SYSTEMS AND APPARATUS FOR BIOMETRIC ENROLMENT AND AUTHENTICATION

Technical Field

The present invention relates to self-service operated identity registration and verification systems. In particular, the present invention relates to a self-service operated fingerprint collection apparatus.

Background Information

This background description is provided for the purpose of generally presenting the context of the disclosure. Contents of this background section are neither expressly nor impliedly admitted as prior art against the present disclosure.

Systems for verifying the identity of an individual are now becoming widely employed for security purposes. In particular, systems for verifying the identity of an individual via a self-service operated means, such as that in an unattended machine, are preferred, to enhance the security of a location or to allow access to certain restricted zones.

Known techniques used for authentication purposes include the use of passwords, tokens, biometrics or any combination of these. The current process of enrolment is counter based and decentralised like an assembly line. This requires a large number of service officers to operate each biometric capture station.

Consequently, the entire process cannot be completed in a single pass. An applicant must queue for each station to capture a single biometric modality. This process may take an applicant several hours to complete.

Moreover, without proper guidance, it can be difficult for users to ensure they have reliably captured biometric information in a repeatable way – i.e., such that subsequent provision of biometric information to access an area, will reliably compare with their registered biometric information.

An example of a biometric information indicator collected is that of rolled fingerprints. Rolled fingerprints cover a larger surface area than plain impressions of a flat fingerprint, in which a finger is pressed straight down, and only the centre of the fingerprint is captured, while the sides and tip are omitted. Rolled fingerprints provide an impression capturing the fingerprint surface from one edge of a fingernail to the other. While the collection of rolled fingerprints provides an accurate means of biometric identification, an operator must be well trained to collect good quality impressions, as the process is slow, detailed and requires careful manipulation of each of the subject's fingers.

There is hence a need for a self-service operated machine which can replace the need for human assistance, and to significantly reduce the cost of labour. A self-service operated machine may also extend the operating hours of a biometric enrolment process to beyond office hours, since it allows for unattended operation.

Summary

Disclosed herein is a fingerprint collection apparatus, comprising:

an imaging plate;

an image capture device; and

a movable hand grip, the hand grip being positioned relative to the plate to be gripped by a hand of a user while a finger of the hand is positioned on the plate for image capture of a fingerprint of the finger by the image capture device, the hand grip being movable to control rolling of the finger on the plate during image capture.

The hand grip may thus be movable by pivoting around an axis during rolling of the hand.

In some embodiments, the hand grip is movable to rotate about a first axis during image capture, the apparatus further comprising a swivel mechanism rotatable about a second axis, perpendicular to the first axis, to position the hand grip for image capture.

In some embodiments, the swivel mechanism is rotatable between a plurality of discrete image capture positions.

In some embodiments, the swivel mechanism is rotatable in a continuous fashion between a first angle and a second angle.

In some embodiments, the fingerprint collection apparatus further comprises a shield positioned at least between the user and the movable hand grip, over a plurality of image capture positions as defined by the swivel mechanism.

Further disclosed herein is a system for registering an identity of a user, comprising:

a verification module for verifying presence of a single user positioned at the system for biometric information capture;

two or more biometric information collectors, each collecting a respective biometric information indicator, wherein a first of the biometric information collectors is an image capture module for capturing an image of a biometric information indicator comprising a face of the single user and a second of the biometric information collectors is an apparatus as described above;

a quality assurance module for making an assessment of usability of each biometric information indicator and the image and providing an output of the assessment; and

a security module for storing the image and each biometric indicator in association with an identity of the single user in a database.

Further disclosed herein is a system for verifying an identity of a user, comprising:

the system for registering an identity of a user; and

a verifier for verifying an identity of the user by comparing each biometric information indicator and the image to identification information for the user, stored in the database.

In some embodiments, each biometric information indicator and the image is used for registration or verification of at least one of: flat fingerprint, rolled fingerprint, face, iris and voice features of the user.

In some embodiments, each biometric information collector is configured to collect information by means of at least one of: a pressure sensor, a laser, a LiDAR sensor,

a proximity sensor, an optical sensor, a series of 3D scanners and a temperature sensor.

In some embodiments, presence of a single user is controlled after verification, by means of an automated swing door.

In some embodiments, the system further comprises a feedback module for providing audio and/or visual feedback when the output of the quality assurance module states the biometric information indicator and/or the image lacks usability.

In some embodiments, the system is configured to provide haptic feedback to the user, the haptic feedback guiding or confirming capture of the fingerprint.

Brief Description of the Drawings

Some embodiments of the present invention of a fingerprint collection apparatus, in accordance with the present disclosure, will now be described, by way of non-limiting example only, with reference to the accompanying drawings in which:

Figure 1, comprising Figures 1a to 1c, illustrates the fingerprint collection apparatus according to a preferred embodiment. The fingerprint collection apparatus is shown to comprise an imaging plate, an image capture device, and a movable hand grip. Figure 1a illustrates the fingerprint collection apparatus with the imaging plate and moveable hand grip. Figures 1b and 1c illustrate example embodiments of positions which the moveable hand grip may take.

Figure 2 illustrates a system for registering an identity of a user, wherein the system comprises a verification module, two or more biometric information collectors, a quality assurance module, and a security module.

Figure 3, comprising Figures 3a and 3b, illustrates a set-up of a kiosk comprising the fingerprint collection apparatus, according to an embodiment of the invention.

Detailed Description

Embodiments of the present invention relate to a fingerprint collection apparatus. In particular, the fingerprint collection apparatus forms part of a self-service operated biometric enrolment and authentication system.

In some embodiments, there is, disclosed, a fingerprint collection apparatus, comprising an imaging plate, an image capture device, and a movable hand grip. The movable hand grip is positioned relative to the plate to be gripped by a hand of a user while a finger of the hand is positioned on the plate. This enables image capture of the fingerprint of the finger by the image capture device, through the plate. The hand grip is movable to control rolling of the finger on the plate during image capture.

Figure 1a illustrates the fingerprint collection apparatus (100) according to an embodiment of the claimed invention. An imaging plate (102) or an optical platen with a transparent scanning area provides a flat surface for a user to place one or more fingers for fingerprint collection. Beneath the imaging plate resides an image capture device, used to image the fingerprints of fingers placed on the imaging plate. Images are captured through the imaging plate. The imaging plate may thus be transparent. The image capture device may comprise a camera, a charge coupled device (CCD) image sensor, an active-pixel sensor (CMOS sensor fabricated using complementary MOS technology) or any other appropriate technology. The image capture device comprising the image sensor may be enclosed in an apparatus housing, with the imaging plate mounted on one face of the apparatus housing.

The movable hand grip (104) is attached or mounted on to the apparatus housing. The movable hand grip is mounted at a distance and angle that allows for a user to place one or more fingers for fingerprint collection on the imaging plate while gripping on to the hand grip with the remaining digits. The hand grip provides a user support and keeps the user's hand stationary with respect to the one or more fingers being imaged, while being movable to allow the user to control rolling of the finger on the imaging plate during image capture.

The hand grip is arranged relative to the imaging plate to ensure alignment between a user's hand – particularly, the finger being scanned or imaged – and the imaging plate. The hand grip is also shaped to fit in the user's hand with a thumb or finger extending from the hand, onto the imaging plate. Thus, by gripping the hand grip,

the user's hand is stabilised and in the correct position for imaging (i.e., image capture).

The movable hand grip may further comprise grooves, or other grip features, shaped to receive two or more fingers to prevent the fingers from unintentionally slipping across the hand grip during fingerprint collection.

In some embodiments, the hand grip is movable to rotate about a first axis during image capture. That axis may extend parallel to a plane of the imaging plate, or at another angle to that plane as necessary for clear and repeatable image capture. The angle of the first axis relative to the plate may be adjustable, to position the grip at different angles for people of different height or differing flexibility in their fingers.

Rotation about the first axis allows for the imaging plate and the corresponding housing and movable hand grip to rotate to accommodate a standing position of the user whose fingerprint(s) is/are being captured. The hand grip is elongate, and the first axis runs along the longitudinal axis of the movable hand grip (i.e., direction of elongation of the hand grip), or parallel to the longitudinal axis. A user can therefore maintain a stationary hand position by gripping the movable hand grip and keeping the finger on the imaging plate, while rotating the hand grip about the first axis and rolling a finger or a thumb over the imaging plate, to collect a rolled fingerprint.

The movable hand grip forms part of a swivel mechanism about which the hand grip rotates about a second axis, perpendicular (in at least one dimension) to the first axis. The swivel mechanism enables the user to change the direction of the hand grip relative to a machine to which the fingerprint collection apparatus is mounted, to accommodate different standing positions relative to the fingerprint collection apparatus.

In some embodiments, the swivel mechanism of the fingerprint collection apparatus is rotatable in a continuous fashion between a first angle A and a second angle B. The first angle and the second angle may enclose a 180° arc, corresponding to a straight edge along which the fingerprint collection apparatus is mounted. The swivel mechanism may use a friction-based mechanism to selectively fix the hand grip in any desired position between the first and second angles (inclusive). In other embodiments, the swivel mechanism is fixable at each of a plurality of discrete

locations between the first and second angles, the first and second angles being illustrated in Figures 1b and 1c, respectively. Fixing of the swivel at each discrete location can be achieved using any desired means, such as a pin and notch or groove system. Where the swivel mechanism is fixed at a discrete location, the imaging plate and the image capture devices may also be fixed and aligned with the position of the movable hand grip. To that end, the image capture device and imaging plate may be mounted to the swivel mechanism so as to rotate with the swivel mechanism between discrete locations, or along a continuous range of movement.

In some embodiments, the fingerprint collection apparatus further comprises a shield positioned at least between the user and the movable hand grip, over a plurality of image capture positions as defined by the swivel mechanism. Where the swivel mechanism is configured to swivel about a 180° arc (or arc of some other range), the shield positioned between the user and the movable grip may form a semicircle and may be mounted adjacent to the apparatus housing, enclosing it. The shield may serve as a barrier between the user and the movable grip. Thus, the shield may protect the fingerprint collection apparatus from damage due to accidental collision. The shield may also protect the user from injury due to the moveable hand grip.

Figure 2 illustrates a system for registering an identity of a user (200), comprising a verification module (202), biometric information collector(s) (204), a quality assurance module (206) and a security module (208). The verification module (202) verifies the presence of a single user positioned at the system for biometric information capture. This avoids confusing the system by, for example, capturing the fingerprint of one person while a facial image is taken of another person. The verification module (202) may achieve this by identifying, using an image recognition model, the number of faces or other attributes of people in the system at any point in time. If the number is greater than 1, then the system will not capture biometric information and may raise an alarm or notification to have all other persons but one person exit the system.

The biometric information collector(s) (204), of which there may be two or more, each collects a respective biometric information indicator. Such an indicator may be a fingerprint, iris or retina, facial features and others. Each biometric information collector (204) collects the desired information in an appropriate manner – e.g., using the fingerprint scanner for fingerprint captures, using an image capture device, such

as a camera, to capture the facial image of a person (the system also potentially including a white panel, where the user must position themselves between the image capture device during image capture).

The quality assurance module (206) assesses the usability of each biometric information indicator or image, and provides an output of the assessment. The output may indicate whether the biometric information was captured clearly and reliably.

The security module (208) stores the image and each biometric indicator in association with an identity of the single user in a database. The image, biometric indicator(s) and identify information may be stored in association with each other, to facilitate later identification of a user by comparing newly capture biometric information with biometric information stored in the security module (208).

The verification module (202) verifies the presence of a single user positioned at the system for biometric information capture. This ensures that when a plurality of biometric information indicators is collected, such as two or more of: a flat fingerprint, an iris, a voice feature, the system is highly confident that the two or more biometric information indicators collected were obtained from a single individual. As set out above, the verification module (202) may achieve this through image recognition, or through sensing multiple persons passing into the system.

Two or more biometric information collectors may be present in the system. At least one biometric information collector is an image capture module (204a) for capturing an image of a biometric information indicator comprising a face of the single user.

The second and subsequent biometric information collectors (204b) may be configured to capture one or more of: the flat fingerprint, rolled fingerprint, face, iris or voice features of the single user. The flat fingerprint and/or rolled fingerprint may be captured using the fingerprint collection apparatus described in an earlier embodiment of the present invention. An image of the iris of the single user may be captured along with the image capture module capturing an image comprising a face of the single user. Iris recognition may be performed by collecting a series of unique patterns within a ring-shaped region surrounding the pupil of each eye of the user. Standard iris recognition technologies may also be used. Collecting the voice features of the single user may be done to employ the unique characteristics in an individual's

voice to authenticate the user's identity. This may involve recording the voice or vocals, using a microphone, and analysing several attributes of the vocals of the user. The attributes may include the pitch, accent, speed of speech, tone, or cadence of the user. The attributes may be further processed and analysed to yield information about the physiological factors of the user, such as the shape and size of the user's mouth and throat.

The quality assurance module (206) assesses the usability of each biometric information indicator and the image and provides an output of the assessment. The usability of a captured image may be determined based on a predefined threshold of certain image quality attributes, below which the captured image may be deemed unusable. The image quality attributes may include, but not be limited to, the sharpness of the image, the noise (i.e., the variation of image density), the colour accuracy (including the shifts, saturation and white balance), the exposure, chromatic aberrations or the presence of any artefacts. The usability of a captured flat or rolled fingerprint may be determined by the percentage of distinguishable patterns and features which aid in the extraction of features, for subsequent matching of fingerprint pairs, or it may be determined by the consistency of minutiae such as the fingerprint ridges, ridge frequencies or detail, and absence of smudges, across repeated fingerprint captures. The quality assurance module may provide an output of the assessment in the form of a binary feedback – i.e., the collected biometric may be broadly classified as "useable" or "unusable".

The system may further comprise a security module (208) for storing the image and each biometric indicator in association with an identity of the single user in a database. The plurality of biometric indicators as collected during enrolment may be stored as part of a biometric template, comprising unique numerical data points corresponding to the biometric data. The biometric data may be stored in a way that prohibits backward engineering to reconstruct the fingerprint, facial features, or iris of the user being enrolled. The biometric data may be stored locally, but is preferably uploaded to a secure global server database for use. The user's identity may be inputted manually, by scanning an identification card (e.g., driver's licence – linked to a centralised database from which the user's identity information can be extracted), or other mechanism.

In some embodiments, the system further comprises a verifier (210) for verifying an identity of a user by comparing each biometric information indicator and the image to identification information for the user, stored in the database. The database may be a local database or it may be a secure global server database with biometric enrolment information uploaded from multiple collection points.

In some embodiments, each biometric information indicator and the image is used for registration or verification of at least one of: flat fingerprint, rolled fingerprint, face, iris and voice features of the user. A flat fingerprint image is collected from a user placing a finger flat on the imaging plate while a rolled fingerprint image is collected from a user rolling a finger about its longitudinal axis on the imaging plate. A facial or iris image may be collected by means of the image capture device. The voice features may be captured by recording and analysing, using any appropriate voice analytics software, vocal attributes of the user being enrolled.

In some embodiments, each of the biometric information collector is configured to collect information by means of at least one of: a pressure sensor, a laser, a LiDAR sensor, a proximity sensor, an optical sensor, a series of 3D scanners and a temperature sensor. A fingerprint sensor may employ a capacitive element to convert electrical charges of the skin into an electronic fingerprint image. An iris scanner may make use of an optical sensor to detect and convert reflected or emitted light into an electronic image of an eye.

In some embodiments, presence of a single user is controlled after verification, by means of an automated swing door. The system for registering and verifying an identity of a user may be located behind an automated swing door, such that upon detecting and verifying the presence of a single user, the automated swing door may be configured to be locked until biometric enrolment and/or identity verification is complete, to prohibit the entrance or intrusion of a second or subsequent individual which may interfere with the enrolment and/or verification process.

In some embodiments, the system further comprises a feedback module for providing audio and/or visual feedback when the output of the quality assurance module states the biometric information indicator and/or the image lacks usability. Audio feedback may be provided in the form of a pre-recorded voice indicating "enrolment success" or "please try again". Visual feedback may be provided in the form of a green LED

indicator to indicate a successful enrolment and a red LED indicator to indicate an unsuccessful enrolment.

In some embodiments, the system is further configured to provide haptic feedback to the user, the haptic feedback guiding or confirming capture of the fingerprint. Haptic feedback may comprise the use of a physical stimulus such as a vibration or a pulse to provide a tactile sensation when the user completes an enrolment. It may be a sensation of resistance generated as feedback for a user when the system receives a user input, such as when the user applies a pressure on the imaging plate by pressing on the imaging plate with his thumb or finger.

Figure 3a shows a kiosk (300), comprising a fingerprint collection apparatus (1) according to an embodiment of the present invention. Figure 3b shows a top view of the kiosk. The fingerprint collection apparatus (1) comprises a shield or guard (11), a drum base (12) to which a movable hand grip or handle (21) is mounted. The drum base (12) has the imaging plate on top and is cylindrical so as to rotate, within a side curve (19) and on sponge (13), to capture fingerprints at various angles relative to the user. The movable hand grip (21) is covered by a cover (23), which ensures robust and durable usage of the movable grip.

The kiosk (300) includes an identification (e.g., passport and barcode) scanner (5) for scanning identification document(s) of the user. The identification is then stored with the biometric information, to identify the user. The identification scanner (5) is sealed into the kiosk using seal (24).

The kiosk (300) comprises a housing, the housing including a base housing (7), back plane (8), back cover (bottom (9) and top (10)). The kiosk (300) also includes a display (4) for displaying directions and/or other information to the user, to ensure or confirm proper collection of identification and biometric information. All display components, such as display (4), are sealed into the kiosk (300) using seals (29) and (35).

It will be appreciated that many further modifications and permutations of various aspects of the described embodiments are possible. Accordingly, the described aspects are intended to embrace all such alterations, modifications, and variations that fall within the spirit and scope of the appended claims.

Throughout this specification and the claims which follow, unless the context requires otherwise, the word "comprise" and variations such as "comprises" and "comprising", will be understood to imply the inclusion of a stated integer or step or group of integers or steps but not the exclusion of any other integer or step or group of integers or steps.

Throughout this specification and the claims which follow, unless the context requires otherwise, the phrase "consisting essentially of", and variations such as "consists essentially of" will be understood to indicate that the recited element(s) is/are essential i.e. necessary elements of the invention. The phrase allows for the presence of other non-recited elements which do not materially affect the characteristics of the invention but excludes additional unspecified elements which would affect the basic and novel characteristics of the method defined.

The reference in this specification to any prior publication (or information derived from it), or to any matter which is known, is not, and should not be taken as an acknowledgement or admission or any form of suggestion that the prior publication (or information derived from it) or known matter forms part of the common general knowledge in the field of endeavour to which this specification relates.

CLAIMS

1. A fingerprint collection apparatus, comprising:

   an imaging plate;

   an image capture device; and

   a movable hand grip, the hand grip being positioned relative to the plate to be gripped by a hand of a user while a finger of the hand is positioned on the plate for image capture of a fingerprint of the finger by the image capture device, the hand grip being movable to control rolling of the finger on the plate during image capture.

2. The fingerprint collection apparatus of claim 1, wherein the hand grip is movable to rotate about a first axis during image capture, the apparatus further comprising a swivel mechanism rotatable about a second axis, perpendicular to the first axis, to position the hand grip for image capture.

3. The fingerprint collection apparatus of claim 2, wherein the swivel mechanism is rotatable between a plurality of discrete image capture positions.

4. The fingerprint collection apparatus of claim 2 or 3, wherein the swivel mechanism is rotatable in a continuous fashion between a first angle and a second angle.

5. The fingerprint collection apparatus of any one of claims 2 to 4, further comprising a shield positioned at least between the user and the movable hand grip, over a plurality of image capture positions as defined by the swivel mechanism.

6. A system for registering an identity of a user, comprising:

   a verification module for verifying presence of a single user positioned at the system for biometric information capture;

   two or more biometric information collectors, each collecting a respective biometric information indicator, wherein a first of the biometric information collectors is an image capture module for capturing an image of a biometric information indicator comprising a face of the single user and a

second of the biometric information collectors is an apparatus according to any one of claims 1 to 5;

a quality assurance module for making an assessment of usability of each biometric information indicator and the image and providing an output of the assessment; and

a security module for storing the image and each biometric indicator in association with an identity of the single user in a database.

7. A system for verifying an identity of a user, comprising:

the system of claim 6; and

a verifier for verifying an identity of the user by comparing each biometric information indicator and the image to identification information for the user, stored in the database.

8. The system of claim 6 or 7, wherein each biometric information indicator and the image is used for registration or verification of at least one of: flat fingerprint, rolled fingerprint, face, iris and voice features of the user.

9. The system of any one of claims 6 to 8, wherein each biometric information collector is configured to collect information by means of at least one of: a pressure sensor, a laser, a LiDAR sensor, a proximity sensor, an optical sensor, a series of 3D scanners and a temperature sensor.

10. The system of any one of claims 6 to 9, wherein presence of a single user is controlled after verification, by means of an automated swing door.

11. The system of any one of claims 6 to 10, further comprising a feedback module for providing audio and/or visual feedback when the output of the quality assurance module states the biometric information indicator and/or the image lacks usability.

12. The system of any one of claims 6 to 11, configured to provide haptic feedback to the user, the haptic feedback guiding or confirming capture of the fingerprint.