Abstract:

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Title: ORGANIZING DIGITAL IMAGES BY CORRELATING FACES

FIG. 5

[Continued on next page]

Abstract: A computer-implemented method for organizing images including receiving an image that includes a representation of a human face; generating a correlation value indicating a likelihood that the human face corresponds to a stored facial profile associated with one or more profile images including a human face; evaluating the received image and the generated correlation value to determine, depending on the result of the evaluating, whether the image corresponds to the stored facial profile; associating the received image with the stored facial profile; and storing an indication of the associating.
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ORGANIZING DIGITAL IMAGES BY CORRELATING FACES

CROSS-REFERENCE TO RELATED APPLICATIONS


TECHNICAL FIELD

[0002] The present disclosure relates to organizing images, such as digital images, by correlating one or more faces represented in the images.

BACKGROUND

[0003] Photography is a popular pastime. Images, including digital images produced through digital photography, are prevalent. Images also can be produced by graphical editing software (e.g., image editing or drawing software), video equipment, rendering systems, scanners, tomography scanners, and radio telescopes.

[0004] Images often represent people and, in particular, the faces of people. Facial detection relates to determining whether images represent one or more faces. Facial recognition (or recognition) relates to identifying a person represented in an image. Recognition can be accomplished by comparing selected facial features from a graphical face to a facial database. Facial recognition algorithms can identify faces by extracting landmarks corresponding to facial features from the image. For example, an algorithm may analyze the relative position, size, and shape of the eyes, nose, cheekbones, and jaw. Recognition algorithms include eigenface, fisherface, the Hidden Markov model, and neuronal motivated dynamic link matching.

SUMMARY

[0005] This disclosure describes technologies and techniques for organizing images, such as digital images, by correlating faces.
[0006] Systems implementing techniques described here enable users to organize images such as media stored on a computer-readable storage device. Images can be automatically assigned to a particular storage location, logically and/or physically, based on the correlation of one or more faces appearing in the media. For example, an album corresponding to a particular individual can be automatically populated with digital images that represent that individual. The degree to which the images included in an album must be correlated can be varied, such as based on user specifications.

[0007] In general, one aspect of the subject matter described in this specification can be embodied in a computer-implemented method for organizing images, the computer-implemented method including receiving an image that includes a representation of a human face; generating a correlation value indicating a likelihood that the human face corresponds to a stored facial profile associated with one or more profile images including a human face; evaluating the received image and the generated correlation value to determine, depending on a result of the evaluating, whether the image corresponds to the stored facial profile; associating the received image with the stored facial profile; and storing an indication of the associating. Aspects of the subject matter also can be implemented in systems, computer program products, and related processes and apparatus.

[0008] These and other implementations can optionally include one or more of the following features. The correlation value can indicate that the image corresponds to another stored facial profile, and evaluating can include evaluating first metadata of the image and second metadata of the one or more profile images. The method can include obtaining the one or more profile images and profile information associated with the one or more profile images from an address book application; and generating the stored facial profile based on the one or more profile images and the profile information. The method also can include prompting, based on the evaluating, a user for confirmation that the human face corresponds to the stored facial profile; and accepting, in response to the prompting, confirmation that the human face corresponds to the stored
facial profile. Accepting can include accepting via a user interface having an affirmative response option and a negative response option.

[0009] Implementations also can optionally include one or more of the following features. The method can include accessing detection information indicating less than a 90-percent likelihood that the image represents a human face; establishing that the image depicts skin-tone colors and sharp image details; and confirming, based on the establishing, that the image represents a human face. The method also can include selecting the image as a key image based on one or more of the detection information, the image, or the correlation value; and displaying the key image as an icon for the stored facial profile. The image can include one or more of a sharpness indication, a capture date, or an image resolution of the image. The detection information can include one or more of a distance from the human face to another human face depicted in the image, or an angle of the human face relative to the image. The human face can include a first human face, and the method can include deriving a potential correspondence between a second human face, represented in the image, and the stored facial profile; and ignoring the derived potential correspondence based on the correlation value and the first human face corresponding to the stored facial profile.

[00010] The method also can include receiving unsorted images representing human faces, unsorted image information, and unsorted correlation values indicating likelihoods that the human faces correspond to the stored facial profile; establishing an initial correlation value threshold; grouping the unsorted images based on the initial correlation value threshold and the unsorted correlation values; deriving a revised correlation threshold based on amounts of unsorted images grouped together and a total number of groups of unsorted images; regrouping the unsorted images based on the revised correlation threshold and the unsorted correlation values; and associating one or more groups of unsorted images with the stored facial profile based on the regrouping. The stored facial profile can include a first stored facial profile and the human face can include a first human face. The method can include presenting the first stored facial profile
and a second stored facial profile in a user interface, wherein the second stored facial profile includes one or more images representing a second human face; receiving an indication in the user interface associating the first stored facial profile with the second stored facial profile; and generating a combined album including one or more profile images from the first stored facial profile and the second stored facial profile.

[0001] The techniques described in this specification can be implemented to realize one or more of the following potential advantages. Correlating faces can be implemented to permit automatically sorting images into one or more storage structures, such as folders or albums. Further, the subject matter can be implemented to permit identifying new individuals for whom a graphical face definition or profile has not been defined. Additionally, the subject matter can be implemented to permit refining the criteria used to correlate faces, such as a definition or profile, based on the association of additional images with an individual.

[00012] The details of one or more implementations are set forth in the accompanying drawings and the description below. Other features and advantages will be apparent from the description and drawings, and from the claims.

**BRIEF DESCRIPTION OF THE DRAWINGS**

[00013] FIG. 1 shows an exemplary overview of correlating graphical faces.

[00014] FIG. 2 shows an exemplary system for correlating graphical faces.

[00015] FIG. 3A is a flow chart showing an exemplary correlation process.

[00016] FIG. 3B is a flow chart showing an exemplary process for setting an adaptive correlation threshold.

[00017] FIG. 3C is a flow chart showing an exemplary process for testing a recognition.

[00018] FIG. 4A is a flow chart showing an exemplary detection elimination process.
FIG. 4 B is a flow chart showing an exemplary correlations elimination process.

FIG. 5 is a diagram of an exemplary user interface for displaying correlated faces.

FIG. 6A is a diagram of an exemplary user interface for receiving user input.

FIG. 6B is a diagram of an exemplary user interface for receiving user input.

FIG. 6C is a diagram of an exemplary user interface for receiving user input.

FIG. 7 is a diagram of an exemplary user interface for creating albums.

FIG. 8 is a diagram of an exemplary user interface for receiving user input.

FIG. 9 is a diagram showing exemplary correlation techniques.

FIG. 10 is a diagram showing selection of an album cover.

Like reference symbols indicate like elements throughout the specification and drawings.

DETAILED DESCRIPTION

Organizing images by correlating faces includes associating representations of the same person across images. Organizing images by the people represented in the media provides several potential advantages. For example, such an organizational scheme can be intuitive for users of an image system, enabling users to quickly understand the functioning of the system. Further, the burden of manually organizing many images can be substantially eliminated or reduced. In addition, images can be accurately grouped based on a person represented in the images. Accurately grouping images can provide improved accessibility, organization and usability of the images by users.

FIG. 1 shows an exemplary overview of correlating graphical faces. In general, images can be transmitted from a camera to a computer. The computer
can include a correlation system. The correlation system can correlate the
ingimages by grouping images of the same individual.

[00031] Digital camera 102 is a camera for capturing digital images. The digital
camera 102 can capture video or still images, or both, by recording images via
an electronic image sensor. The digital camera 102 can be a stand-alone digital
camera or can be incorporated into any of several devices. For example, the
digital camera 102 can be incorporated into a personal digital assistant (PDA), a
mobile phone, or a web cam. Further, the digital camera 102 can utilize
removable storage media to store captured image data. For example, the digital
camera 102 can store images in a removable flash memory device (e.g.,
CompactFlash and Secure Digital cards). The digital camera 102 can record
images in various formats (e.g., raw format or in accordance with the standard of
the joint photographic experts group (JPEG)). The digital camera 102 also can
include one or more interfaces for communicating with a computer. For example,
the digital camera 102 can include a wired interface, such as universal serial bus
(USB) or FireWire, and/or a wireless interface, such as infrared or radio
frequency.

[00032] The image 104 is a digital image produced by a digital camera (e.g.,
the digital camera 102). The image 104 represents a face. The image 104 also
can include representations of other items. For example, the image 104 can be
an image of a person standing in front of a landmark, and can represent
buildings, trees, the sky, etc. Further, the image 104 can be stored in various
formats, such as a compressed format (e.g., JPEG), or an uncompressed format
(e.g., RAW). The image 104 can include graphical data and metadata. The
metadata can conform to the exchangeable image file format (Exif) specification.
The Exif data can include aperture, exposure time, date and time, location and
other information about the image 104.

[00033] The digital camera 102 can capture images. For example, the images
106, 108, and 110 can be other images like the image 104. Each of the images
106, 108, and 110 also can represent a graphical face.
[00034] The computer system 112 can be configured to receive images transferred from a digital camera, such as the digital camera 102. The computer system 112 can be a computer (e.g., a desktop, a laptop, a server, etc.), a mobile telephone (e.g., a Blackberry), a PDA, or other such device. The computer system 112 can include hardware configured to execute one or more software applications. Further, the computer system 112 can include electronic storage media, such as random access memory (RAM), flash memory, and a hard drive. Additionally, the computer system 112 can include one or more communications interfaces capable of receiving digital information, such as images. The one or more communications interfaces can be wired or wireless.

[00035] The correlation system 114 can be configured to correlate graphical faces represented in images. The correlation system 114 can be implemented in software executing on a computer system (e.g., the computer system 112), hardware included in the computer system, or a combination thereof. The correlation system 114 can access images (e.g., digital images), analyze data associated with the images, and correlate two or more images determined to represent a common graphical face. For example, digital images can be analyzed and images including the same person can be associated with one another to form an image group.

[00036] The correlation system 114 can process the images 104, 106, 108, and 110, and generate one or more image groups. The image group 116 includes digital images, where each of the digital images represents a face corresponding to the same individual. An image group, such as the image group 116 can be a very large group of images (e.g., hundreds or thousands of images), a small group of images (e.g., ones or tens of images), or even a single image. Further, the same image can belong to multiple image groups. For example, an image including a person named Jack and another person named Mary can be included both in an image group associated with Jack and a different image group associated with Mary.

[00037] The image group 118 includes only one image. The image group 118 may include only one image for a variety of reasons, such as because the
individual is represented in only one image, the individual whose face appears in
the image has not yet been defined in the correlation system 114, or because the
individual in the image is not recognized as someone already defined in the
correlation system 114. Similarly, the image group 120 also can include only one
image.

[00038] In operation, the images 104, 106, 108, 110 can be transmitted from
the camera 102 to the computer system 112. The correlation system 114 can run
on the computer system 112 and process the images 104, 106, 108 and 110,
such as in response to a command received from a user or automatically in
response to the transmission of images. The correlation system 114 can
determine that image 106 and image 110 represent faces corresponding to the
same person, and thus group image 106 and image 110 together in image group
116. Image group 116 also can include images already stored on the computer
system 112 that represent the same person. Further, the correlation system 114
may not recognize one or more faces in an image, such as image 104 and image
108, and thus can create image groups containing only a single image, such as
image group 118 and image group 120. Images containing an unrecognized face
can be referred to as singletons. In some implementations, the correlation
system 114 can group some or all of the singletons in an image group.

[00039] FIG. 2 shows an exemplary system 200 for correlating graphical faces.
Correlating can involve various hardware and software components. Input, such
as images and identification information, can be received and used to correlate
faces represented in digital images. Further, the results of the correlating
process can be iteratively improved by receiving additional input and performing
additional correlation.

[00040] As shown in figure 2, the system 200 can include a digital camera 202.
The digital camera 202 can be similar to the digital camera 102 in figure 1.

[00041] A computer system 204 can be similar to the computer system 112 in
figure 1. In addition, the computer system 204 can include hardware and
software to receive and transmit information over a network (e.g., the network
206). The computer system 204 also can be configured to transmit information to and receive information from a storage device (e.g., the storage 210).

[00042] A correlation system 212 can be configured to correlate faces appearing in digital images. The correlation system 212 can include software and/or hardware components. Further, the correlation system 212 can be a stand alone software application or can be implemented as part of a larger software application. The correlation system 212 can be configured to run in the background. Alternatively or additionally, the correlation system 212 can include a user interface 214 that enables a user to actively perform one or more management and/or processing functions.

[00043] The user interface 214 can be, e.g., a graphical user interface (GUI), a command line interface, a tactile interface, or a network interface for receiving input from a remote user. The user interface 214 can include mechanisms for input and output of commands and data, including digital images. For example, a user can input commands and other information to manipulate the correlation system 212. The user interface 214 also can output information to the user through one or more interface screens.

[00044] The user input module 216 can be configured to receive, store, and process input from an external source. For example, the user input module 216 can receive input from a user identifying a person in a digital image. The identification can be used subsequently in identifying other images of the same person. In addition, input can be received from other applications having relevant information. For example, data from an address book application can be used. The data can include images, names, email addresses, etc. The data can be used to seed the system with names. When a user is identifying people, the system can suggest names from the address book. Furthermore, the data can be used to seed the system with named faces. The data can include associations between names and faces. Advantageously, the data can be used to begin suggesting names to users before they have positively identified anyone (e.g., a user can have an image of a contact in an address book and the information can be used to suggest images representing the contact).
User input also can be received through a network 206 (e.g., the Internet) from a remote server 208 (e.g., a website). For example, if a user uploads images to a social network site (e.g., Facebook), the user and the user's friends can identify faces in the images. The identifications can be received as input and used in correlating images. Differing levels of confidence can be assigned to input received through the network (e.g., identifications by a user can be more confidently relied upon than identifications by the user's friends).

A preprocessing module 218 can be configured to process an image prior to passing the image to a facial analysis engine 220. The preprocessing module 218 can perform functions including applying rules and heuristics that can improve the performance of the facial analysis engine 220. For example, the preprocessing module 218 can apply a rule stating that an individual can only appear in an image once.

The facial analysis engine 220 can be configured to detect and recognize one or more faces represented in images. The facial analysis engine 220 can receive an image and settings, and can detect whether the image represents a face corresponding to a person. The settings can include parameters that affect the operation of the facial analysis engine 220, such as thresholds indicating, e.g., the level of confidence the facial analysis engine 220 should have about a detection before providing information about the detection (e.g., to the post-processing module 222).

Further, the facial analysis engine 220 also can correlate faces by comparing a graphical face to other graphical faces to determine if they belong to the same person. The facial analysis engine 220 can be configured to use algorithms such as eigenface or fisherface, or techniques such as a neural network to perform facial recognition. Additionally, the facial analysis engine 220 can be implemented as a library of facial analysis tools, such as the tools provided by OMRON Corp. of Schaumburg, Illinois in the OKAO Vision suite.

The post-processing module 222 can be configured to receive information from the facial analysis engine 220. Further, the post-processing module 222 can apply rules based on the input received from the engine 220 to
improve the performance of the engine 220. For example, the post-processing module 222 can analyze an image to determine whether the portion of the image asserted by the facial analysis engine 220 to be a face is a skin tone or appears sharp. If one or both of the conditions is failed, the module 222 can disregard the detection of a face. Skin tone and sharpness are discussed more fully below with respect to FIG. 4. Further, the module 222 can resubmit information to the engine 220 for processing again with new settings based on the post processing.

[00050] An induction module 224 can use inductive reasoning to make educated guesses as to whom a face may belong. For example, if the induction module 224 believes that two images represent the face of the same person (e.g., as received from the post-processing module 222), and a user identifies the person in one images (e.g., as received from the user input module 216), the induction module 224 can induce that the other image is also of the same person.

[00051] A correlation module 226 can be configured to use the information provided by one or more of the other modules included in the correlation system 212 to correlate faces appearing in digital images. The correlation process can include organizing images into groups based on the faces represented in the images. In particular, a group can be formed that contains all of the images accessible to the system that are known or believed to belong to a certain individual.

[00052] FIG. 3 is a flow chart showing an exemplary correlation process 300. The correlation process 300 iteratively adjusts a correlation threshold to produce an acceptable number of groups of images. The groups can be referred to as "buckets." Each bucket can contain images believed to represent the same person. If the correlation threshold is set very high, the process 300 will not correlate two images unless it is virtually certain that the images represent the face of the same person. Thus, if the correlation threshold is set very high, more buckets with fewer images in each will be generated as some images of the same individual likely will not be correlated. If the correlation threshold is set very low, the process 300 can frequently correlate faces that may not correspond
to the same person. Thus, setting the correlation threshold to a low value can produce fewer buckets with more images in each. However, the likelihood is increased that two images will be correlated that do not represent a face corresponding to the same individual. Ideally, a bucket will include as many images as possible of the same person and few or no images that do not represent that person.

[00053] Images representing faces can be received (302). Further, the threshold can be set to a default value (304). The default value can be an intermediate value. Once the default value has been set, images can be correlated, such that images believed to represent the face of the same person are associated with a single bucket (306). If then can be determined whether the number of buckets generated is acceptable (308). If the number of buckets is acceptable (e.g., there are not substantially as many buckets as images and not very few buckets relative to the number of images), the process 300 can determine whether too many singletons are remaining (310). Singletons can be images containing one or more faces for which the process 300 cannot identify a corresponding person. Having too many singletons can be a sign that the threshold value is set too high and that faces thus are not being correlated appropriately with other images containing faces of the same person.

[00054] If it is determined that there are too few buckets, the threshold value can be increased (314). Increasing the threshold value requires the process 300 to have additional confidence that faces in a bucket belong to the same person. Once the threshold value is increased, the process 300 once again performs correlation of the images (306).

[00055] If it is determined that there are too many buckets, the threshold value can be decreased (316). In addition, if the process 300, at 310, determines that there are too many singletons (e.g., indicating the degree of confidence required to assign an image to a bucket is too high), the threshold value also can be decreased (316). Decreasing the threshold value allows the process 300 to correlate images based on a lower degree of confidence. Once the threshold
value is decreased, the process 300 once again performs correlation of the images (306).

[00056] If it is determined that there are an acceptable number of singletons (e.g., relative to the total number of images), the process 300 can continue by receiving user input (312). For example, the user input can include information about whose faces are represented in one or more images.

[00057] FIG. 3B is a flow chart showing an exemplary process 350 for setting an adaptive correlation threshold. A threshold value for correlation confidence can be set on a per bucket basis. Initially, the threshold can be set at a moderate value (352). The bucket size can increase (354). For example, more images can be added to the system or more faces in images can be identified as a given individual. As the bucket size increase, the threshold can be increased (356) making correlating faces for the particular bucket more difficult (relative to a lower threshold).

[00058] FIG. 3C is a flow chart showing an exemplary process 370 for testing a potential correlation. A potential correlation of a face in an image to a bucket can be examined (372). The examination can include determining whether the confidence value for the potential correlation is just (e.g., slightly) below the threshold requirement for including the image in a given bucket (374). If the confidence value is just below the threshold, a metadata test can be run (376). The test can include comparing, e.g., the source image’s histogram, exposure value, and capture date and time. Images taken close together in time and with similar histogram and exposure values can include the same subject matter and people. If it is determined that the metadata is similar (378) (e.g., indicating the image was taken at the same time as other images already in a bucket), the face can be correlated (382) with the bucket. In addition to or instead of comparing the histogram of the entire image, when an image represents multiple faces, the histogram of just the face area can be used for the test.

[00059] If, on the other hand, the confidence value is determined to not be just below the threshold (e.g., relative to a predetermined setting such as 10%), or in other words is significantly below the threshold, the correlation can be ignored.
Also, if it is determined that the metadata is not similar (378), the correlation also can be ignored (380).

[00060] FIG. 4A is a flow chart showing an exemplary detection elimination process 400. In some instances, a detection engine detects an area of an image that supposedly represents a face (i.e., a detection) but which in actuality does not represent a face. The process 400 can eliminate such false-positive detections.

[00061] The detection elimination process 400 can be initiated by receiving a detection confidence (402). The detection confidence can be a value provided by an analysis engine indicating how confident the engine is about the detection actually being of a face.

[00062] The process 400 continues by testing the detection for sharpness and skin tone (404). Sharpness can include analyzing whether a face appears sharp in an image. Blurriness can result from a lack of either or both of actual or apparent sharpness. For example, a lack of actual sharpness can be result from improper camera focus or movement of the camera or subject at the time a picture is taken. Apparent sharpness can refer to the acutance (i.e., edge contrast) of an image. Acutance is related to the amplitude of the derivative of brightness with respect to space. An image with higher acutance can appear sharper and be more appealing to a user even if the image does not have a higher resolution or actual sharpness than an image with lower acutance. Image processing techniques, such as unsharp masking, can increase the acutance in images but may at the same time decrease actual sharpness. Either or both of actual and apparent sharpness can be evaluated to determine whether the detection is blurry.

[00063] The process 400 also can determine whether the detection represents a potential skin tone (404). Skin tones can be colors corresponding to the range of human skin colors as determined, e.g., in images by the pigmentation of the subject, the lighting and the camera exposure. For example, a detection representing bright green hues is unlikely to correspond to a face.
The process 400 continues by determining whether the detection confidence is relatively high (406). The determination can be based on comparing a value representing the detection confidence with predetermined values. For example, 1000 can represent the highest confidence that a detection represents a face. It can be determined that confidence values higher than 800 are high.

If the detection confidence is high, the process 400 continues and in anticipation of an evaluation of whether the detection is valid (412), weighs the sharpness and skin tone tests less relative to the confidence (408). If the detection confidence is high, the process 400 continues and, again, anticipation of an evaluation of whether the detection is valid (412), weighs the sharpness and skin tone tests more relative to the confidence (410).

The process 400 continues by determining whether the detection is valid (412). The determination can be made based on the confidence value and results of the sharpness and skin tone tests. When the confidence value is determined to be high (406), the sharpness and skin tone tests can be weighted less (408) in the determination. In contrast, when the confidence value is determined to be low (406), the sharpness and skin tone tests can be weighted more (410) in the determination. Although the exemplary process 400 uses a binary determination with respect to the detection confidence being high (406), some implementations can proportionally factor in detection confidence and the results of graphical tests based on their relative values. The result can be a sliding scale in which the weight given to graphical tests depends on where the detection confidence lies on a scale from low to high (e.g., where at the highest confidence, the test are weighted very little relative to the confidence).

In addition to sharpness and skin tone tests, some implementations can use other factors in determining whether a detection is correct. For example, a detection engine may provide information about the angle at which the detected face appears relative to the image. If the image represents multiple faces, and one of the faces is upside down relative to the other faces, the upside down detection can be considered less likely to be valid. Other factors can
influence the determination, such as circumstances that rarely occur given a correct detection.

[00068] The process 400 continues by eliminating a detection (414) determined to not be valid (412). Elimination can include, e.g., deleting the detection from memory, associating the detection with a suppression indication, or storing the detection in a list of false positives.

[00069] If the detection is determined to be valid (412) or after an invalid detection is eliminated (414), the process 400 ends.

[00070] FIG. 4B is a flow chart showing an exemplary correlations elimination process 450. An image can be correlated with other images based on indications that the image represents a face corresponding to an individual that also appears the other images. Examining the correlations can reveal situations that are unlikely to occur and provide a basis for eliminating the correlations. Advantageously, eliminating correlations determined to be unlikely can improve the quality of information provided to users. For example, two faces appearing in the same image can be correlated to the same individual. Since images rarely represent two faces that correspond to the same individual, eliminating the less likely correlation (e.g., as determined by an identification confidence score) can result in eliminating a correlation likely to be invalid. Thus, the elimination can improve the accuracy of the correlations overall.

[00071] The correlations elimination process 450 can be initiated by correlating faces (452). In general, correlating faces can include extracting features in an image that potentially identify a face. The features can then be compared to features of other faces to identify which faces correspond to the same person. In specific, correlating can include giving a same face key (e.g., unique identifier) to two or more faces. Potentially each face having the same face key corresponds to the same individual. A group of faces having the same face key can be referred to as a bucket. Correlating also can include giving an image key to each face to identify the originating image for the face. In some implementations, correlating faces (402) occurs on an image by image basis. Doing so can allow invalid correlations to be eliminated before buckets are updated.
Correlating faces also can be done by the user. For example, a user can identify a graphical face. The face may have already been believed to be of a different individual and grouped in a bucket which is inconsistent with the information provided by the user.

The correlations can be examined (454). Examining correlations can include comparing face keys and image keys. Examination can result in discovering unlikely correlations. If it is determined that certain correlations are unlikely (456), the correlations can be eliminated (458). Elimination can include deleting the correlation from memory, associating the correlation with a suppression indication, or storing the correlation in a list of false positives. If it is determined that the correlations are not unlikely (456) or the unlikely correlations are eliminated (458), the process 450 ends.

For example, correlating faces can result in two faces from the same image being assigned the same face key. Since it is rare that an image represents two faces corresponding the same individual, the less likely correlation (e.g., determined by confidence value) can be eliminated. Furthermore, if a face belongs to a bucket (e.g., as assigned by a correlation system), but then is removed by a user, the remaining faces in the bucket may also be erroneously correlated and can, e.g., be reevaluated.

FIG. 5 is a diagram of an exemplary user interface 502 for displaying correlated faces. A user can provide information about the faces shown in one or more images displayed in the user interface 502. This positive identification provided by the user can be the basis of grouping images of one or more individuals. In addition, a correlation system can determine that other images for which the user has not provided information likely represent a known individual. Rather than adding the images to a group of positively identified images, the correlated images can be provided in a separate area of a user interface. Advantageously, the user can obtain the benefit of automatic correlation while at the same time not having to accept a correlation system's determinations.

The user interface 502 allows a user to receive information from a correlation system. The user interface 502 can include graphical, textual, and/or
auditory information presented to the user, and the mechanism by which control sequences (e.g., keystrokes with the computer keyboard, movements of the computer mouse, and selections with the touchscreen) are received from the user. The user interface 502 can be a graphical user interface (GUI) and can accept input via devices such as a computer keyboard and a mouse, and can provide graphical output on one or more output devices, such as a computer display (e.g., liquid crystal display (LCD) monitor). The user interface 502 also can be a web-based user interface or a web user interface (WUI), and can accept input and provide output by generating web pages which are transmitted via the Internet and viewed by the user using a web browser (e.g., Microsoft Internet Explorer). The user interface 502 also can be implemented to include a tactile interface that supplements or replaces other forms of output with haptic feedback. The user interface 502 also can be or can include a touch interface using a touchscreen display as a combined input and output device.

[00077] A menu 516 represented in the user interface 502 can provide a way for a user to access the face-display functionality of a correlation system. For example, a user can click the faces option 518 on the menu 516 and be presented with a list of individuals already available in the system (not shown). Further, the user can select an individual from the list of individuals to see images containing the individual's face. Also, when the faces option 518 is selected, the user interface can display one or more of the individuals represented in the system.

[00078] The face display area 512 of the user interface 502 can include one or more images associated with a given individual. The exemplary face display area 512 is associated with an individual named James and includes two images 504 and 506 corresponding to James. The area 512 can include zero (e.g., if a profile for an individual has been created but no corresponding images have been identified), one, or many images of an individual. Further, one or both of the images 504 and 506 can include faces that were positively identified by a user as James. In addition faces being positively identified by a user, the area
512 also can include faces identified by the correlation system without input from
the user (e.g., faces identified by the system with a high degree of confidence).

[00079] The correlation display area 514 can include one or more images that
the correlation system has determined likely represent the same individual
displayed in the images included in the face display area 512. The user can
positively identify one or more of the images as corresponding to James. The
user also can simply leave system-identified images in the area 514 as a
convenient way of seeing more images of an individual without having to
positively identify each face in each image. This can allow significant time saving
given that the user may have thousands of images on their computer. For
example, image 508 can be an image of James that is displayed along with other
images of James even though the user has never positively identified the face in
the image 508 as corresponding to James. Alternatively, the image 510 can
represent a face that is not James and the user can negatively identify the face
as not being that of James. In this way, for correlation systems that make the
majority of determinations correctly, a user can save additional time by positively
identifying some faces and then subsequently only negatively identifying
mismatched images.

[00080] The images for the correlation display area 514 can be selected using
buckets. For example, if a face in a bucket is positively identified, the remaining
faces in the bucket can be displayed in the correlation display area 514, since it
is believed they correspond to the same individual.

[00081] FIG. 6A is a diagram of an exemplary user interface 602 for receiving
user input. In general, a user interface can be provided that indicates both that
the system has found a face in an image and that the system has potentially
identified the person corresponding to the face.

[00082] The user interface 602 can display an image containing the face of a
person 606. A marker 604, such as a rectangle or other such outline, can be
used to indicate where in the image the face is believed to be. The user interface
602 can prompt a user to provide input through a dialogue box 608 confirming
the identity of a person (e.g., James) or otherwise providing identifying
information. In some implementations, the dialogue box 608 can include a "Yes" option 610 and "No" option 612 to allow the user to indicate whether the face belongs to James. The dialogue box 608, providing only confirmation options 610 and 612, can be provided when the correlation system is very confident about the identity of the person 606 shown. When the user selects one of the options 610 and 612, the correlation system can use the information (e.g., learn from it) to perform more accurate correlation in the future. The system also can reevaluate determinations already made based on the new information.

[00083] FIG. 6B is a diagram of an exemplary user interface 652 for receiving user input. In general, the user interface 652 can be configured to indicate that the system has found a face in an image and to suggest one or more potential identities of the face.

[00084] The user interface 652 can display an image containing the face of a person 656. A marker 654 can be used to indicate where in the image the face is believed to be located. The user interface 652 can request input from the user through a dialogue box 658 indicating that the face is not yet identified and suggesting the names of one or more potential matches in the system. For example, the dialogue box 658 can include a selectable "James" option 660 showing the name and a small thumbnail or other such icon associated with James. If the system also thinks the face could belong to William, a selectable William option 662 can be provided. If the person shown in the image is not yet identified in the system, a Create New Person option 664 can be provided. Upon selecting the Create New Person option 664, the user can enter the name of the individual corresponding to the image and any other information to create a profile that can be used subsequently to group images. The dialogue box 608 also can include an Ignore option 668 in case the user does not want to provide input corresponding to the represented individual.

[00085] FIG. 6C is a diagram of an exemplary user interface 672 for receiving user input. In general, the user interface 672 can be configured to receive input regarding the identity of a face.
The user interface 672 can display an image containing the face of a person 676. The face can be located in the image by a correlation system or by a user. For example, a user could click on the face of the person 676 if the system did not discover a face in the image. In such a case, the system would not have information resulting for an automatic recognition. However, after indication by a user of a face's location, the system can use the location to re-run an analysis process. The process can potentially require less confidence about the face's existence since the user has indicated a face does exist in the area. A face also can be detected by the system, e.g., in response to being loaded into the system without user input.

A marker 674 can be used to indicate a particular face in an image. The marker 674 can distinguish a face from other faces when an image represents multiple faces. A user can dismiss the marker 674 by clicking on the X 680 associated with the marker 674. A user may wish, for example, to dismiss a marker 674 when the system incorrectly identifies something as a face that does not actually represent a face.

The user interface 672 can request input from the user through a dialogue box 678. For example, the system can request input when an individual is unknown to the system. When a user begins typing in text box 682, the system can provide an options menu 684 listing people in the system matching what the user has typed. For example, if the user types "ja" into the text box 682, the system can provide an options menu 684 listing "Jack" and "James" since both names match the "ja" type by the user. The user can then click on one of the names, such as the name Jack 686, to identify the person 676 by the name. The dialog box 678 can be dismissed, e.g., without the user entering a name by the user clicking the X 680 associated with the face marker 674. The dialog box 678 also can include a mechanism for being dismissed, such as an X in the upper right corner (not shown).

FIG. 7 is a diagram of an exemplary user interface 702 for creating one or more albums. An albums can be a groups of images based on a theme, such as a particular individual or group of individuals. For example, a parent can
make an album of images showing both of her children (i.e., an "and" album). Thus, each image in the album represents both children. In addition, the parent also can make an album of images showing either of her two children (i.e., an "or" album). Thus, each image in the album represents at least one of the two children.

[00090] The user interface 702 can include a menu 704 configured to allow a user to navigate within the user interface 702. The user interface 702 also can include one or more individuals, such as the two identified individuals 708 and 710. A James album 708 is shown with information 712 providing his name, "James," and the number of images (e.g., photos) in which he is pictured, 14. A cover image 713 for the James album 708 also can be displayed. The cover image can be selected by a user or automatically selected based on one or more criteria, such as the image quality of the detected face or the number of times the image has been viewed. A Bert album 710 is similarly shown with information 714 providing his name and the number of images (e.g., photos) contained in the album.

[00091] In operation, to create a new smart album that includes images from both the James album 708 and the Bert album 710, a user can drag 716 the James album 708 to the Smart Albums area 706 of the menu and drop the James album 708. The user also can drag 718 the Bert album 710 to the Smart Albums area 706 and drop the Bert album 710 there as well. By dragging both albums 708 and 710, the system can create either an album of pictures including both people together or an album of pictures including either person. When an album associated with a named individual is dropped in the Smart Albums area 706, one type of album or the other can be created by default. Alternatively, the user can be prompted to choose the type of album to be created.

[00092] FIG. 8 is a diagram of an exemplary user interface 802 for receiving user input. In general, a correlation system can group images believed to represent the same person together into a single bucket. A user interface 802 can be provided for modifying the buckets, such as to combined two buckets that each contain images of the same person. Some implementations include the
bucket concept shown in FIG. 8 but do not include a user interface (e.g., the user interface 802) for modifying or otherwise interacting with buckets.

[00093] The user interface 802 can include a menu 818 for navigating the user interface 802. Selecting the buckets option 820 in the menu 818 can cause an interface 802 for modifying one or more buckets to be displayed. For example, a correlation process can generate three buckets 804, 806, and 808. A user may have identified the first bucket 804 as having images of a particular person (e.g., James). The interface 802 can display information 810 about the named individual such as his or her name and the number of images (e.g., photos) in the first bucket 804. The first bucket 804 also can include an icon 822 displaying the individual. Similarly, the interface 802 can display an icon 824 and information 812 corresponding to the second bucket 806 and an icon 826 and information 814 corresponding to the third bucket 808.

[00094] In operation, a user can drag 816 the third bucket 808 to another bucket, such as the first 804, to merge the buckets. In addition to consolidating two groups of images, merging the first bucket 804 with the third bucket 808 also can provide additional information to the system. For example, the system can refine recognition criteria associated with James based on the additional images contained in the third bucket 808. If two buckets are named inconsistently, standard merging rules can be employed (e.g., requiring the user to choose which name is correct for the resulting merged bucket).

[00095] FIG. 9 is a diagram showing exemplary correlation techniques. By grouping images in buckets, a correlation system can use inductive reasoning to make determinations about the bucket as a whole from information known about individual members of the bucket.

[00096] A group of images 902 can be processed by a correlation system. The group of images 902 can represent the faces of individuals. During the correlation process 904, the group of images 902 can be divided and assigned to buckets 906, 908 or 910. Each image of the group of images 902 is assigned to a bucket, such as one of the buckets 906, 908, and 910. Potentially, one or more
of the group of images 902 could be assigned to multiple buckets (e.g., if an image represents two or more people).

[00097] After correlation 904, bucket A 906 includes image 1 912, image 3 914, image 4 916, and image 5 918. Each of the images represents, based on a threshold confidence level, the face of the same individual. Further, Bucket B 908 includes image 2 920, image 6 922, and image 8 924. Additionally, Bucket C 910 includes image 7 926 and image 9 928. Each of the buckets 906, 908, and 910 can be created based on the same correlation criteria.

[00098] In operation, the correlation system can present 930 to the user image 1 912. The user can request to see image 1 912 or can be prompted with the image 1 912. Once image 1 912 has been presented, the user can respond 934. Responding can include, for example, clicking on an option in a dialog box presented to the user through a user interface (e.g., the dialog 658 shown in FIG. 6B). Responding also can include a positive identification (ID) 932 of the face in image 1 912. The positive ID 932 can then be used to determine, e.g., that image 3 914 is of the same individual. Thus, based on the established confidence level, identification of one image in a bucket can be used to identify each of the remaining images in that bucket. Similarly, the correlation system can present 942 to the user image 7 926. The user can respond 946 and provide a positive ID 944 of the face in image 7 926. The positive ID 944 can then be used to determine, e.g., that image 9 928 is of the same individual whose identity was confirmed in the identification 944.

[00099] Further, the correlation system can present 936 to the user image 2 920. The user can respond 940 and provide a negative ID 938 indicating that the face in image 2 920 is not of a particular individual. The ID 938 can be used to determine, e.g., that image 6 922 also is not of the individual identified 938.

[000100] The correlation system also can combine one or both of the positive and negative information provided by the user to make further determinations. For example, if the positive IDs 932 and 944 are for the same individual, it can be determined that image 9 928 and image 3 914 are potentially the same individual. In addition, if the negative ID 938 is for the same individual as the
positive ID 932, it can be determined that image 6 922 is likely not the same individual shown in image 3 914.

[000101] FIG. 10 is a diagram showing selection of an album cover. An albums can be a group of images based on a theme. For example, a named individual can have an album 1002 of all images 1034 of the individual. A user can select one of the images 1004 from the album to be the cover (e.g., the image used to graphically identify the album). Alternatively, the album cover can be automatically selected from the album 1002, such as the first image. However, when a user has not selected an image, the first image may not be the best representation of the person to use for the cover. Thus, a satisfactory cover image can be selected based on data characterizing the images without user input. In some implementations, a cover image also can be automatically cropped to emphasize the face of the individual associated with the album.

[000102] In operation, a cover can be selected using information known about the images 1034 in an album 1002. For example, image 1004 can include image data 1006. There can be multiple types of image data 1006, such as graphical data 1012, metadata 1020, and analysis data 1028. The graphical data 1012 can include, e.g., the resolution 1008 of the image and sharpness 1010 of the face represented in the image. A higher resolution image can look better than a low resolution image. Similarly, a sharp (e.g., in focus) face can look better than a blurry face.

[000103] The metadata 1020 can include the date the image was taken 1014, a rating 1016, and a log of web posting 1018. The date 1014 can be used to determine if the image is relatively recent, both temporally and relative to other images in the album. The rating 1016 can be a rating indicating one or more users valuation of the image. The web posting log 1018 can include information about, e.g., the user uploading the image to a social network website, which can, in turn, indicate that the user thinks more highly of the image.

[000104] The analysis data 1028 can include the distance 1022 from other faces also in the image 1004, confidence 1024 (e.g., of the recognition or detection), and the face angle 1026. The distance 1022 can be helpful if a face is to be
automatically cropped for the cover. If a face if very close to one or more other faces, automatic cropping can result in a portion of someone else's face being represented in the cover or the subject's face being too tightly cropped. The confidence 1024 can indicate how likely it is that a face actually corresponds to the subject in question. Thus, the album cover can be an image determined by the correlation system to represent the face of the subject rather than a face which was positively identified by the user. In addition, even when the image has been positively identified by a user, the confidence 1024 can help determine if an image is representative of the individual by assessing how closely correlated the image is to others in the album 1002. Additionally, the face angle 1026 can be used to help select, e.g., a face that is directly facing the viewer rather a profile.

[000105] The various images 1034 in the album can be compared 1030 using, e.g., the components of the image data for each of the images. Based on the comparison 1030, a cover can be selected 1032 that is visually appealing and representative of the group of images 1034.

[000106] Implementations of the subject matter and functional operations described in this specification can be implemented in electronic circuitry, computer software, firmware, or hardware, or in combinations or equivalents thereof. The subject matter can be implemented as one or more computer program products, such as one or more computer programs tangibly embodied in a device or medium, including a machine-readable storage device, or a machine-readable storage medium. Machine-readable includes optically readable, such as involving optically readable physical marks made on a substrate that are readable with the aid of light. Machine-readable also includes magnetically interpretable storage or recording involving physical patterns made in a magnetizable material. Computer program products can be used for execution by, or to control the operation of data processing apparatus, including one or more processors, or computers. The data processing apparatus can include any of hardware, processor firmware, a protocol stack, a database management system, and an operating system.
A computer program (also known as a program, software, software application, or code) can be written in a programming language, including compiled or interpreted languages, and deployed in various forms, including as a stand-alone program or as a module, component, subroutine, or other unit suitable for use in a computing environment. A computer program does not necessarily correspond to a file. A computer program can be stored in a portion of a file that holds other programs or data, in a single file dedicated to the program in question, or in multiple coordinated files (e.g., files that store one or more modules, sub-programs, or portions of code). A computer program can be executed on one computer or on multiple computers at one site or distributed across multiple sites and interconnected by a communication network, such as a network or internetwork of networks (e.g., the Internet).

The processes and logic flows described in this specification can be performed by computer program products operating on input data and generating output. Processors suitable for the execution of a computer program product include general and special purpose microprocessors, and one or more computer processors. A processor can receive, retrieve and execute instructions and data from read-only memory, random access memory or both.

A computer can include a processor for executing instructions and one or more memory devices for storing instructions and data. A computer also can include, or be operatively coupled to receive data from or transfer data to, or both, one or more mass storage devices for storing data, e.g., magnetic, magneto-optical disks, or optical disks. A computer can be embedded in another device, such as a mobile telephone, a digital camera, a digital scanner, a digital video recorder, a personal digital assistant (PDA), a mobile audio player, or a Global Positioning System (GPS) receiver. Machine-readable storage devices or storage media suitable for embodying computer program instructions and data can include non-volatile memory, such as semiconductor memory devices (e.g., EPROM, EEPROM, and flash memory devices), magnetic disks (e.g., internal hard disks or removable disks), magneto-optical disks, and CD-ROM and DVD-
ROM disks. The processor and the memory can be supplemented by, or incorporated in, special purpose logic circuitry.

[0001 10] User interaction can be implemented on a computer or other device having a display device, e.g., a CRT (cathode ray tube) or LCD (liquid crystal display) monitor, for displaying information to the user, and any form of input device, e.g., keyboard and a pointing device, e.g., a mouse or a trackball, by use of which the user can provide input. Other kinds of devices can be used to provide for interaction with a user as well; for example, feedback provided to the user can be any form of sensory feedback, e.g., visual feedback, auditory feedback, or haptic feedback; and input from the user can be received in any form, including acoustic, speech, or haptic input.

[0001 11] A number of implementations have been disclosed herein. Nevertheless, it will be understood that various modifications may be made without departing from the spirit and scope of the claims. Accordingly, other implementations are within the scope of the following claims.
What is claimed is:

CLAIMS

1. A computer-implemented method for organizing images, the computer-implemented method comprising:
   - receiving an image that includes a representation of a human face;
   - generating a correlation value indicating a likelihood that the human face corresponds to a stored facial profile associated with one or more profile images including a human face;
   - evaluating the received image and the generated correlation value to determine, depending on a result of the evaluating, whether the image corresponds to the stored facial profile;
   - associating the received image with the stored facial profile; and
   - storing an indication of the associating.

2. The computer-implemented method of claim 1, wherein the correlation value indicates that the image corresponds to another stored facial profile, and wherein evaluating further comprises evaluating first metadata of the image and second metadata of the one or more profile images.

3. The computer-implemented method of claim 1, further comprising:
   - obtaining the one or more profile images and profile information associated with the one or more profile images from an address book application;
   - and
   - generating the stored facial profile based on the one or more profile images and the profile information.

4. The computer-implemented method of claim 1, further comprising:
   - prompting, based on the evaluating, a user for confirmation that the human face corresponds to the stored facial profile; and
   - accepting, in response to the prompting, confirmation that the human face corresponds to the stored facial profile.
5. The computer-implemented method of claim 4, wherein accepting further comprises accepting via a user interface having an affirmative response option and a negative response option.

6. The computer-implemented method of claim 1, further comprising:
   accessing detection information indicating less than a 90% likelihood that the image represents a human face;
   establishing that the image depicts skin-tone colors and sharp image details; and
   confirming, based on the establishing, that the image represents a human face.

7. The computer-implemented method of claim 6, further comprising:
   selecting the image as a key image based on one or more of the detection information, the image, or the correlation value; and
   displaying the key image as an icon for the stored facial profile.

8. The computer-implemented method of claim 7, wherein the image comprises one or more of a sharpness indication, a capture date, or an image resolution of the image.

9. The computer-implemented method of claim 7, wherein the detection information comprises one or more of a distance from the human face to another human face depicted in the image, or an angle of the human face relative to the image.

10. The computer-implemented method of claim 1, wherein the human face comprises a first human face, the computer-implemented method further comprising:
    deriving a potential correspondence between a second human face, represented in the image, and the stored facial profile; and
    ignoring the derived potential correspondence based on the correlation value and the first human face corresponding to the stored facial profile.
11. The computer-implemented method of claim 1, further comprising:

receiving unsorted images representing human faces, unsorted image information, and unsorted correlation values indicating likelihoods that the human faces correspond to the stored facial profile;

establishing an initial correlation value threshold;

grouping the unsorted images based on the initial correlation value threshold and the unsorted correlation values;

 deriving a revised correlation threshold based on amounts of unsorted images grouped together and a total number of groups of unsorted images;

regrouping the unsorted images based on the revised correlation threshold and the unsorted correlation values; and

associating one or more groups of unsorted images with the stored facial profile based on the regrouping.

12. The computer-implemented method of claim 1, wherein the stored facial profile comprises a first stored facial profile and the human face comprises a first human face, the computer-implemented method further comprising:

presenting the first stored facial profile and a second stored facial profile in a user interface, wherein the second stored facial profile includes one or more images representing a second human face;

receiving an indication in the user interface associating the first stored facial profile with the second stored facial profile; and

 generating a combined album including one or more profile images from the first stored facial profile and the second stored facial profile.
13. A system comprising:
   a user interface device;
   a storage device operable to store executable software instructions and image data; and
   one or more computers operable to interact with the user interface device and the storage device, and to perform operations comprising:
   receiving an image that includes a representation of a human face;
   generating a correlation value indicating a likelihood that the human face corresponds to a stored facial profile associated with one or more profile images including a human face;
   evaluating the received image and the generated correlation value to determine, depending on a result of the evaluating, whether the image corresponds to the stored facial profile; and
   displaying, using the user interface device, the received image in association with the stored facial profile.

14. The system of claim 13, further comprising:
   an external input operable to receive data, and to perform input operations comprising:
   obtaining the one or more profile images and profile information associated with the one or more profile images through the external input.

15. The system of claim 14, the operations further comprising:
   generating the stored facial profile based on the obtained one or more profile images and the profile information.

16. The system of claim 14, wherein the external input comprises an address book application adapter for obtaining the one or more profile images and the profile information from an address book application.
17. The system of claim 13, the operations further comprising:
   prompting, based on the determining, a user via the user interface device for confirmation that the human face corresponds to the stored facial profile; and
   accepting, in response to the prompting, confirmation via the user interface device that the human face corresponds to the stored facial profile.

18. The system of claim 13, the operations further comprising:
   selecting the image as a key image based on one or more of the image or the correlation value; and
   displaying the key image as an icon in association with the stored facial profile.

19. The system of claim 18, wherein the image comprises one or more of a sharpness indication, a capture date, or an image resolution of the image.

20. The system of claim 13, wherein the human face comprises a first human face, the operations further comprising:
   deriving a potential correspondence between a second human face, represented in the image, and the stored facial profile; and
   ignoring the derived potential correspondence based on the correlation value and the first human face corresponding to the stored facial profile.
21. The system of claim 13, further comprising:

receiving unsorted images representing human faces with associated correlation values indicating likelihoods that the human faces correspond to the stored facial profile;

establishing an initial correlation value threshold;

grouping the unsorted images based on the initial correlation value threshold and the associated correlation values;

deriving a revised correlation threshold based on numbers of unsorted images grouped together and a total number of groups of unsorted images;

regrouping the unsorted images based on the revised correlation threshold and the unsorted correlation values; and

associating one or more groups of unsorted images with the stored facial profile based on the regrouping.

22. The system of claim 13, wherein the stored facial profile comprises a first stored facial profile and the human face comprises a first human face, the system further comprising:

presenting the first stored facial profile and a second stored facial profile through the user interface device, wherein the second stored facial profile includes one or more images representing a second human face;

receiving an indication through the user interface device to associate the first stored facial profile with the second stored facial profile; and

generating a combined album including one or more profile images from the first stored facial profile and the second stored facial profile.
23. A computer program product comprising a computer useable medium having computer readable instructions therein for organizing images by correlating faces, the computer program product comprising computer readable instruction devices configured to cause a computer system to:

- receive an image including a human face;
- generate a correlation value indicating a likelihood that the human face corresponds to a facial profile;
- determine, using the image and the facial profile, that the image corresponds to the facial profile; and
- store the image in association with the facial profile.

24. The computer program product of claim 23, additionally comprising computer readable instructions configured to cause the computer system to:

- prompt a user for confirmation that the human face corresponds to the facial profile; and
- accept, in response to prompting, confirmation that the human face corresponds to the facial profile.

25. The computer program product of claim 23, wherein the human face comprises a first human face, the computer program additionally comprising computer readable instructions configured to cause the computer system to:

- derive a potential correspondence between a second human face, represented in the image, and the facial profile; and
- ignore the derived potential correspondence based on the correlation value and the first human face corresponding to the facial profile.
26. The computer program product of claim 23, additionally comprising computer readable instructions configured to cause the computer system to:

- receive unsorted images representing human faces, unsorted image information, and unsorted correlation values indicating likelihoods that the human faces correspond to the facial profile;
- establish an initial correlation value threshold;
- group the unsorted images based on the initial correlation value threshold and the unsorted correlation values;
- derive a revised correlation threshold based on amounts of unsorted images grouped together and a total number of groups of unsorted images;
- regroup the unsorted images based on the revised correlation threshold and the unsorted correlation values; and
- associate one or more groups of unsorted images with the facial profile based on the regrouping.

27. The computer program product of claim 23, wherein the facial profile comprises a first facial profile and the human face comprises a first human face, the computer program additionally comprising computer readable instructions configured to cause the computer system to:

- present the first facial profile and a second facial profile in a user interface, wherein the second facial profile includes one or more images representing a second human face;
- receive an indication in the user interface associating the first facial profile with the second facial profile; and
- generate a combined album including one or more profile images from the first facial profile and the second facial profile.

28. The computer program product of claim 23, additionally comprising computer readable instructions configured to cause the computer system to:

- receive one or more profile images representing the human face; and
- associate the one or more profile images with the facial profile.
29. The computer program product of claim 28, wherein to determine comprises to determine that the correlation value indicates the image corresponds to other than the facial profile, and that the image information, including first metadata, corresponds to second metadata associated with the one or more profile images.

30. The computer program product of claim 28, additionally comprising computer readable instructions configured to cause the computer system to:
   obtain the one or more profile images and profile information associated with the one or more profile images from an external source; and
   generate the facial profile based on the one or more profile images and the profile information.

31. The computer program product of claim 30, wherein the external source comprises a user interface.

32. The computer program product of claim 30, wherein the external source comprises an address book application.

33. The computer program product of claim 23, further comprising:
   accessing detection information indicating less than a 90% likelihood that the image represents a human face;
   establishing that the image depicts skin-tone colors and sharp image details; and
   confirming, based on the establishing, that the image represents a human face.

34. The computer program product of claim 33, additionally comprising computer readable instructions configured to cause the computer system to:
   select the image as a key image based on one or more of the image information, the detection information, or the correlation value; and
   display the key image as an icon in association with the facial profile.
35. The computer program product of claim 33, wherein the image information comprises a capture date.

36. The computer program product of claim 33, wherein the detection information comprises an angle of the human face relative to the image.
350

Start

Set Threshold at Moderate Value

Increase Bucket Size

Increase Threshold

FIG. 3B
Start

Examine Potential Correlation

No
Just Below Threshold?

Yes
Run Metadata Test

No
Similar Metadata?

Yes
Correlate Face

Ignore Correlation

FIG. 3C
Start 400

Receive Detection Confidence 402

Test Sharpness and Skin Tone 404

Confidence High? 406

Yes

Weight Tests Less Relative to Confidence 408

No

Weight Tests More Relative to Confidence 410

Detection Valid? 412

Yes

End

No

Eliminate Detection 414

FIG. 4A
Start

Correlate Faces 452

Examine Correlations 454

Unlikely Correlations? 456

Yes

Eliminate Unlikely Correlations 458

End

No

FIG. 4B