user, for example, by clicking with a computer mouse on the eye position of the image shown on the screen. The
measurement values for the eye positions entered in this way will then be used for
the verification of the corresponding characteristic, which means, for instance, the
characteristic "eye distance." In accordance with the embodiment, manual entering
can be either required generally or only in case of a correction if, for instance, a

Such an image analysis program, for instance, for determination of the eye
positions, may be part of a computer program according to the invention or foreseen
as an external component.

By means of a data file containing the evaluation scheme, an objective evaluation
criterion is created that makes the evaluation of the image quality independent of
the subjective determination by, for example, a responsible person at the passport
and identification document office. Such objective evaluation criterion is particularly
advantageous for the verification of the biometric capability of the image.

According to an embodiment of the invention, the evaluation data file is a data file of
a mark-up language, such as Extended Mark-Up Language (XML). In such a case,
the evaluation data file contains one or more structured evaluation schemes for
corresponding image characteristics.

The use of a mark-up language for the evaluation data file is particularly
advantageous for the reason that such mark-up language allows an intuitive 1:1
transfer of a predefined criteria catalogue into an evaluation scheme that is easy to
read and edit.

According to an embodiment of the invention, the evaluation data file is selectable.
For instance, the evaluation data file can be selected from several evaluation data
files.

According to an embodiment of the invention, different evaluation data files are
attributed to different types of people. Possible types of people are, for instance,
adults, children, and people with or without head covering. Attention must be paid
to the fact that, generally, the wearing of a head covering for an image that is
destined to be an identification document is not allowed, although this must be
allowed in exceptional cases for people of the Muslim faith.

According to an embodiment of the invention, different evaluation data files are
attributed to different utilization purposes of the image. For instance, different
evaluation data files may exist for an electronic passport and a driver's license since
the corresponding quality requirements and image specifications may also be
different.

According to an embodiment of the invention, the image analysis results are output
as an image analysis data file. Preferably, this image analysis data file is also a
data file of a mark-up language such as, for instance, an XML data file. This allows
the storage of image analysis results in a structured manner.

According to an embodiment of the invention, the evaluation data file contains path
information to individual image analysis results of the image analysis data file.
Evaluation schemes that serve for the evaluation of the corresponding image
analysis results are attributed to the corresponding path indications. Preferably,
also, the path information in the evaluation data file is provided in the mark-up
language.

According to an embodiment of the invention, image analysis contains one or more
of the following image characteristics:

- Data type
- Data size
- Color range
- Color depth
- Image width
- Image height
- Image side ratio
- Number of objects shown in image such as, e.g., number of faces or number of fingerprints
- Number of eyes
- Eye distance
- Relative horizontal head position
- Relative vertical head position
- Ratio of head width to image width
- Ratio of head height to image height
- Head pose
- Brightness
- Contrast
- Dynamics
- Sharpness
- Noise
- Artifacts

According to an embodiment of the invention, the evaluation scheme contains one or more mandatory and one or more optional criteria, with the image, upon noncompliance with only one mandatory criterion, being assessed as unusable.

For instance, the evaluation scheme contains evaluation points attributed to the individual mandatory and optional image characteristics. If one mandatory or one optional criterion is fulfilled, the corresponding evaluation points are totaled. The sum of the evaluation points is compared to a threshold value. For this, the possibility of weighting the different criteria over different point values attributed in each case to the characteristics to be tested proves to be particularly advantageous. In addition, this allows a flexible adaptation and further development of the evaluation scheme in order to introduce, for instance, experience as to the practical use of the evaluation scheme in the sense of fine-tuning.

In order to ensure that only those images that fulfill all mandatory criteria are assessed as usable, no evaluation points are issued for fulfilling optional criteria if
even only one of the mandatory criteria is not fulfilled. This ensures that an unfulfilled mandatory criterion cannot be compensated for by the fulfilling of optional criteria.

According to an embodiment of the invention, an image area such as, for instance, the face or the eyes shown in the image, can be automatically detected. This can be done with the help of generally known state of the art image analysis software. The detected image area is marked by a marker on the image screen. This allows the responsible person to perform a plausibility control for correct recognition of, for instance, the position of the face and the eyes.

Alternately and additionally, such markers can also be set manually, for instance, by a mouse click with a computer mouse. For instance, the responsible person may correct in this manner an obviously not relevant result of automatic recognition of an image area.

According to an embodiment of the invention, a first and second signal are generated for the output of the evaluation of the image, wherein the first signal serves as an indication of the usability and the second signal for the indication of the non-usability of the image. The first and second signals may be, for example, visual and/or acoustic signals. The first signal, for instance, is generated at a point when the total point value that is reached by an evaluated image has reached a predefined minimum value. This minimum value can also be part of the evaluation scheme.

Alternately or additionally, the image quality can be output, for example, relative to an evaluation continuum as a percentage or point value. In this case, the position of the threshold value is preferably output together with that point value. According to an embodiment of the invention, unfulfilled mandatory criteria are output in the screen window. This allows a corresponding correction of the image recording parameters.
The method according to the invention may be used, in addition to its use in the passport and identification document offices, for other different purposes. It may be used, for example, for camera systems in order to evaluate the quality of an image recorded by the camera. This is particularly advantageous for photographers who offer the taking of passport pictures, or for passport picture automats.

In addition, the method according to the invention may be used advantageously for the generation of image databases, particularly face image databases, wherein only those images are stored in the database that have a minimum quality defined by the evaluation data file according to the invention.

In a further aspect, the invention relates to a computer program product with executable instructions for the execution of a method according to the invention, particularly for the generation of a document with an image. The computer program product can be executed, for instance, by a common personal computer, such as those used also at passport and identification document offices. In addition, the computer program product may also be formed for the execution in another electronic device; particularly in the latter case, the computer program product may be a so-called firmware.

In a further aspect, the invention relates to a method for the generation of a document with an image, particularly a value or safety document such as, e.g., an identification document. The document has an electronic storage device for storing the image data, wherein the image data is only written into the electronic storage device if it has been classified as qualitatively sufficient by using the method according to the invention.

In a further aspect, the invention relates to a user interface for an electronic device for the evaluation of the quality of an image. Through user interface, one of the available evaluation data files can be selected, for instance, as a function of the type of people.
In a further aspect, the invention relates to an electronic device such as, for instance, a computer system, camera system, passport image automat, or an image database, particularly a face image database. The electronic device includes means for output of image data. Image data can be delivered by an external device such as, for instance, a scanner, or read from a storage medium such as, for instance, a multimedia card.

Alternately, or additionally, the image data can also be generated by the electronic device itself, for instance, by a digital camera integrated in the electronic device, a scanner, particularly for recording fingerprints, or another sensor such as, e.g., a fingerprint semiconductor sensor. The electronic device is formed for the execution of a method according to the invention for the evaluation of the quality of an input image, for instance, a recorded image.

The use of an evaluation data file for the definition of an evaluation scheme for the evaluation of the quality of an image is particularly advantageous for the reason that it allows a high degree of flexibility. For instance, in case of a change in evaluation criteria, only the evaluation data file must be updated without having to exchange the computer program, user interface, or the electronic device. In addition, the same procedure can be used in this manner for different purposes that require each different evaluation scheme. Based on the 1:1 transfer of the criteria catalogue into the evaluation scheme of the evaluation data file, this can be adapted without large effort to a changed criteria catalogue. Particularly if the evaluation data file exists in a mark-up language, this can be changed by opening and editing the evaluation data file in order to adapt it to changes of the criteria catalogue and/or to change, e.g., the point values attributed to the mandatory and/or optional criteria.

In a further aspect, the invention relates to an evaluation data file that contains an evaluation scheme. The evaluation scheme defines image characteristics and criteria each attributed to the image characteristics such as, e.g., thresholds. Preferably, point values are attributed to the characteristics that are assigned and
added upon fulfillment of the corresponding criterion, for instance, compliance with the threshold value.

In the following, embodiments of the invention are described in more detail by referring to the drawings. Shown are:

Figure 1 a block diagram of an embodiment of an electronic device according to the invention,

Figure 2 a flow diagram of an embodiment of a method according to the invention,

Figure 3 an embodiment of a user interface according to the invention,

Figure 4 the user interface of Figure 3 with an indication of the individual point values achieved in the evaluation,

Figure 5 a block diagram of a document with an image data memory.

Figure 1 shows electronic device 100. Electronic device 100 may be a computer, particularly a personal computer (PC), a database system, particularly a face database system, a camera system, or a passport image automat or similar.

Electronic device 100 can be connected to an image data source 102 or includes one. Image data source 102 may be a scanner, a digital camera, or a storage medium on which image data file 104 is stored.

If image data source 102 is, for instance, a scanner, a passport photo is scanned in order to generate image data file 104 and enter it into electronic device 100.

Electronic data file 100 has at least one processor 106 and a data storage unit 108.
Processor 106 serves for the execution of analysis program 110 that is formed for the performance of an image analysis of a face image. For this purpose, analysis program 110 contains different program components, such as a program component 112 for the determination of the data type of image data file 104, program component 114 for the determination of the color space, program component 116 for the determination of the color depth, program component 118 for the determination of the image side ratio (so called aspect ratio), program component 120 for the determination of the image width, program component 122 for the determination of image height, program component 124 that is formed as a face finder, program component 126 that is formed as an eye finder, and/or other program components for the analysis of image data file 104 relative to other or complementary image characteristics.

Analysis program 110 is formed in a way that analysis results that are obtained with the help of program components 112 to 126 are output in a structured form. For instance, the output is done in form of an image analysis data file 128. The image analysis data file is preferably a data file in a mark-up language such as, for instance, XML. Image analysis data file 128 contains the image characteristic, corresponding to each predefined evaluation category, which has been determined by means of one or more program components 112 to 126.

Processor 106 additionally serves for the execution of an evaluation program 130. Evaluation program 130 serves for the evaluation of the image analysis results, as they are stored in image analysis data file 128, based on an evaluation scheme. The evaluation scheme itself is not part of the evaluation program 130 but is defined in a separate evaluation data file that is accessed by evaluation program 130.

In the embodiment discussed here, evaluation data file 132 and an alternate evaluation data file 134 are stored in data storage device 108. Evaluation data files 132 and 134 each contain a structured evaluation scheme. Evaluation data files 132 and 134 are preferably formed as XML data files. The evaluation data files
each contain an evaluation scheme that implements, essentially 1:1, the predefined criteria catalogues.

As a matter of example, evaluation data file 132 contains a predefined criterion for each evaluation category upon the fulfillment of which a predefined point value is assigned. Path information is additionally assigned to the evaluation category, which allows access to the corresponding image characteristic in image analysis data file 128 that belongs to the evaluation category and that must be verified relative to the predefined criterion.

As a matter of example, evaluation data file 132 contains the evaluation category "data file type" with the attributed criteria "JPEG" or "JPEG2000," as well as the point value of 100 points. Path A, in image analysis data file 128, is attributed to the evaluation category "data file type." This path is displayed by indicator 136 in Figure 1. The path information, therefore, does not indicate the storage address of image analysis data file 128 or the image characteristics of interest here, but the logical path within image analysis data file 128 to the image characteristics of interest, i.e., in this case, the data file type.

For the evaluation of the image analysis results in the evaluation category "data file type," the corresponding image analysis result, in this case "TIFF," is accessed in image analysis data file 128 by using path information A, and compared with the criterion of this evaluation category, i.e., "JPEG" or "JPEG2000." Since the data type "TIFF" does not correspond to any of the two data types, i.e., is neither of the type "JPEG" nor of "JPEG2000," this criterion is not fulfilled and no points are assigned.

The entry into evaluation data file 132 in the evaluation category "color space" is structured correspondingly. As criterion for the evaluation of the color space, one or more color spaces are defined such as, for example, 24-Bit-RGB. The attributed point value here is 200. In addition, the entry in the evaluation category "color space" contains the path information B. By Path B, the entry into the image analysis data file 128 is defined relative to the image analysis result in this evaluation category as indicated by indicator 138 in Figure 1.
Evaluation data file 132 may contain additional evaluation categories such as, for instance, the color depth, aspect ratio, image width, image height, eye distance, and/or further evaluation categories.

In the embodiment discussed here, the criteria attributed to the evaluation categories in evaluation data file 132 are adapted to the front face image of an adult.

In alternate evaluation data file 134, these criteria are adapted to the front face image of a child. If, therefore, image data file 104 also concerns the face image of an adult, evaluation data file 132 is accessed for the evaluation of image data file 104 by evaluation program 130; if image data file 104, however, concerns the face image of a child, evaluation data file 134 will be accessed instead.

Additional evaluation data files may be stored in storage device 108, which may be attributed, for instance, to specific people types or image recording situations.

As an example, an additional evaluation data file may exist that is adapted to people with head covers, etc.

Processor 106 further serves for the execution of program instructions of user interface 140, for instance, a graphic user interface. Through user interface 140, the output of the evaluation result is performed.

In accordance with the embodiment, the evaluation data file, which shall be used for evaluation through evaluation program 130, can be selected by the user through user interface 140. In another embodiment, the selection can also be made automatically if analysis program 110 is formed in a way that it is able to detect automatically the people type of image data file 104.

In this case, the people type, for instance, "adult" or "child," can also be written in image analysis data file 128 as an image analysis result. Evaluation program 130
then accesses the entry in image analysis data file 128 through a corresponding predefined path in order to read out the people type and then to select the corresponding evaluation data file that shall be used to the consequent evaluation of image analysis data file 128.

User interface 140 is formed for the generation of output signals that indicate the evaluation result. As an example, the user interface can be formed as a traffic light, which means that it shows one red and one green control light. If the result of the evaluation of image data file 104 shows sufficient quality and is, for instance, usable for biometrics, the green control light is triggered; in the opposite case, the red control light is triggered.

User interface 140 can also generate output signals that indicate the position of the determined quality on an evaluation continuum in other embodiments. As an example, the output of the quality can be output as point value, percentage, or indicator position.

Alternately, or additionally, the evaluation result can also be output by an acoustic or other signal.

In an embodiment, evaluation program 130 is formed in a way that the total point value that was achieved during the evaluation of image analysis data file 128 is compared with a predefined threshold value. If this value is lower than the threshold value, it means that image data file 104 does not have sufficient quality, so the corresponding output signal is generated by user interface 140. The position of the threshold value can be programmed in evaluation program 130. Alternately, the position of the threshold value may also be defined in evaluation data files 132 and 134.

Figure 2 shows a corresponding flow diagram. In step 200, an image is entered into the electronic device. This can be done by photographically taking an image with a digital camera, by scanning of a paper copy, or by readout of the image data file in a storage medium. In step 202, an analysis of the image data file is performed by the
electronic device. By doing so, different image characteristics are determined that are output in step 204 in a structured form as an image analysis data file. For this, the image characteristics to be evaluated may be firmly defined, for instance, by corresponding programming of analysis program 110.

In step 206, evaluation program 100 is started after the analysis program has generated and output the image analysis data file. The evaluation program then accesses the evaluation data file stored in the memory of the electronic device and on the image analysis data file in order to correspondingly evaluate the image analysis results (step 208). In step 210, the result of the quality evaluation is output through the user interface of the electronic device.

If several evaluation data files exist in the memory of the electronic device, a selection of one of the evaluation data files, which shall be used for the performance of the evaluation, must be done before the performance of the evaluation. This can be done manually by a user through the user interface or by program control, for instance, by automatically selecting the evaluation data file as a function of the people type recognized by the analysis program or as a function of the usage purpose for the image.

The evaluation categories of the evaluation data files can be identical so that the image analysis data file always has the same structure and always contains the same image characteristics independently of the evaluation data file. In another embodiment, the evaluation categories of the evaluation data files can also be different. In this case, the analysis program can access the selected evaluation data file in order to read out the evaluation categories that are listed in this selected evaluation data file. The image analysis can then be limited to these evaluation categories since further image characteristics will not enter into the evaluation according to the selected evaluation data file.
Exhibit 1 shows an excerpt from an embodiment of an evaluation data file that is formed as an XML data file. The data file name of the evaluation data file is "XMLEvaluationScheme-External."

The evaluation data file serves for the qualitative evaluation of frontal face images for the generation of electronic identification documents such as, for instance, passports, ID cards, driver's licenses, visas, and the like.

The evaluation data file contains different evaluation categories that are each marked by <measurement name="...">. After the information of the evaluation category follows the path information "path" for access to the corresponding image analysis result in the image analysis data file (See Path A and B in Figure 1).

Afterwards, follows the definition of the criterion in this evaluation category, i.e., a listing of the different image characteristics to be considered.

Later, follows the indication "mandatory" or "optional" to specify whether this is a mandatory or an optional criterion. Finally, the specific condition is formulated that must be fulfilled so a certain point value can be assigned.

The excerpt of the evaluation data file of Exhibit 1 shows the evaluation categories data file type ("Check File Type") with the data files under consideration, to which numbers 1 to 7 are attributed. The verification criterion is here that it must either be a data file type of the format JPEG (1) or of JPEG2000 (2) to be able to assign 100 points. By the indication "Mandatory," it is further clarified that this is an optional criterion. By the indication </measurement>, the entry into the evaluation category "Data Type" is completed.

Subsequently follow the evaluation categories data size ("Check File Size"), image compression ("Check Image Compression"), color space ("Check Image Color Space"), and additional entries not shown in Exhibit 1, for instance, for the evaluation categories color depth, image width, image height, image aspect ratio,
number of faces shown in the image, number of eyes, eye distance, relative horizontal head position, relative vertical head position, ratio of head width to image width, ratio of head height to image height, and/or additional evaluation categories.

Exhibit 2 shows an excerpt of another embodiment of the evaluation data file of Exhibit 1. In distinction from the embodiment of Exhibit 1, the evaluation category "Data Type" contains a mandatory and an optional criterion. As optional criterion is defined, the data type must be JPEG, JPEG2000, BMP, TIFF, GIF, or PNG. In this case, the point value of 100 points is assigned. As optional criterion is defined, the data type must be of the type JPEG or JPEG2000. If this condition is fulfilled, an additional 50 points are assigned that are added to the 100 points of the optional criterion.

The further evaluation categories of the evaluation data file in the embodiment of Exhibit 2 can contain additional mandatory and optional criteria.

Preferably, points for the fulfillment of optional criteria are only assigned if all mandatory criteria in all evaluation categories are fulfilled. Through this, one avoids the situation that upon nonfulfillment of one of the mandatory criteria, the corresponding number of points is compensated by fulfillment of optional criteria.

The assigned point values are added up and compared to a defined threshold value in order to assess the quality of the image.

Figure 3 shows an embodiment of a graphic user interface. The user interface has a display window ("Window") 142 with a display area 144 for image data file 104 (see Figure 1). In the application case discussed here, image data file 104 is a digitized image of a frontal face recording of a male adult.

Image data file 104, to be assessed, can be selected by the entry of the corresponding access path into entry field 146. The evaluation data file (e.g., evaluation data file 132 or 134 – see Figure 1), which shall be used for the
evaluation of the selected image data file, can be selected by entry of path information in entry field 148. By activation of virtual operation element 150, for instance, by clicking with a computer mouse, the selected evaluation data file can be opened and displayed for control purposes.

By clicking on entry field 152 ("Write Log File"), the user can specify that the performed evaluations are logged in a so-called "Log File." The "Log File" is specified by entering the corresponding path into entry field 154. By activation of the "Log File" can be opened.

By clicking on entry field 158, the user can specify that the markings relative to automatically recognized face features be displayed in display area 144 ("Show Landmarks"). By clicking on entry field 160, the user can specify that a marker shall be indicated for the eyes ("Eyes"); by clicking on entry field 162, for the face region ("Face Region"); by clicking entry field 164, for the head region ("Head Region"); and by clicking on entry field 166, for the approximate face region ("Face Region[approx."]).

Display area 168 serves as the indication of unfulfilled mandatory criteria.

Display area 170 serves as the output of evaluation results on an evaluation continuum between 0% and 100%. On this evaluation continuum, threshold value 172 is defined, wherein the result of the quality evaluation is indicated by indicator 174 on this continuum between 0% and 100%.

In addition, in display area 170, the added points for fulfillment of mandatory criteria ("Mandatory Points") is in clear text, as well as the added point values for fulfillment of optional criteria ("Optional Points") of the assessed image data file 104.

Display window 142 has, additionally, display area 176 for the display of image analysis results in structured form, as well as individual evaluation results, wherein
the presentation can be changed by clicking on the tab riders "Analysis Result" and "Evaluation Result."

In addition, display window 142 has entry field 178 for path information to an image directory ("Image Directory") in which several images are located. These can be evaluated automatically and sequentially, wherein, for the purpose of monitoring the running evaluation, a delay ("Delay") can be specified by the user by entering a corresponding time delay into entry field 180.

If an individual image shall be evaluated, the user activates operating element 182 so the evaluation is started for image data file 104 specified by the path entry into entry field 146. By activating operating element 184, however, the evaluation of the images is begun that is specified in the image directory in entry field 178.

In the application case discussed here, the user has entered path information to image data file 104 into entry field 146 and has selected an evaluation data file by entering a path into entry field 148. By clicking on operating element 182, the user has started the analysis and consequent evaluation of selected image data file 104.

The result of the analysis and the evaluation is presented in Figure 3. In display area 144, for image data file 104, special markers have been added for the eyes and the head region. The display of these markers allows the user a plausibility control for the purpose of determining whether automatic recognition of face areas and features has worked correctly or not. If, for instance, the markers for the eyes are not shown at the correct position, the user can manually shift the marker with the computer mouse in order to correct the incorrect automatic recognition of the position of the eyes. After entry of such manual correction, the evaluation will again be done automatically.

In the example case discussed here, the quality of image data file 104 does not quite reach threshold value 172 as indicated by the position of indicator 174. For the fulfillment of optional criteria, 7,300 of 7,700 points were assigned, which means
that one or more mandatory criteria have not been fulfilled. For this reason, the missing points could not be compensated for the achieved points by fulfillment of optional criteria, in this case 2,350 points.

The details of the image analysis results are output in the form of a tree structure in display area 176 as presented in Figure 3. By clicking on the tab rider “Evaluation Result,” the evaluation results in the individual evaluation categories are also output in the form of a tree structure in display area 176, as shown in Figure 4.

If the quality of image data file 104 lies above threshold value 172, it is considered suitable for the generation of an identification document.

Figure 5 schematically shows corresponding identification document 186. This can be, for instance, a paper-based document or a chipcard. Identification document 186 contains nonvolatile memory 188 in which image data 190 of the holder of identification document 186 are stored. It is also possible to access storage device 188 through interface 192 if required by means of cryptographic protocol 194. The interface can be formed by contact or wireless, for instance, as RFID.

Additionally, the image of the holder of identification document 186, which has served for the generation of image data 190, can be printed onto identification document 186 (image 196).

For improved identification control, image data 190 is read out of storage device 188, displayed, and compared with printed image 196. This provides an additional protection against falsification.

In addition, image data 190 can also be used for the purpose of face biometrics.
### Reference List

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<tr>
<td>156</td>
<td>Operating element</td>
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178 Entry field
180 Entry field
182 Operating element
184 Operating element
186 Identity document
188 Storage unit
190 Image data
192 Interface
194 Cryptographic protocol
196 Image
Exhibit 1

<?xml version="1.0" encoding="UTF-8"?>
<evaluationConfiguration version="1.0" name="BDr full frontal face image requirements (external)"
<measurements>

<measurement name="Check file type" path="analysisResult/file/@type" key="1.01">
<!--
File type.
1 = JPEG
2 = JPEG2000
3 = BMP
4 = TIFF
5 = GIF
6 = PNG
7 = (Other)
ICAO: JPEG or JPEG2000
BDr: similar
--> 
<mandatory>
<validation min="1" max="2" borders="[]" points="100"></validation>
</mandatory>
</measurement>

<measurement name="Check file size" path="analysisResult/file/@size" key="1.02a">
<!--
File size in bytes.
ICAO: at least 11 kb
BDr: similar
--> 
<mandatory>
<validation min="11264" borders="[]" points="300"></validation>
</mandatory>
</measurement>

<measurement name="Check image compression"
path="analysisResult/image/@compression" key="1.02b">
<!--
Image compression in percent (calculation: 100 - (file_size_compressed * 100 / file_size_uncompressed)).
Higher values means higher compression, 0.00 means no compression.
ICAO: at most 97.50 %
BDr: similar
--> 
<mandatory>
<validation max="97.50" borders="[]" points="400"></validation>
<measurement name="Check image color space" path="analysisResult/file/@colorSpace"
key="1.03">  
  <!--
  Image color space.
  1 = 24-Bit-RGB
  2 = YUV422
  3 = 8-Bit-Grayscale
  4 = (Other)
  ICAO: 1, 2 or 3
  BD: similar
  -->
<mandatory>
  <validation min="1" max="3" borders="[]" points="200"></validation>
</mandatory>
</measurement>

...
Exhibit 2

<?xml version="1.0" encoding="UTF-8" ?>
<evaluationConfiguration version="1.0" name="BDr full frontal face image
requirements (internal, extended)">
  <measurements>
    <measurement name="Check file type" path="analysisResult/file/@type"
key="file_type">
      <!--

file type.
1 = JPEG
2 = JPEG2000
3 = BMP
4 = TIFF
5 = GIF
6 = PNG
7 = [Other]
ICAO [mandatory]: 1 or 2
ICAO [recommendation]: -
NAC: 1,2,3,4,5 or 6

-->>
  <validation set="1,2,3,4,5,6" points="100" />
  </mandatory>
  <optional>
  <validation set="1,2" points="50" />
  </optional>
    </measurement>
    <measurement name="Check file size" path="analysisResult/file/@size"
key="file_size">
      <!--

...
Claims

1. Method of evaluation of the quality of an image in the following steps:
   - access to an evaluation file (132, 134), which contains an evaluation scheme,
   - evaluation of image analysis results by using the evaluation scheme,
   - output of the evaluation.

2. Method of Claim 1, wherein the evaluation is made for the verification of the biometric capability of the image.

3. Method of Claim 1 or 2, wherein the evaluation data file is a data file in a mark-up language.

4. Method of Claim 3, wherein the mark-up language is the Extended Mark-Up Language (XML).

5. Method of one of the previous Claims, wherein the evaluation data file is selected from at least first and second evaluation data files (132, 134), wherein each of the first and second evaluation data files contains a different evaluation scheme.

6. Method of Claim 5, wherein the first evaluation data file is foreseen for the evaluation of the image of a first type of person and the second evaluation data file for the evaluation of the image of a second type of person.

7. Method of one of the previous Claims, wherein the evaluation scheme defines characteristics and thresholds attributed to the characteristics, and wherein the
image analysis results contain measurement values of the characteristics that are compared to the corresponding thresholds.

8. Method of Claim 7, wherein an image analysis is performed relative to one or more characteristics in order to determine the measurement values of the characteristics.

9. Method of Claim 7 or 8, wherein the measurement values of one or more characteristics are entered manually or are determined by an external program component.

10. Method of one of the previous Claims, wherein an image analysis data file (128) is generated that contains the image analysis data file, and wherein the evaluation of the image analysis results is done by using the image analysis data file.

11. Method of Claim 10, wherein the image analysis data file is a data file of a mark-up language.

12. Method of Claim 11, wherein the mark-up language is the Extended Mark-Up Language (XML).

13. Method of Claims 10, 11, or 12, wherein the evaluation data file contains path information (A, B) to individual image analysis results of the image analysis data file, and criteria attributed to each of the path information.

14. Method of Claim 13, wherein the path information is provided in a mark-up language.

15. Method of Claims 13 or 14, wherein each of the path information refers to one of the image analysis results.
16. Method of one of the previous Claims, wherein the evaluation scheme contains one or more mandatory criteria and one or more optional criteria, wherein upon the nonfulfillment of one of the mandatory criteria the image will be assessed as unusable independently of the optional criteria.

17. Method of Claim 16, wherein evaluation points are attributed to each of the mandatory criteria and the optional criteria, and wherein the evaluation is performed in a way that the corresponding evaluation points are not issued for compliance with optional criteria unless at least one of the mandatory criteria is fulfilled.

18. Method of one of the previous Claims with the following further steps:

   - recognition of an image area,

   - display of a marker for marking the recognized image area.

19. Method of one of the previous Claims, wherein a marker can be manually used for identification of an image area.

20. Method of Claim 18 or 19, wherein the marked image area is assessed as image analysis result.

21. Method of one of the previous Claims, wherein for output of the evaluation a first and a second signal are generated, wherein the first signal indicates that the image is of sufficient quality and the second signal indicates that the image is not of sufficient quality.

22. Method of one of the previous Claims, wherein the output of the evaluation is made as an indication of the quality on an evaluation continuum.
23. Method of one of the previous Claims, wherein with the help of the evaluation scheme a point value is determined that is compared to a threshold value.

24. Method of one of the previous Claims, wherein unfulfilled mandatory criteria are output.

25. Computer program product with executable program instructions for the execution of a method according to one of the previous Claims.

26. Method for the generation of document (186) with the following steps:

- evaluation of the quality of an image with a method according to one of the previous Claims 1 to 25,

- storage of the image in an electronic memory (188) of the document if the image is of sufficient quality.

27. Method of Claim 26, wherein the image is printed onto the document.

28. User interface for an electronic device for the evaluation of the quality of an image with:

- input means (148) for selection of an evaluation data file that contains an evaluation scheme,

- means (170, 172, 174) for output of the evaluation.

29. Electronic device with:

- means (102) for the input of image data (104),

- means (106, 130) for access to an evaluation data file (132, 134) that contains an evaluation scheme,
- means (106, 110) for performance of an image analysis,

- means (106, 130) for evaluation of the image analysis results by using the evaluation scheme,

- means (170, 172, 174) for output of the evaluation.

30. Electronic device of Claim 29, with means (148) for the selection of an evaluation data file from at least two evaluation data files (132, 134).

31. Electronic device of Claim 30, wherein the means for selection of the evaluation data file can be formed so that the selection can be done manually or automatically.

32. Evaluation data file with an evaluation scheme, wherein the evaluation scheme defines image characteristics and criteria such as, e.g., thresholds, which are attributed to the image characteristics.

33. Evaluation data file of Claim 32, wherein point values are attributed to the image characteristics that upon fulfillment of corresponding criteria can be assigned and added.
### Fig. 1

#### Electronic device

**Processor**

- Analysis
  - Type of data file
  - Color space
  - Color depth
  - Image aspect ratio
  - Image width
  - Image height
  - Face finder
  - Eye finder

#### Storage unit

**Evaluation data file (adult)**

<table>
<thead>
<tr>
<th>Evaluation category</th>
<th>Criterion</th>
<th>Points</th>
<th>Path</th>
</tr>
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<tbody>
<tr>
<td>Data file type</td>
<td>JPEG, JPEG2000</td>
<td>100</td>
<td>A</td>
</tr>
<tr>
<td>Color space</td>
<td>24-BIT-RGB, ...</td>
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<td>B</td>
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</tbody>
</table>

**Evaluation data file (child)**

<table>
<thead>
<tr>
<th>Evaluation category</th>
<th>Criterion</th>
<th>Points</th>
<th>Path</th>
</tr>
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<tbody>
<tr>
<td>Data file type</td>
<td>JPEG, JPEG2000</td>
<td>100</td>
<td>A</td>
</tr>
<tr>
<td>Color space</td>
<td>24-BIT-RGB, ...</td>
<td>200</td>
<td>B</td>
</tr>
</tbody>
</table>
Fig. 2

Entry image 200

Image analysis 202

Structured output of image analysis results 204

Access to evaluation data file 206

Access to image analysis results 208

Output evaluation 210
Entry image

Image analysis

Structured output of image analysis results

Access to evaluation data file

Access to image analysis results

Output evaluation