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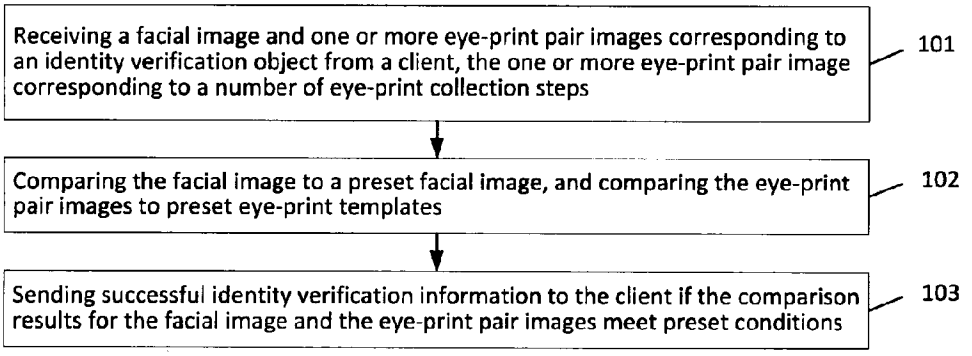

(57) **Abrégé/Abstract:**
This invention discloses a user identity verification method, apparatus, and system, relating to the field of information technology. This invention primarily is used to solve the problems of low precision and reliability in current user identity verification methods. The method comprises: first receiving a facial image and one or more eye-print pair images corresponding to an identity verification object from a client, the one or more eye-print pair images corresponding to a number of eye-print collection steps, then comparing the facial image to a preset facial image, comparing the eye-print pair images to preset eye- print templates, and sending successful identity verification information to the client if the comparison results for the facial image and the eye-print pair images meet preset conditions.

Abstract

This invention discloses a user identity verification method, apparatus, and system, relating to the field of information technology. This invention primarily is used to solve the problems of low precision and reliability in current user identity verification methods. The method comprises: first receiving a facial image and one or more eye-print pair images corresponding to an identity verification object from a client, the one or more eye-print pair images corresponding to a number of eye-print collection steps, then comparing the facial image to a preset facial image, comparing the eye-print pair images to preset eye-print templates, and sending successful identity verification information to the client if the comparison results for the facial image and the eye-print pair images meet preset conditions.

User Identity Verification Method, Apparatus and System

This application claims priority to the Chinese patent application No. **201610717080.1** filed on August **24, 2016**, and entitled "User Identity Verification Method, Apparatus and System".

Technical field

This disclosure relates to the field of information technology, particularly to a user identity verification method, apparatus, and system.

Background

With the continuous development of information technologies and the Internet, a variety of applications have emerged. Of these, more and more financial institutions are providing users with apps to manage associated financial transactions. To ensure the security of user information, it is necessary to perform identity verification of the users managing financial transactions through apps, that is, performing user security verification operations such as identity authentication and name authentication.

Today, user identity verification is normally performed by employing a method of combining facial image recognition with live facial image verification, i.e.: issuing facial movement parameters to the user when verifying a collected facial image, requiring the user to complete live movement verification according to these movement parameters. However, now it is possible to synthesize rather lifelike **3**D facial images and simulate user movements and expressions, resulting in low precision and reliability for existing user identity verification methods, and making it unlikely to ensure the security of the apps used by users.

Summary

In view of this, the embodiments described herein provide a user identity verification method, apparatus, and system, with the main objective being to solve the problems of low precision and reliability in the user identity verification methods of current technologies.

In one embodiment, there is provided a user identity verification method. The user identity verification method involves sending a facial quality score threshold and a number of eye-print collection steps corresponding to an identity verification mode to a client to obtain facial images based on the facial quality score threshold and obtain eye-print pair images

corresponding to the number of eye-print collection steps. The user identity verification method involves receiving a facial image and one or more eye-print pair images corresponding to an identity verification object from the client, wherein the facial image meets the facial quality score threshold and a number of the one or more eye-print pair images corresponds to the number of eye-print collection steps. The user identity verification method involves comparing the facial image to a preset facial image, and comparing the one or more eye-print pair images to preset eye-print templates corresponding to the identity verification object, and when comparison results for the facial image and the one or more eye-print pair images meet preset conditions, sending successful identity verification information to the client.

In another embodiment, there is provided a user identity verification method. The user identity verification method involves receiving a facial quality score threshold and a number of eye-print collection steps corresponding to a current mode, and obtaining a facial image and one or more eye-print pair images corresponding to an identity verification object, the facial image being obtained based on the facial quality score threshold and a number of the one or more eye-print pair images corresponding to the number of eye-print collection steps. The user identity verification method involves sending the obtained facial image and the one or more eye-print pair images to a server to perform identity verification of the identity verification object.

In one aspect, an embodiment provides a user identity verification method, comprising:

receiving a facial image and one or more eye-print pair images corresponding to an identity verification object from a client, the one or more eye-print pair images corresponding to a number of eye-print collection steps;

comparing the facial image to a preset facial image, and comparing the eye-print pair images to preset eye-print templates;

sending successful identity verification information to the client if the comparison results for the facial image and the eye-print pair images meet preset conditions.

In another aspect, an embodiment provides another user identity verification method, comprising:

collecting a facial image and one or more eye-print pair images corresponding to an identity verification object, the one or more eye-print pair images corresponding to a number of eye-print collection steps;

sending the facial image and eye-print pair images to the server, causing the server to perform identity verification of the identity verification object.

In another aspect, an embodiment provides a server, comprising:

a receiving unit, configured to receive a facial image and one or more eye-print pair images corresponding to an identity verification object from a client, the one or more eye-print pair images corresponding to the number of eye-print collection steps;

a comparison unit, configured to compare the facial image to a preset facial image, and compare the eye-print pair images to preset eye-print templates;

a sending unit, configured to send successful identity verification information to the client if the comparison results for the facial image and the eye-print pair images meet preset conditions.

In another aspect, an embodiment provides a client, comprising:

a collection unit, configured to collect a facial image and one or more eye-print pair images corresponding to an identity verification object, the one or more eye-print pair images corresponding to a number of eye-print collection steps; a sending unit, configured to send the facial image and eye-print pair images to the server, causing the server to perform identity verification of the identity verification object.

In another aspect, an embodiment provides a user identity verification system, comprising:

a server, when receiving a user identity verification request, configured to send, to a client, a facial quality score threshold and a number of eye-print collection steps corresponding to the current mode;

a client, configured to obtain a facial image based on the facial quality score threshold and obtain eye-print pair images corresponding to the number of eye-print collections steps;

the server is also configured to receive a facial image sent by a client and eye-print pair images corresponding to a number of eye-print collection steps; compare the facial image to a

preset facial image, and compare the eye-print pair images to preset eye-print templates; and send successful identity verification information to the client if the comparison results for the facial image and the eye-print pair images meet preset conditions.

The technical solutions provided by the embodiments described herein possess at least the following advantages:

The user identity verification method, apparatus, and system provided by the embodiments described herein comprise first receiving a facial image and one or more eye-print pair images corresponding to an identity verification object from a client, the one or more eye-print pair images corresponding to a number of eye-print collection steps, when a user identity verification request is received; then comparing the facial image to a preset facial image, comparing the eye-print pair images to preset eye-print templates; and sending successful identity verification information to the client if the comparison results for the facial image and the eye-print pair images meet preset conditions. Compared to the method of combining facial image recognition with live facial image verification, commonly used today when performing user identity verification, the embodiments described herein use multidimensional verification modes such as facial verification combined with eye-print image verification and live eye-print image verification to perform user identity verification, thereby boosting the precision and reliability of the user identity verification method, and ensuring the security of apps used by the user.

The preceding explanation is merely a summary of certain technical solutions. To enable a clearer understanding of the technical measures described herein, to enable implementation in accordance with the content of this description, and to make the preceding and other objectives, features, and advantages clearer and more easily understood, specific implementations are presented below.

Brief Description of the Drawings

By reading the following detailed description of preferred implementation manners, a variety of other advantages and benefits will become clear to persons having ordinary skill in the art. The drawings are merely used to illustrate the objectives of preferred implementation

manners and are not to be taken as limitations. The same reference symbols used in all drawings represent the same components. In the drawings:

FIG. **1** presents a flow diagram of a user identity verification method provided by an embodiment;

FIG. **2** presents a flow diagram of another user identity verification method provided by an embodiment;

FIG. **3** presents a flow diagram of another user identity verification method provided by an embodiment;

FIG. **4** presents a flow diagram of another user identity verification method provided by an embodiment;

FIG. **5** presents a schematic diagram of a server provided by an embodiment;

FIG. **6** presents a schematic diagram of another server provided by an embodiment;

FIG. **7** presents a schematic diagram of a client provided by an embodiment;

FIG. **8** presents a schematic diagram of another client provided by an embodiment;

FIG. **9** presents a diagram of a user identity verification system provided by an embodiment;

FIG. **10** presents a flow diagram of a user identity verification scenario presented by an embodiment.

Detailed Description

Referencing the drawings, a more detailed description of the exemplary embodiments of this disclosure is given below. Even though the drawings present exemplary embodiments of this disclosure, it should be understood that this disclosure may be achieved in other forms and should not be limited by the embodiments described here. Rather, these embodiments are provided to enable a more thorough understanding of this disclosure and to transmit the scope of this disclosure in its entirety to persons skilled in the art.

An embodiment provides a user identity verification method, as shown in FIG. **1**, the method comprising:

101. Receiving a facial image and one or more eye-print pair images corresponding to an identity verification object from a client, the one or more eye-print pair images corresponding to a number of eye-print collection steps.

Here, because a larger number of eye-print collection steps results in a longer period of time in eye-print collection, when a number of the eye-print templates of the identity verification object is ample, a smaller number of eye-print collection steps may be used; when the number of the eye-print templates of the identity verification object is smaller, to collect eye-print pair images for the accumulation of eye-print templates for the identity verification object, a larger number of eye-print collection steps may be used. For this embodiment, it is possible to further boost the precision of user identity verification by configuring different numbers of eye-print collection steps based on different circumstances. The server can use communication means such as mobile cellular networks and WIFI networks to perform data transmission with the client. No limitations are placed on this by the embodiments described herein.

102. Comparing the facial image to a preset facial image, and comparing the eye-print pair images to preset eye-print templates.

Here, the preset facial image may be a photograph of the user that has been registered with a public security network or a facial photograph that has been verified by a user identity verification. No limitations are placed on this by the embodiments described herein. The preset eye-print templates may be multiple sets of eye-print pair images that have been verified by a security verification. The comparison operation may be determining whether the degree of matching between images meets preset requirements. No limitations are placed on this by the embodiments described herein.

103. Sending successful identity verification information to the client if the comparison results for the facial image and the eye-print pair images meet preset conditions.

Here, the preset conditions may be facial comparison score thresholds and eye-print match score thresholds. No limitations are placed on this by the embodiments described herein. For this embodiment, when both the facial image and eye-print pair images comparison results meet preset conditions, a successful identity verification is determined, thus performing the user

identity verification through multiple dimensions such as facial images and eye-print pair images, and thereby making it possible to boost the precision of the user identity verification method.

An embodiment provides a user identity verification method. When a user identity verification request is received, first a facial image and one or more eye-print pair images corresponding to an identity verification object are received, the one or more eye-print pair images corresponding to a number of eye-print collection steps, then the facial image is compared to a preset facial image, and the eye-print pair images are compared to preset eye-print templates. Successful identity verification information is sent to the client if the comparison results for the facial image and the eye-print pair images meet preset conditions. Compared to the method of combining facial image recognition with live facial image verification commonly used today when performing user identity verification, the embodiments use multidimensional verification modes such as facial image verification combined with eye-print image verification and live eye-print image verification to perform user identity verification, thereby boosting the precision and reliability of the user identity verification method, and ensuring the security of apps when used by the user.

Furthermore, an embodiment provides another user identity verification method, as shown in FIG. **2**. The method comprises:

201. Obtaining a number of eye-print templates corresponding to the identity verification object from a preset storage location, when a user identity verification request is received.

Here, eye-print templates corresponding to different identity verification objects are stored in the preset storage location. When a user needs to perform security verification such as login identity validation or payment identity validation, a user identity verification request is sent to a client.

Following step **201**, the embodiments may also comprise: if the number of eye-print templates is less than a preset threshold, determining the current mode as an eye-print enrollment mode; sending a facial quality score threshold and the number of eye-print collection steps corresponding to the eye-print enrollment mode to the client, to make the client obtain a facial image based on the facial quality score threshold and obtain eye-print pair images corresponding

to the number of eye-print collection steps; and storing the eye-print pair images in the preset storage location as the eye-print templates corresponding to the preset identity verification object.

It should be noted that when the number of eye-print templates is less than the preset threshold, it means that the number of eye-print templates at that time is rather low, and it is not possible to ensure the precision of an eye-print verification. At that time, the current mode is determined as eye-print enrollment mode. This can enable the client to input in real time an eligible eye-print as the eye-print templates of the identity verification object, thus achieving the accumulation of eye-print templates. When the number of eye-print templates reaches the preset threshold, the identity verification mode is switched on, thus making it possible to further boost the precision and reliability of the user identity verification.

202. Determining that the current mode as identity verification mode if the number of eye-print templates is greater than or equal to a preset threshold.

Here, the current mode may comprise eye-print collection mode, identity verification mode, etc. The current mode is associated with the number of eye-print templates corresponding to the user that are stored in the preset storage location. No limitations are placed on this by the embodiments described herein. It should be noted that for eye-print collection mode, the collected eye-print image quality requirements are quite high, to facilitate the server's accumulation of eye-print templates; for identity verification modes, average eye-print image quality is sufficient, because the server can perform eye-print comparisons using previously accumulated eye-print templates. For the facial quality score threshold used to indicate the quality of the facial image collected by the client, a higher facial quality score threshold requires a higher quality in the facial image collected by the client. The number of eye-print collection steps is used to indicate the number of eye-print pairs collected at one time by the client. For example, when the number of eye-print collection steps is **5**, the client needs to collect **5** pairs of eye-prints.

It should be noted that, because a larger number of eye-print collection steps results in a longer period of time in eye-print collection, there will be different numbers of eye-print collection steps configured for different modes. For example, for identity verification mode, because there are an ample number of eye-print templates under this mode, a smaller number of

eye-print collection steps may be configured; for eye-print collection mode, because the main objective of this mode is to collect eye-print pair images for the accumulation of eye-print templates, a larger number of eye-print collection steps may be configured. For this embodiment, it is possible to further boost the precision of user identity verification by configuring different numbers of eye-print collection steps based on different modes.

203. Sending a facial quality score threshold and the number of eye-print collection steps corresponding to identity validation mode to a client.

Furthermore, the client is caused to obtain a facial image based on the facial quality score threshold and obtain eye-print pair images corresponding to the number of eye-print collection steps. Here, the client may be configured on a mobile device with a webcam and microphone. These mobile devices include but are not limited to smartphones and tablet PCs. The client can use the webcam to collect relevant images.

204. Receiving a facial image and one or more eye-print pair images corresponding to an identity verification object from a client, the one or more eye-print pair images corresponding to the number of eye-print collection steps.

Here, the server can use communication means such as mobile cellular networks and WIFI networks to perform data transmission. No limitations are placed on this by the embodiments described herein.

205. Comparing the facial image to a preset facial image, and comparing the eye-print pair images to preset eye-print templates.

Here, the preset facial image may be a photograph of the user that has been registered with a public security network or a facial photograph that has been verified by a user identity verification. No limitations are placed on this by the embodiments described herein. The preset eye-print templates may be multiple sets of eye-print pair images that have been verified by a security verification.

For this embodiment, if the current mode is determined as the identity verification mode, comparing the facial image to a preset facial image may comprise: using the facial image and the preset facial image as input to a preset facial algorithm, and obtaining a facial comparison score corresponding to the identity verification object. Comparing the eye-print pair images to preset

eye-print templates comprises: using the eye-print pair images and the eye-print templates corresponding to the identity verification object as input to a preset eye-print algorithm, and obtaining multiple eye-print liveness scores corresponding to the number of eye-print collection steps and an eye-print match score.

Here, the preset facial algorithm and the preset eye-print algorithm may be convolutional neural network algorithms, multi-layer neural network algorithms, etc. No limitations are placed on this by the embodiments described herein. The facial comparison score is used to reflect the degree to which the facial image of the identity verification object matches the preset facial image. A higher facial comparison score means a higher match between the facial image of the identity verification object and the preset facial image. The eye-print liveness score is used to reflect the fidelity of the currently collected eye-print pair images of the identity verification object. A higher eye-print liveness score means higher fidelity of the eye-print pair image. The eye-print match score is used to reflect the degree to which the eye-print pair images of the identity verification object match the preset eye-print templates. A higher eye-print match score means a higher match between the eye-print pair images of the identity verification object and the preset eye-print templates.

206. Sending successful identity verification information to the client if the comparison results for the facial image and the eye-print pair images meet preset conditions.

For this embodiment, step **206** may comprise: sending successful identity verification information to the client if the facial comparison score, multiple eye-print liveness scores, and the eye-print match score are greater than respective preset thresholds. In this embodiment, when the facial comparison score, multiple eye-print liveness scores, and eye-print match score all are greater than the preset thresholds, identity verification is determined as successful, thus making it possible to boost the precision and reliability of the user identity verification method.

207. When user identity verification is determined as successful, updating the eye-print templates corresponding to the identity verification object that are stored in the preset storage location based on the eye-print pair images collected by the client.

For this embodiment, when user identity verification is determined as successful, it indicates that the eye-print pair images collected by the client at this time are true and reliable,

and the eye-print templates corresponding to the identity verification object stored in the preset storage location are updated based on the eye-print pair images collected by the client. This can further ensure the accuracy of the eye-print templates corresponding to the identity verification object that are stored in the preset storage location, thereby further boosting the precision of the user identity verification method.

For this embodiment, a specific application scenario flow may be, but is not limited to that, as shown in FIG. **10**, first, the server may use a configured decision module, FEArbitrator, to obtain an eye-print template number of **10**, corresponding to the identity verification object. This is greater than the preset template number threshold of **9**, so the current mode is determined as identity verification mode: Verify. Next, a facial quality score threshold QT and the number of eye-print collection steps **1** corresponding to the identity verification mode Verify is sent to the client. At this time, the client collects a facial image and one eye-print pair. Then, after determining that the quality of the collected facial image is greater than or equal to QT, preprocessing such as optimization and compression is performed on the collected facial image and eye-print pair image, then the preprocessed facial image and eye-print pair image are sent to the server. At this time, the server uses a preset facial algorithm to compare the facial image to a verified preset facial image and obtains a facial image comparison score FX; and uses a preset eye-print algorithm to compare the collected eye-print pair to preset eye-print templates and obtains an eye-print liveness score LK and eye-print match score MX. If FX is greater than or equal to the preset facial comparison score threshold FT, LK is greater than or equal to the preset eye-print liveness score threshold LT, and MX is greater than or equal to the preset eye-print match score threshold, at this point, successful identity verification information is sent to the client, and the preset eye-print templates are updated based on the collected eye-print pair image. If the number of eye-print templates corresponding to the identity verification object is less than **9**, the client is instructed to conduct eye-print pair images collection until the number of eye-print templates corresponding to the identity verification object is greater than or equal to **9**, and the mode is switched to identity verification mode.

In another user identity verification method provided by an embodiment, when a user identity verification request is received, first a facial image and one or more eye-print pair images corresponding to an identity verification object are received, the one or more eye-print pair images corresponding to a number of eye-print collection steps, then the facial image is compared to a preset facial image, and the eye-print pair images are compared to preset eye-print templates. If the comparison results for the facial image and the eye-print pair images meet preset conditions, successful identity verification information will be sent to the client. Compared to the method of combining facial image recognition with live facial image verification commonly used today when performing user identity verification, this embodiment uses multidimensional verification modes such as facial verification combined with eye-print image verification and live eye-print image verification to perform user identity verification, thereby boosting the precision and reliability of the user identity verification method, and it can ensure the security of apps used by the user.

Furthermore, an embodiment described herein provides a user identity verification method, as shown in FIG. **3**. The method comprises:

301. Collecting a facial image and one or more eye-print pair images corresponding to an identity verification object, the one or more eye-print pair images corresponding to a number of eye-print collection steps.

Here, the executing entity of this embodiment may be a client. The client may be configured on a mobile device with a webcam and microphone. These mobile devices include but are not limited to smartphones and tablet PCs. When the client receives a user request such as account login or payment, a facial image and one or more eye-print pair images corresponding to an identity verification object are collected, for a server to perform security verification such as identity validation or payment identity validation for the user. The one or more eye-print pair images corresponding to the number of eye-print collection steps.

302. Sending the facial image and the number of eye-print pair images to the server.

Furthermore, it causes the server to perform identity verification of the identity verification object.

For this embodiment, before step **302**, the method may also comprise: the client performing preprocessing of the collected facial image and eye-print pair images, wherein the preprocessing may comprise: image optimization, image segmentation, image compression, facial image quality calculation, and eye-print liveness calculation. No limitations are placed on this by the embodiments described herein. By performing preprocessing of the collected facial image and eye-print pair images, it is possible to ensure the true accuracy of the image used by the server for identity verification, thereby ensuring the precision of user identity verification.

An embodiment described herein provides another user identity verification method. First, a facial image corresponding to the identity verification object and a number of eye-print pair images corresponding to a number of eye-print collection steps are collected, then the facial image and the eye-print pair images are sent to the server, causing the server to perform identity verification of the identity verification object. Compared to the method of combining facial image recognition with live facial image verification, commonly used today when performing user identity verification, this embodiment uses multidimensional verification modes such as facial verification combined with eye-print image verification and live eye-print image verification to perform user identity verification, thereby boosting the precision and reliability of the user identity verification method, and it can ensure the security of apps used by the user.

Furthermore, an embodiment provides another user identity verification method, as shown in FIG. **4**. The method comprises:

401. Sending a user identity verification request to a server.

Here, the executing entity of this embodiment may be a client. The client may be configured on a mobile device with a webcam and microphone. These mobile devices include but are not limited to smartphones and tablet PCs. When the user requests the performance of an operation such as account login or payment, a user identity verification request is sent to a server, causing the server to perform security verification of the user, such as identity validation and payment identity validation. The user identity verification request may include identification information of the user, to enable the server to extract information such as the user's preset facial image or preset eye-print templates, etc. from a database to perform subsequent user identity verification.

402. Receiving a facial quality score threshold and the number of eye-print collection steps corresponding to the current mode and sent by the server.

Here, the client can use communication means such as mobile cellular networks and WIFI networks to perform data transmission with the server. No limitations are placed on this by the embodiments described herein. The relevant portions of step **101** may be referenced for an explanation of the identity verification mode, facial quality score threshold, and the number of eye-print collection steps. Further details will not be given here.

403. Obtaining a facial image based on the facial quality score threshold and obtaining a number of eye-print pair images corresponding to the number of eye-print collections steps.

For example, a client may use a preset webcam to obtain a facial image and eye-print pair images of the current identity verification object. No limitations are placed on this by the embodiments described herein.

404. Determining whether the image quality of the currently obtained facial image is greater than or equal to the facial quality score threshold, and determining whether the eye-print pair images meet preset eye-print liveness conditions.

Here, the preset eye-print liveness conditions are used to reflect the authenticity of the eye-print pair image. For this embodiment, before sending the facial image and the eye-print pair images to the server, by determining whether the image quality of the currently obtained facial image is greater than or equal to the facial quality score threshold, and by determining whether the eye-print pair images meet preset eye-print liveness conditions, it is possible to ensure the true accuracy of the image sent to the server for identity verification, thereby ensuring the precision of user identity verification.

405. Sending the facial image and the eye-print pair images to the server if the image quality of the currently obtained facial image is greater than or equal to the facial quality score threshold and the eye-print pair images meet preset eye-print liveness conditions.

Furthermore, it causes the server to perform identity verification of the user. For this embodiment, after determining that the quality of the collected facial image and eye-print pair images meets requirements, these images are sent to the server. Thus it is possible to ensure the

true accuracy of the images sent to the server for identity verification, thereby ensuring the precision of user identity verification.

An embodiment provides another user identity verification method. First, a facial image and one or more eye-print pair images corresponding to an identity verification object from are collected, the one or more eye-print pair images corresponding to a number of eye-print collection steps are collected, then the facial image and the eye-print pair images are sent to the server, causing the server to perform identity verification of the identity verification object. Compared to the method of combining facial image recognition with live facial image verification, commonly used today when performing user identity verification, this embodiment uses multidimensional verification modes such as facial verification combined with eye-print image verification and live eye-print image verification to perform user identity verification, thereby boosting the precision and reliability of the user identity verification method, and it can ensure the security of apps used by the user.

Furthermore, as an implementation of the method shown in FIG. **1**, an embodiment provides a server, as shown in FIG. **5**. The server may comprise: a receiving unit **51**, comparison unit **52**, and sending unit **53**.

The receiving unit **51** is configured to receive a facial image and one or more eye-print pair images corresponding to an identity verification object from a client, the one or more eye-print pair images corresponding to ae number of eye-print collection steps;

the comparison unit **52** is configured to compare the facial image to a preset facial image, and compare the eye-print pair images to a preset eye-print template;

the sending unit **53** is configured to send successful identity verification information to the client if the comparison results for the facial image and the eye-print pair images meet preset conditions.

It should be noted that this apparatus embodiment corresponds to the aforementioned method embodiment. For ease of reading, this apparatus embodiment will not go over each detail given in the aforementioned method embodiment, but it should be clear that the apparatus of this embodiment is capable of correspondingly achieving everything in the aforementioned method embodiment.

An embodiment provides a server. When a user identity verification request is received, first, a facial image and one or more eye-print pair images corresponding to an identity verification object from a client are received, the one or more eye-print pair images corresponding to a number of eye-print collection steps, then the facial image is compared to a preset facial image, and the eye-print pair images are compared to preset eye-print templates. Successful identity verification information is sent to the client if the comparison results for the facial image and the eye-print pair images meet preset conditions. Compared to the method of combining facial image recognition with live facial image verification, commonly used today when performing user identity verification, this embodiment uses multidimensional verification modes such as facial verification combined with eye-print image verification and live eye-print image verification to perform user identity verification, thereby boosting the precision and reliability of the user identity verification method and making it possible to ensure security when a user uses an application.

Furthermore, as an implementation of the method shown in FIG. **2**, an embodimentprovides another server, as shown in FIG. **6**. The server may comprise: a receiving unit **61**, comparison unit **62**, sending unit **63**, acquisition unit **64**, determination unit **65**, storing unit **66**, and update unit **67**.

The receiving unit **61** is configured to receive a facial image and one or more eye-print pair images corresponding to an identity verification object from a client, the one or more eye-print images corresponding to a number of eye-print collection steps;

the comparison unit **62** is configured to compare the facial image to a preset facial image, and compare the eye-print pair images to preset eye-print templates:

the sending unit **63** is configured to send successful identity verification information to the client if the comparison results for the facial image and the eye-print pair images meet preset conditions.

Furthermore, the server also comprises:

the acquisition unit **64**, when receiving a user identity verification request, configured to obtain a number of eye-print templates corresponding to the identity verification object from a

preset storage location, where the eye-print templates corresponding to different identity verification objects are stored;

the determination unit **65**, configured to determine that the current mode is identity verification mode if the number of eye-print templates is greater than or equal to a preset threshold.

The sending unit **63** is also configured to send a facial quality score threshold and the number of eye-print collection steps corresponding to identity verification mode to a client, causing the client to obtain a facial image based on the facial quality score threshold and obtain one or more eye-print pair images corresponding to the number of eye-print collection steps.

Furthermore, the server also comprises: the storing unit **66**.

The determination unit **65** is also configured to determine that the current mode is an eye-print enrollment mode if the number of eye-print templates is less than the preset threshold;

the sending unit **63** is also configured to send a facial quality score and the number of eye-print collection steps corresponding to the eye-print enrollment mode to the client, causing the client to obtain a facial image based on the facial quality score threshold and obtain one or more eye-print pair images corresponding to the number of eye-print collection steps;

the storing unit **66** is configured to store the eye-print pair images in the preset storage location as the eye-print template corresponding to the preset identity verification object.

Furthermore, the comparison unit **62** is configured to use the facial image and the preset facial image as input to a preset facial algorithm, and obtain a facial comparison score corresponding to the identity verification object;

the eye-print pair images and the eye-print template corresponding to the identity verification object are used as input to an eye-print algorithm to obtain multiple eye-print liveness scores corresponding to the number of eye-print collection steps and an eye-print match score.

Furthermore, the sending unit **63** is configured to send successful identity verification information to the client if the facial comparison score, multiple eye-print liveness scores, and the eye-print match score are greater than respective preset thresholds.

Furthermore, the server also comprises:

the updating unit **67**, when user identity verification is determined as successful, based on the eye-print pair images collected by the client, configured to update the eye-print templates corresponding to the identity verification object that is stored in the preset storage location.

It should be noted that this apparatus embodiment corresponds to the aforementioned method embodiment. For ease of reading, this apparatus embodiment will not go over each detail given in the aforementioned method embodiment, but it should be clear that the apparatus of this embodiment is capable of correspondingly achieving everything in the aforementioned method embodiment.

An embodiment provides another server. When a user identity verification request is received, first a facial image and one or more eye-print pair images corresponding to an identity verification object from a client are received, the one or more eye-print pair images corresponding to the number of eye-print collections steps, the facial image is compared to a preset facial image, and the eye-print pair images are compared to preset eye-print templates. Successful identity verification information is sent to the client if the comparison results for the facial image and the eye-print pair images meet preset conditions. Compared to the method of combining facial image recognition with live facial image verification commonly used today when performing user identity verification, the embodiments described herein use multidimensional verification modes such as facial image verification combined with eye-print image verification and live eye-print image verification to perform user identity verification, thereby boosting the precision and reliability of the user identity verification method, and it can ensure the security of apps used by the user.

Furthermore, as an implementation of the method shown in FIG. **3**, an embodiment described herein provides a client, as shown in FIG. **7**. The client may comprise: a collection unit **71** and sending unit **72**.

The collection unit **71** is configured to collect a facial image corresponding to the identity verification object and one or more eye-print pair images corresponding to a number of eye-print collection steps;

the sending unit **72** is configured to send the facial image and the eye-print pair images to the server, causing the server to perform identity verification of the identity verification object.

It should be noted that this apparatus embodiment corresponds to the aforementioned method embodiment. For ease of reading, this apparatus embodiment will not go over each detail given in the aforementioned method embodiment, but it should be clear that the apparatus of this embodiment is capable of correspondingly achieving everything in the aforementioned method embodiment.

An embodiment provides a client which first collects a facial image and one or more eye-print pair images corresponding to an identity verification object, the one or more eye-print pair images corresponding to a number of eye-print collection steps, then sends the facial image and the eye-print pair images to the server, causing the server to perform identity verification of the identity verification object. Compared to the method of combining facial image recognition with live facial image verification, commonly used today when performing user identity verification, this embodiment uses multidimensional verification modes such as facial verification combined with eye-print image verification and live eye-print image verification to perform user identity verification, thereby boosting the precision and reliability of the user identity verification method, and it can ensure the security of apps used by the user.

Furthermore, as an implementation of the method shown in FIG. **4**, an embodiment provides another client, as shown in FIG. **8**. The client may comprise: a collection unit **81**, sending unit **82**, receiving unit **83**, and determination unit **84**.

The collection unit **81** is configured to collect a facial image and one or more eye-print pair images corresponding to an identity verification object, the one or more eye-print pair images corresponding to a number of eye-print collection steps;

the sending unit **82** is configured to send the facial image and the eye-print pair images to the server, causing the server to perform identity verification of the identity verification object.

Furthermore, the client also comprises: the receiving unit **83**;

the sending unit **82** is configured to send a user identity verification request to a server;

the receiving unit **83** is configured to receive a facial quality score threshold and the number of eye-print collection steps corresponding to the current mode and sent by the server;

the collection unit **81** is configured to obtain a facial image corresponding to the identity verification object based on the facial quality score threshold and to obtain one or more eye-print pair images corresponding to the number of eye-print collection steps.

Furthermore, the client also comprises: the determination unit **84**;

the determination unit **84** is configured to determine whether the image quality of the currently obtained facial image is greater than or equal to the facial quality score threshold;

if so, the sending unit is configured to send the facial image to the server.

The determination unit **84** is also configured to determine whether the eye-print pair images meet preset eye-print liveness conditions;

the sending unit **81** is also configured to send the eye-print pair images to the server if conditions are met.

It should be noted that this apparatus embodiment corresponds to the aforementioned method embodiment. For ease of reading, this apparatus embodiment will not go over each detail given in the aforementioned method embodiment, but it should be clear that the apparatus of this embodiment is capable of correspondingly achieving everything in the aforementioned method embodiment.

Another client provided by an embodiment first collects a facial image and one or more eye-print pair images corresponding to an identity verification object, the one or more eye-print pair images corresponding to a number of eye-print collection steps, then sends the facial image and the eye-print pair images to the server, causing the server to perform identity verification of the identity verification object. Compared to the method of combining facial image recognition with live facial image verification, commonly used today when performing user identity verification, this embodiment uses multidimensional verification modes such as facial verification combined with eye-print image verification and live eye-print image verification to perform user identity verification, thereby boosting the precision and reliability of the user identity verification method, and it can ensure the security of apps used by the user.

Furthermore, as an implementation of the methods shown in FIG. **1** and FIG. **3**, an embodiment provides a user identity verification system, as shown in FIG. **9**. The user identity verification system comprises: a server **91** and a client **92**.

The server **91** is configured to send a facial quality score threshold and the number of eye-print collection steps corresponding to the current mode to a client when a user identity verification request is received;

The client **92** is configured to obtain a facial image based on the facial quality score threshold and obtain one or more eye-print pair images corresponding to the number of eye-print collections steps;

the server **91** is also configured to receive a facial image sent by a client and one or more eye-print pair images corresponding to a number of eye-print collection steps; compare the facial image to a preset facial image, and compare the eye-print pair images to preset eye-print templates; and send successful identity verification information to the client if the comparison results for the facial image and the eye-print pair images meet preset conditions.

It should be noted that this apparatus embodiment corresponds to the aforementioned method embodiment. For ease of reading, this apparatus embodiment will not go over each detail given in the aforementioned method embodiment, but it should be clear that the apparatus of this embodiment is capable of correspondingly achieving everything in the aforementioned method embodiment.

In a user identity verification system provided by an embodiment, when a user identity verification request is received, first a facial image and one or more eye-print pair images corresponding to an identity verification object from a client are received, the one or more eye-print pair images corresponding to a number of eye-print collection steps, then the facial image is compared to a preset facial image, and the eye-print pair images are compared to preset eye-print templates, and successful identity verification information is sent to the client if the comparison results for the facial image and the eye-print pair images meet preset conditions. Compared to the method of combining facial image recognition with live facial image verification commonly used today when performing user identity verification, this embodiment uses multidimensional verification modes such as facial verification combined with eye-print image verification and live eye-print image verification to perform user identity verification, thereby boosting the precision and reliability of the user identity verification method, and it can ensure the security of apps used by the user.

The user identity verification apparatus comprises a processor and a memory. The aforementioned virtual elements are all stored in the memory as program units, and the processor executes these program units that are stored in the memory to perform corresponding functions.

The processor contains a kernel. The kernel retrieves the corresponding program units from the memory. There may be one or more kernels. By adjusting kernel parameters, it is possible to solve the existing problem of low precision in user identity verification methods.

The memory could comprise the forms of volatile memory on computer-readable media, random access memory (RAM), and/or non-volatile RAM, such as read-only memory (ROM) or flash RAM. The memory comprises at least one storage chip.

This application also provides a computer program product. When it is executed on a data processing device, it is suitable for executing and initializing program code with the following method steps. As an example:

a server is configured to send a facial quality score threshold and number of eye-print collection steps corresponding to the current mode to a client when a user identity verification request is received;

a client is configured to obtain a facial image based on the facial quality score threshold and obtain one or more eye-print pair images corresponding to the number of eye-print collections steps; and

the server is also configured to receive a facial image sent by a client and one or more eye-print pair images corresponding to the number of eye-print collection steps; compare the facial image to a preset facial image, and compare the eye-print pair images to preset eye-print templates; and send successful identity verification information to the client if the comparison results for the facial image and the eye-print pair images meet preset conditions.

A person skilled in the art should understand that the embodiments of this application can be provided as methods, systems, or computer program products. Therefore, this application may employ a purely hardware embodiment form, purely software embodiment form, or an embodiment form that combines software and hardware. Also, this application may employ the form of computer program products achieved through one or more computer storage media

(including but not limited to magnetic disc memory, CD-ROM, and optical memory) comprising computer-executable program code.

This application is described by referencing flow diagrams and/or block diagrams based on the user identity verification method, apparatus, system, and computer program product of this embodiment. It should be understood that computer program instructions can be used to achieve every flow and/or block in the flow diagrams and/or block diagrams, as well as combinations of flows and/or blocks in the flow diagrams and/or block diagrams. These computer program instructions can be provided to the processor of a general-purpose computer, special-purpose computer, embedded processing machine, or other programmable data processing device to produce a machine, causing the instructions executed by the processor of a computer or other programmable data processing device to produce a device used to achieve the specified functions of one or more flows in a flow diagram and/or one or more blocks in a block diagram.

These computer program instructions can also be stored in computer-readable memory that can cause a computer or other programmable data processing device to operate in a given mode, causing the instructions stored in this computer-readable memory to generate a product comprising an instruction apparatus. This instruction apparatus achieves the functions specified in one or more flows of a flow chart and/or one or more blocks of a block diagram.

These computer program instructions can also be loaded onto a computer or other programmable data processing device, enabling the execution of a series of operation steps on the computer or other programmable device to produce computer processing. Thus, the instructions executed on the computer or other programmable device provide steps for achieving the specified functions of one or more flows in a flow chart and/or one or more blocks in a block diagram.

In one typical configuration, the computation equipment comprises one or more processors (CPUs), input/output interfaces, network interfaces, and internal memory.

The memory could comprise the forms of volatile memory on computer-readable media, random access memory (RAM), and/or non-volatile RAM, such as read-only memory (ROM) or flash RAM. Memory is an example of computer-readable media.

Computer-readable media include permanent, nonpermanent, mobile, and immobile media, which can achieve information storage through any method or technology. The information may be computer-readable instructions, data structures, program modules, or other data. Examples of computer storage media include, but are not limited to, Phase-change RAM (PRAM), Static RAM (SRAM), Dynamic RAM (DRAM), other types of Random Access Memory (RAM), Read-Only Memory (ROM), Electrically Erasable Programmable Read-Only Memory (EEPROM), flash memory or other internal memory technologies, Compact Disk Read-Only Memory (CD-ROM), Digital Versatile Discs (DVD) or other optical memories, cassettes, magnetic tape and disk memories or other magnetic memory devices, or any other non-transmission media, which can be used for storing information that can be accessed by a computation device. According to the definitions herein, computer-readable media exclude transitory computer-readable media (transitory media), such as modulated data signals and carriers.

The preceding are merely embodiments of this application. They are not used to limit this application. For persons skilled in the art, this application could have various modifications and changes. All revisions, equivalent substitutions, and improvements made within the spirit and principles of this application are included.

EMBODIMENTS IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. A user identity verification method, comprising:

sending a facial quality score threshold and a number of eye-print collection steps corresponding to an identity verification mode to a client to obtain facial images based on the facial quality score threshold and obtain eye-print pair images corresponding to the number of eye-print collection steps;

receiving a facial image and one or more eye-print pair images corresponding to an identity verification object from the client, wherein the facial image meets the facial quality score threshold and a number of the one or more eye-print pair images corresponds to the number of eye-print collection steps;

comparing the facial image to a preset facial image, and comparing the one or more eye-print pair images to preset eye-print templates corresponding to the identity verification object; and

when comparison results for the facial image and the one or more eye-print pair images meet preset conditions, sending successful identity verification information to the client.

2. The method according to claim **1**, wherein before sending the facial quality score threshold and the number of eye-print collection steps, the method further comprises:

receiving a user identity verification request;

obtaining a number of preset eye-print templates corresponding to the identity verification object from a preset storage location, wherein the preset storage location stores eye-print templates corresponding to different identity verification objects; and

when the number of eye-print templates corresponding to the identity verification object is no less than a preset threshold, determining a current mode as the identity verification mode.

3. The method according to claim **2**, wherein after obtaining the number of eye-print templates corresponding to the identity verification object, the method further comprises:

when the number of eye-print templates is less than the preset threshold, determining the current mode as an eye-print enrollment mode;

sending the facial quality score threshold and the number of eye-print collection steps corresponding to the eye-print enrollment mode to the client to obtain facial images based on the facial quality score threshold and obtain eye-print pair images corresponding to the number of eye-print collection steps; and

storing the obtained eye-print pair images in the preset storage location as the eye-print templates corresponding to the identity verification object.

4. The method according to claim **1**, wherein comparing the facial image to the preset facial image comprises:

using the facial image and the preset facial image as input to a preset facial algorithm; and

obtaining a facial comparison score corresponding to the identity verification object from the preset facial algorithm.

5. The method according to claim **4**, wherein comparing the one or more eye-print pair images to the preset eye-print templates comprises:

using the one or more eye-print pair images and the eye-print templates corresponding to the identity verification object as input to a preset eye-print algorithm; and

obtaining multiple eye-print liveness scores and an eye-print match score from the preset eye-print algorithm, wherein a number of the multiple eye-print liveness scores corresponds to the number of eye-print collection steps.

6. The method according to claim **5**, wherein the preset conditions include:

the facial comparison score, the multiple eye-print liveness scores, and the eye-print match score are greater than respective preset threshold scores.

7. The method according to claim **4**, further comprising:

when the comparison results for the facial image and the one or more eye-print pair images meet the preset conditions, updating the eye-print templates corresponding to the identity verification object.

8. A user identity verification method, comprising:

receiving a facial quality score threshold and a number of eye-print collection steps corresponding to a current mode;

obtaining a facial image and one or more eye-print pair images corresponding to an identity verification object, the facial image being obtained based on the facial

quality score threshold and a number of the one or more eye-print pair images corresponding to the number of eye-print collection steps; and

sending the obtained facial image and the one or more eye-print pair images to a server to perform identity verification of the identity verification object.

9. The user identity verification method according to claim **8**, wherein sending the obtained facial image to a server comprises:

determining an image quality of the obtained facial image is no less than the facial quality score threshold; and

sending the obtained facial image to the server.

10. The user identity verification method according to claim **8**, wherein before sending the obtained one or more eye-print pair images to the server, the method further comprises:

determining the one or more eye-print pair images meet preset eye-print liveness conditions.

11. A non-transitory computer-readable storage medium for user identity verification, storing instructions executable by one or more processors causing the one or more processors to perform operations comprising:

sending a facial quality score threshold and a number of eye-print collection steps corresponding to an identity verification mode to a client to obtain facial images based on the facial quality score threshold and obtain eye-print pair images corresponding to the number of eye-print collection steps;

receiving a facial image and one or more eye-print pair images corresponding to an identity verification object from the client, wherein the facial image meets the facial quality score threshold and a number of the one or more eye-print pair images corresponds to the number of eye-print collection steps;

comparing the facial image to a preset facial image, and comparing the one or more eye-print pair images to preset eye-print templates; and

when comparison results for the facial image and the one or more eye-print pair images meet preset conditions, sending successful identity verification information to the client.

12. The non-transitory computer-readable storage medium according to claim **11**, wherein before sending the facial quality score threshold and the number of eye-print collection steps, the operations further comprise:

receiving a user identity verification request;

obtaining a number of preset eye-print templates corresponding to the identity verification object from a preset storage location, wherein the preset storage location stores eye-print templates corresponding to different identity verification objects; and

when the number of eye-print templates corresponding to the identity verification object is no less than a preset threshold, determining a current mode as the identity verification mode.

13. The non-transitory computer-readable storage medium according to claim **12**, wherein after obtaining the number of eye-print templates corresponding to the identity verification object, the operations further comprise:

when the number of eye-print templates corresponding to the identity verification object is less than the preset threshold, determining the current mode as an eye-print enrollment mode;

sending the facial quality score threshold and the number of eye-print collection steps corresponding to the eye-print enrollment mode to the client to obtain facial images based on the facial quality score threshold and obtain eye-print pair images corresponding to the number of eye-print collection steps; and

storing the obtained eye-print pair images in the preset storage location as the eye-print templates corresponding to the identity verification object.

14. The non-transitory computer-readable storage medium according to claim **12**, wherein comparing the facial image to the preset facial image comprises:

using the facial image and the preset facial image as input to a preset facial algorithm; and

obtaining a facial comparison score corresponding to the identity verification object from the preset facial algorithm.

15. The non-transitory computer-readable storage medium according to claim **14**, wherein comparing the one or more eye-print pair images to the preset eye-print templates comprises:

using the one or more eye-print pair images and the eye-print templates corresponding to the identity verification object as input to a preset eye-print algorithm; and

obtaining multiple eye-print liveness scores and an eye-print match score from the preset eye-print algorithm, wherein a number of the multiple eye-print liveness scores corresponds to the number of eye-print collection steps.

16. The non-transitory computer-readable storage medium according to claim **15**, wherein the preset conditions include:

the facial comparison score, the multiple eye-print liveness scores, and the eye-print match score are greater than respective preset threshold scores.

17. The non-transitory computer-readable storage medium according to claim **14**, wherein the operations further comprise:

when the comparison results for the facial image and the one or more eye-print pair images meet the preset conditions, updating the eye-print templates corresponding to the identity verification object.

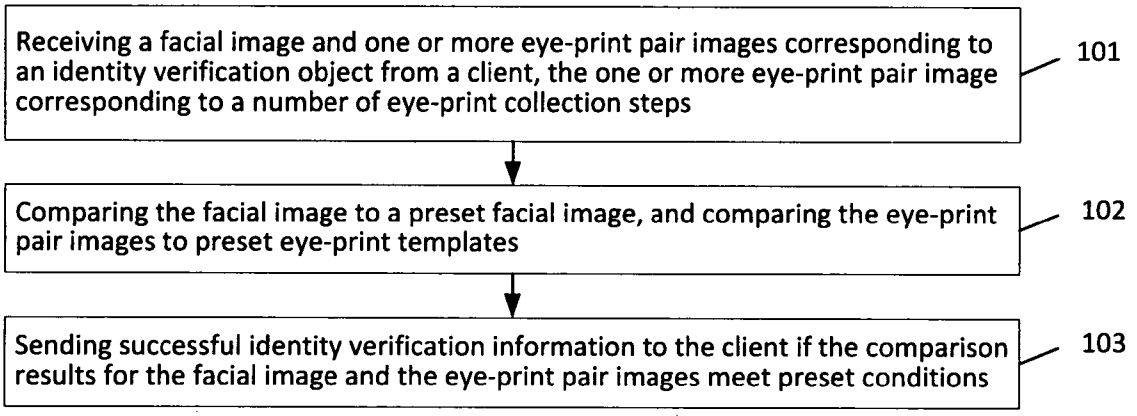
Receiving a facial image and one or more eye-print pair images corresponding to an identity verification object from a client, the one or more eye-print pair image corresponding to a number of eye-print collection steps
101
Comparing the facial image to a preset facial image, and comparing the eye-print pair images to preset eye-print templates
102
Sending successful identity verification information to the client if the comparison results for the facial image and the eye-print pair images meet preset conditions
103

FIG. 1

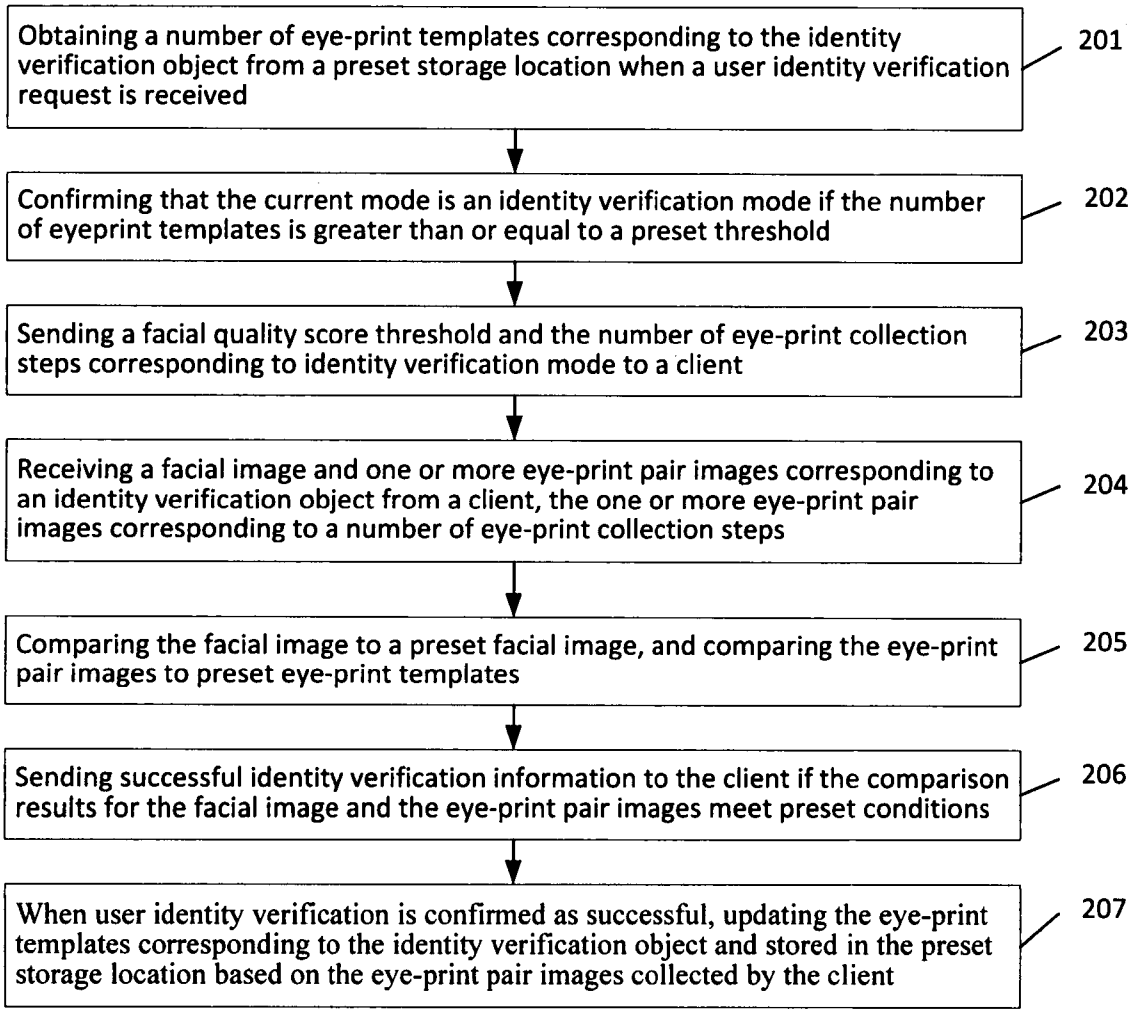
Obtaining a number of eye-print templates corresponding to the identity verification object from a preset storage location when a user identity verification request is received
201
Confirming that the current mode is an identity verification mode if the number of eyeprint templates is greater than or equal to a preset threshold
202
Sending a facial quality score threshold and the number of eye-print collection steps corresponding to identity verification mode to a client
203
Receiving a facial image and one or more eye-print pair images corresponding to an identity verification object from a client, the one or more eye-print pair images corresponding to a number of eye-print collection steps
204
Comparing the facial image to a preset facial image, and comparing the eye-print pair images to preset eye-print templates
205
Sending successful identity verification information to the client if the comparison results for the facial image and the eye-print pair images meet preset conditions
206
When user identity verification is confirmed as successful, updating the eye-print templates corresponding to the identity verification object and stored in the preset storage location based on the eye-print pair images collected by the client
207

FIG. 2

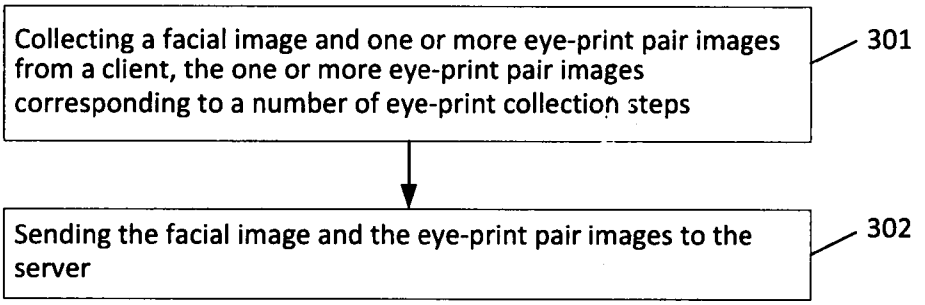

FIG. 3

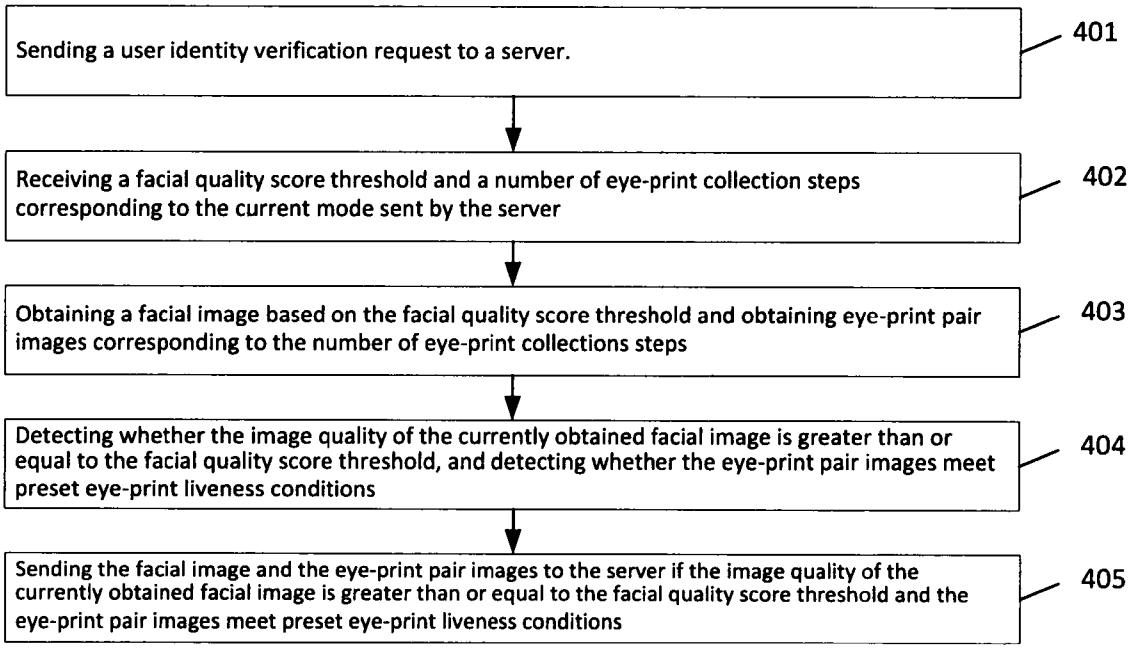

FIG. 4

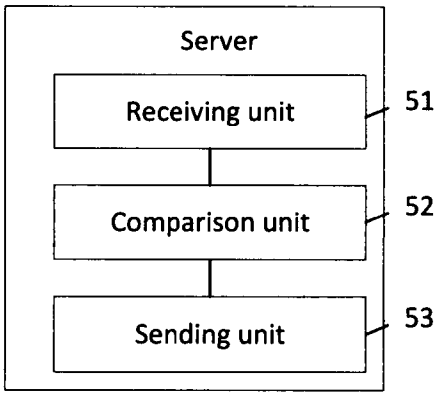

FIG. 5

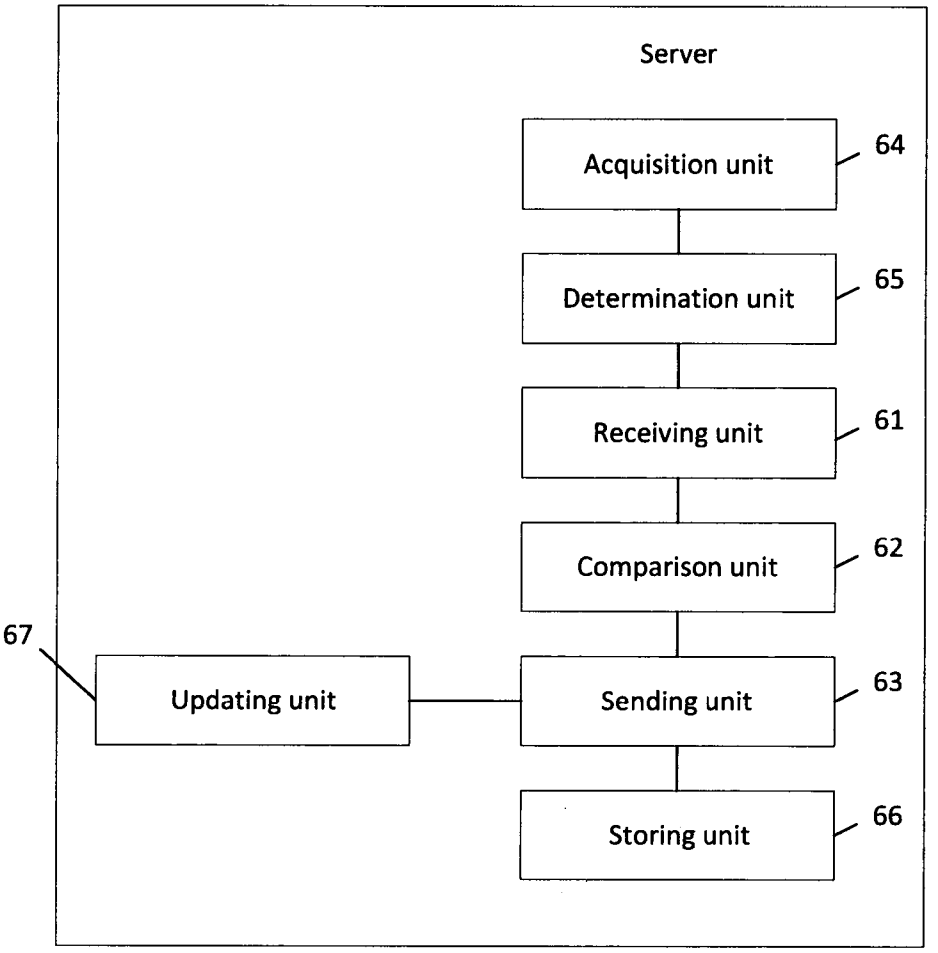
Server
Acquisition unit
64
Determination unit
65
Receiving unit
61
Comparison unit
62
67
Updating unit
Sending unit
63
Storing unit
66

FIG. 6

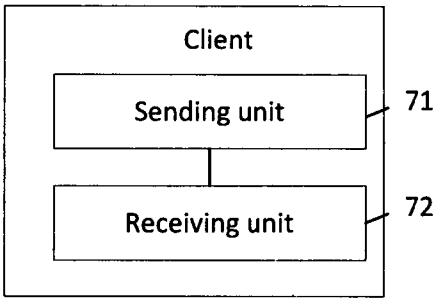
Client
Sending unit
71
Receiving unit
72

FIG. 7

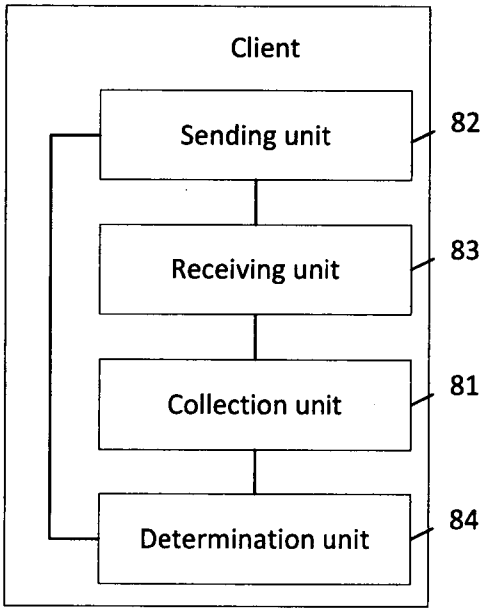
Client
Sending unit
82
Receiving unit
83
Collection unit
81
Determination unit
84

FIG. 8

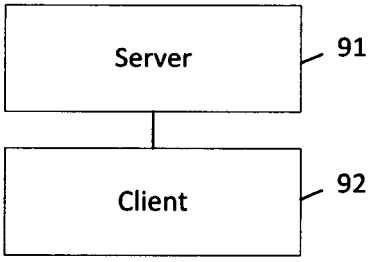
Server
91
Client
92

FIG. 9

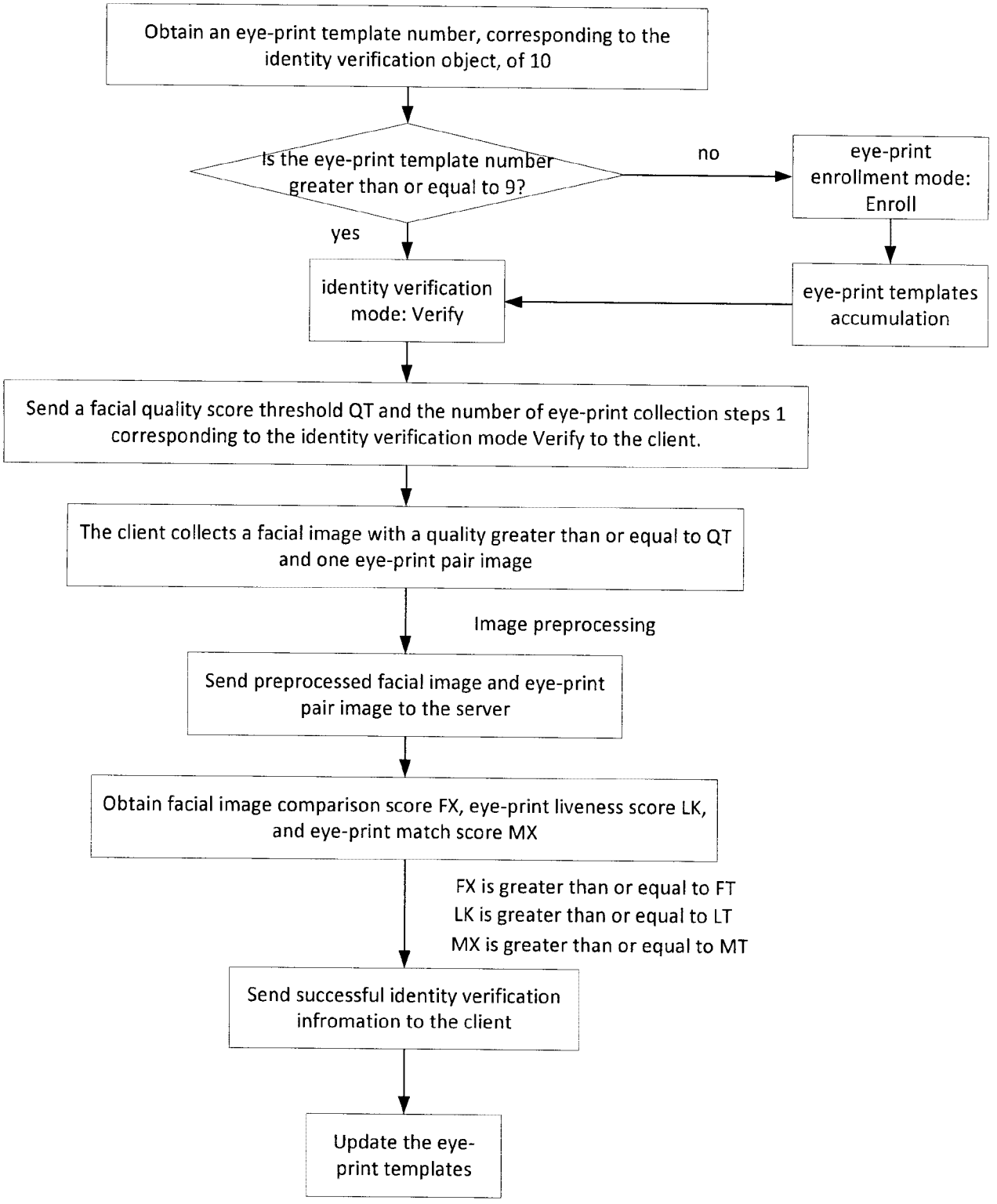
Obtain an eye-print template number, corresponding to the identity verification object, of 10
Is the eye-print template number greater than or equal to 9?
no
eye-print enrollment mode: Enroll
yes
identity verification mode: Verify
eye-print templates accumulation
Send a facial quality score threshold QT and the number of eye-print collection steps 1 corresponding to the identity verification mode Verify to the client.
The client collects a facial image with a quality greater than or equal to QT and one eye-print pair image
Image preprocessing
Send preprocessed facial image and eye-print pair image to the server
Obtain facial image comparison score FX, eye-print liveness score LK, and eye-print match score MX
FX is greater than or equal to FT
LK is greater than or equal to LT
MX is greater than or equal to MT
Send successful identity verification infromation to the client
Update the eye-print templates

FIG. 10

Receiving a facial image and one or more eye-print pair images corresponding to an identity verification object from a client, the one or more eye-print pair images corresponding to a number of eye-print collection steps

Comparing the facial image to a preset facial image, and comparing the eye-print pair images to preset eye-print templates

Sending successful identity verification information to the client if the comparison results for the facial image and the eye-print pair images meet preset conditions

FIG. 1