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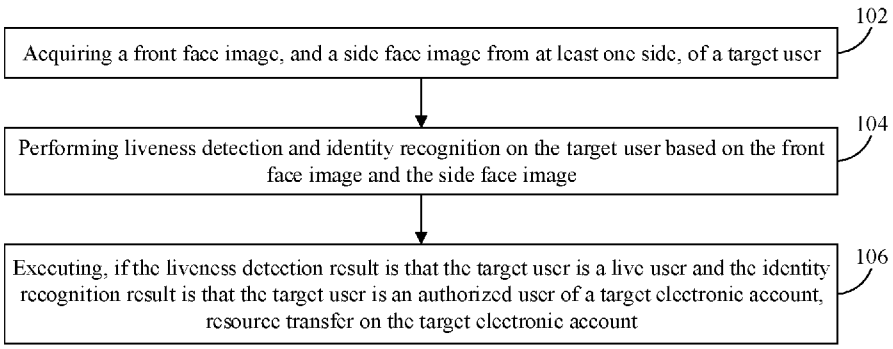


**FIG. 1**

(57) Abstract: Embodiments of the present specification provide a method, apparatus and system for resource transfer, the method comprising: acquiring a front face image and a side face image, from at least one side, of a target user; performing liveness detection and identity recognition on the target user based on the front face image and the side face image; and executing, if the liveness detection result is that the target user is a live user and the identity recognition result is that the target user is an authorized user of a target electronic account, resource transfer on the target electronic account.

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# METHOD, APPARATUS, AND SYSTEM FOR RESOURCE TRANSFER

## Cross-Reference to Related Applications

**[0001]** This international application is based upon and claims priority to Chinese Patent Application No. 201811024632.6, filed on September 4, 2018, the entire content of all of which is incorporated herein by reference.

## Technical Field

**[0002]** The present application relates to the technical field of the Internet, and in particular, to a method, apparatus and system for resource transfer.

## Technical Background

**[0003]** With the rapid development of information technologies, people can use various terminals, such as mobile phones, tablet computers, and vending machines, to perform resource transfer. When a user intends to use a terminal for resource transfer, in order to protect the security of an electronic account of the user, generally only after the user enters a correct payment password, will resource transfer on the electronic account be executed, thereby completing resource transfer.

**[0004]** However, the mode of resource transfer by password authentication may cause password leakage, resulting in a problem of security risks in electronic accounts. Or, when the user forgets the password, resource transfer cannot be carried out.

**[0005]** Therefore, how to improve the security of users' electronic accounts and enable users to transfer resources when forgetting their passwords has become a technical problem to be urgently solved at present.

## Summary of the Invention

**[0006]** An object of embodiments of the present specification is to provide a method, apparatus and system for resource transfer. During resource transfer, whether a target user is an authorized user of a target electronic account is verified by identity recognition based on a front face image and a side face image of the target user, and resource transfer can be carried out without

entering a password by a user, thereby avoiding a situation that resource transfer cannot be carried out because the user forgets the password; in addition, whether the target user is a live user is verified by liveness detection based on the front face image and the side face image, avoiding the problem of security risks in electronic accounts caused by face images of users being acquired by others, thereby improving the security of the electronic accounts; moreover, more feature information is added by combining a front face image and a side face image during liveness detection and identity recognition, thereby improving the accuracy of the liveness detection and the identity recognition, and further protecting the security of users' electronic accounts.

**[0007]** To solve the above technical problems, the embodiments of the present specification are implemented as follows.

**[0008]** An embodiment of the present specification provides a method for resource transfer, including: acquiring a front face image, and a side face image from at least one side, of a target user; performing liveness detection and identity recognition on the target user based on the front face image and the side face image; and executing, if the liveness detection result is that the target user is a live user and the identity recognition result is that the target user is an authorized user of a target electronic account, resource transfer on the target electronic account.

**[0009]** An embodiment of the present specification further provides an apparatus for resource transfer, including: an acquiring module configured to acquire a front face image, and a side face image from at least one side, of a target user; an identifying module configured to perform liveness detection and identity recognition on the target user based on the front face image and the side face image; and an executing module configured to execute, if the liveness detection result is that the target user is a live user and the identity recognition result is that the target user is an authorized user of a target electronic account, resource transfer on the target electronic account.

**[0010]** An embodiment of the present specification further provides a system for resource transfer, including: a client terminal device and a resource transfer server, the client terminal device

being provided with a front face image capturing device and at least one side face image capturing device; wherein

**[0011]** the client terminal device is configured to control, when a target user intends to make a payment using a target electronic account, the front face image capturing device to capture a front face image of the target user and the side face image capturing device to capture a side face image of the target user simultaneously; and send the front face image and the side face image to the resource transfer server; and

**[0012]** the resource transfer server is configured to acquire the front face image and the side face image of the target user; perform liveness detection and identity recognition on the target user based on the front face image and the side face image; and execute, if the liveness detection result is that the target user is a live user and the identity recognition result is that the target user is an authorized user of the target electronic account, resource transfer on the target electronic account.

**[0013]** An embodiment of the present specification further provides a device for resource transfer, including: a processor; and a memory configured to store computer executable instructions, wherein the executable instructions, when being executed, enable the processor to: acquire a front face image, and a side face image from at least one side, of a target user; perform liveness detection and identity recognition on the target user based on the front face image and the side face image; and execute, if the liveness detection result is that the target user is a live user and the identity recognition result is that the target user is an authorized user of a target electronic account, resource transfer on the target electronic account.

**[0014]** An embodiment of the present specification further provides a storage medium configured to store computer executable instructions, the executable instructions, when being executed, implementing the following processes: acquiring a front face image, and a side face image from at least one side, of a target user; performing liveness detection and identity recognition on the target user based on the front face image and the side face image; and executing, if the

liveness detection result is that the target user is a live user and the identity recognition result is that the target user is an authorized user of a target electronic account, resource transfer on the target electronic account.

**[0015]** In the technical solutions of the present embodiments, whether a target user is an authorized user of a target electronic account is verified by identity recognition based on a front face image and a side face image of the target user during resource transfer, and resource transfer can be carried out without entering a password by a user, thereby avoiding a situation that resource transfer cannot be carried out because the user forgets the password; in addition, whether the target user is a live user is verified by liveness detection based on the front face image and the side face image, avoiding the problem of security risks in electronic accounts caused by face images of users being acquired by others, thereby improving the security of the electronic accounts; moreover, more feature information is added by combining a front face image and a side face image during liveness detection and identity recognition, thereby improving the accuracy of the liveness detection and the identity recognition, and further protecting the security of users' electronic accounts.

**Brief Description of the Drawings**

**[0016]** To more clearly describe the technical solutions of the embodiments of the present specification or the prior art, the accompany drawings to be used in the description of the embodiments or of the prior art will be briefly introduced below. Apparently, the accompanying drawings described below are merely some embodiments disclosed in the present application. For those of ordinary skills in the art, other drawings may also be obtained based on these drawings without inventive efforts.

**[0017]** FIG. 1 is one of flowcharts of a method for resource transfer provided in an embodiment of the present specification;

**[0018]** FIG. 2(a) is a schematic diagram of a captured front face image of a target user in the method for resource transfer provided in an embodiment of the present specification;

**[0019]** FIG. 2(b) is a schematic diagram of a captured side face image of the target user in the method for resource transfer provided in an embodiment of the present specification;

**[0020]** FIG. 3(a) is a first one of schematic flowcharts of performing liveness detection on the target user in the method for resource transfer provided in an embodiment of the present specification;

**[0021]** FIG. 3(b) is a first one of schematic diagrams of combined front face image and side face image in the method for resource transfer provided in an embodiment of the present specification;

**[0022]** FIG. 3(c) is a second one of the schematic diagrams of the combined front face image and side face image in the method for resource transfer provided in an embodiment of the present specification;

**[0023]** FIG. 3(d) is a third one of the schematic diagrams of the combined front face image and side face image in the method for resource transfer provided in an embodiment of the present specification;

**[0024]** FIG. 3(e) is a second one of the schematic flowcharts of performing liveness detection on the target user in the method for resource transfer provided in an embodiment of the present specification;

**[0025]** FIG. 4(a) is a schematic diagram of key points on the side face image in the method for resource transfer provided in an embodiment of the present specification;

**[0026]** FIG. 4(b) is a schematic diagram of a standard side face image after conversion in the method for resource transfer provided in an embodiment of the present specification;

**[0027]** FIG. 5 is a second one of the flowcharts of the method for resource transfer provided in an embodiment of the present specification;

**[0028]** FIG. 6 is a third one of the flowcharts of the method for resource transfer provided in an embodiment of the present specification;

**[0029]** FIG. 7 is a fourth one of the flowcharts of the method for resource transfer provided in an embodiment of the present specification;

**[0030]** FIG. 8 is a schematic diagram of a module structure of an apparatus for resource transfer provided in an embodiment of the present specification;

**[0031]** FIG. 9 is a first schematic structural diagram of a system for resource transfer provided in an embodiment of the present specification;

**[0032]** FIG. 10 is a second schematic structural diagram of the system for resource transfer provided in an embodiment of the present specification;

**[0033]** FIG. 11 is a specific schematic structural diagram of a client terminal device in the system for resource transfer provided in an embodiment of the present specification; and

**[0034]** FIG. 12 is a schematic structural diagram of a device for resource transfer provided in an embodiment of the present specification.

**Detailed Description**

**[0035]** To enable those skilled in the art to better understand the technical solutions in the present application, the technical solutions in the embodiments of the present specification will be clearly and completely described below with reference to the accompanying drawings in the embodiments of the present specification. Apparently, the described embodiments are merely a part, rather than all, of the embodiments of the present application. All other embodiments obtained by those of ordinary skills in the art based on the embodiments of the present application without creative efforts shall fall within the scope of protection of the present application.

**[0036]** An embodiment of the present specification provides a method for resource transfer. The method performs, based on a front face image and a side face image of a target user, liveness detection and identity recognition on the target user before executing resource transfer, which can further improve the accuracy of identity recognition by combining the front face image with the side face image; moreover, the occurrence of fraud by using non-live images, such as photos, images displayed on a mobile phone screen, photos printed on paper and the like, can be prevented

through liveness detection, thereby improving the security of users' account numbers; and resource transfer can be carried out without entering a password by a user, thereby avoiding a situation that resource transfer cannot be carried out because the user forgets the password.

**[0037]** The embodiment of the present specification provides a method for resource transfer. The method may be applied to a server side, i.e., an execution entity of the method provided in the embodiment of the present specification is a server.

**[0038]** The resource mentioned in the embodiments of the present specification may be money, virtual currency, credits, etc. Accordingly, the resource transfer may be a payment operation, a virtual currency payment operation, a credits exchange operation, or the like.

**[0039]** FIG. 1 is one of flowcharts of a method for resource transfer provided in an embodiment of the present specification. The method shown in FIG. 1 at least includes the following steps:

**[0040]** Step 102: acquiring a front face image, and a side face image from at least one side, of a target user.

**[0041]** The side face image from at least one side may be a side face image from any one side or side face images from two sides, and therefore, the step 102 at least may include the following three situations: acquiring the front face image and a side face image of a left side of the target user; acquiring the front face image and a side face image of a right side of the target user; and acquiring the front face image, the side face image of the left side, and the side face image of the right side of the target user.

**[0042]** It should be noted that the front face image mentioned in the embodiment of the present specification is an image photographed right in front of the target user and including a whole face portion of the target user, and one schematic diagram of the front face image is shown in FIG. 2(a); and the side face image mentioned in the embodiment of the present specification is an image photographed from a side of the target user and not including the whole face portion of the target user, and one schematic diagram of the side face image is shown in FIG. 2(b).

**[0043]** In the embodiments of the present specification, in step 102, the front face image and the side face image of the target user may be acquired from a client terminal device. In a specific implementation, the front face image and the side face image, from at least one side, of the target user can be captured by the client terminal device and sent to a server.

**[0044]** The client terminal device may be a terminal device, such as a mobile phone, or a tablet computer; or may be a vending machine, or the like. The client terminal device may capture the front face image and the side face image of the target user simultaneously or successively in a sequential order. If the client terminal device captures the front face image and the side face image of the target user successively in a sequential order, the client terminal device may first capture the front face image of the target user, and then capture the side face image of the target user; or may first capture the side face image of the target user, and then capture the front face image of the target user.

**[0045]** The process of capturing the front face image and the side face image is illustrated below by taking the resource transfer being a payment operation as an example.

**[0046]** In a specific implementation, the vending machine may be provided with a front face image capturing device and at least one side face image capturing device, and when a user purchases goods and intends to make a payment through the vending machine, the user can put his/her face in a specific region under the guidance of the vending machine, thereby completing capturing of the front face image and the side face image.

**[0047]** In another specific implementation, the vending machine may also be provided with merely one image capturing device, and when the user purchases goods and intends to make a payment through the vending machine, the user can put his/her face in a first specific region under the guidance of the vending machine to capture the front face image. After completing capturing of the front face image, the user puts his/her face in a second specific region under the guidance of the vending machine to capture the side face image.

**[0048]** Alternatively, when the user is to make a payment using a terminal device, such as a mobile phone or a tablet computer, the user may also first capture the front face image and then capture the side face image as prompted by the terminal device.

**[0049]** Step 104: performing liveness detection and identity recognition on the target user based on the front face image and the side face image.

**[0050]** In the embodiments of the present specification, the purpose of performing liveness detection is to prevent occurrence of a situation that a target electronic account is stolen by outputting an image of the target user, which is acquired by other users, to a carrier (such as a photo, a mobile phone screen, paper printing, or a gum mask) to generate a non-live representation of the target user for identity recognition.

**[0051]** The identity recognition is performed to authenticate whether the target user is an authorized user of the target electronic account. Specifically, the process of liveness detection and the process of identity recognition may be executed simultaneously; or the process of liveness detection may be first executed, and after the liveness detection result indicates that the target user is a live user, the process of identity recognition is executed; or the process of identity recognition may be first executed, and when the identity recognition result indicates that the target user is an authorized user of the target electronic account, the process of liveness detection is executed.

**[0052]** In the embodiments of the present specification, if the process of liveness detection and the process of identity recognition are executed simultaneously, then the time consumption of resource transfer can be shortened, resulting in better user experience; while if the two processes are executed in a sequential order, resource transfer failure can be determined if the target user being not an live user or the target user being not an authorized user of the target electronic account is first identified, and it is not necessary to further execute subsequent steps, thereby reducing workload of the server.

**[0053]** Step 106: executing, if the liveness detection result is that the target user is a live user and the identity recognition result is that the target user is an authorized user of a target electronic account, resource transfer on the target electronic account.

**[0054]** Accordingly, the executing resource transfer on the target electronic account may be executing money deducting operations, credits deducting operations, or the like on the target electronic account. Specific implementation processes of the above steps will be respectively introduced in detail below.

**[0055]** For the ease of understanding, a specific implementation process of the above step 104 will be introduced below by taking first performing liveness detection and then performing identity recognition as an example.

**[0056]** In a specific implementation, the performing liveness detection and identity recognition on the target user based on the front face image and the side face image in step 104 may include step (1) and step (2) as follows.

**[0057]** Step (1): performing liveness detection on the target user based on the front face image and the side face image.

**[0058]** Step (2): identifying whether the target user is an authorized user of a target electronic account based on the front face image and the side face image, if the liveness detection result is that the target user is a live user.

**[0059]** The authorized user of the target electronic account may be a target electronic account holder, or other users authorized by the target electronic account holder to use the target electronic account.

**[0060]** In the embodiments of the present specification, the performing liveness detection on the target user in the above step (1) may be implemented at least by two approaches as follows, which will be respectively introduced below.

**[0061]** Approach I

**[0062]** The performing liveness detection on the target user based on the front face image and the side face image includes the following step I and step II.

**[0063]** Step I: inputting the front face image into a pre-trained first liveness detection model for processing to acquire a first probability outputted from the first liveness detection model; and inputting the side face image into a pre-trained second liveness detection model for processing to acquire a second probability outputted from the second liveness detection model.

**[0064]** The first probability and the second probability are each a probability that the target user is a live user; or the first probability and the second probability are each a probability that the target user is a non-live representation of a user.

**[0065]** Step II: identifying whether the target user is a live user based on the first probability and the second probability.

**[0066]** The first liveness detection model and the second liveness detection model may be the same model. In the embodiments of the present specification, in order to shorten the time consumption of the liveness detection and improve the efficiency of the liveness detection, the front face image and the side face image are inputted into two liveness detection models respectively, whilst performing liveness detection on the target user based on the front face image and the side face image simultaneously.

**[0067]** In some embodiments, a liveness detection model may be pre-trained, the front face image may be first inputted into the liveness detection model for processing to acquire a first probability outputted from the liveness detection model, and then the side face image may be inputted into the liveness detection model for processing to acquire a second probability outputted from the liveness detection model.

**[0068]** Of course, in the embodiments of the present specification, if the side face image of the left side and the side face image of the right side of the target user are captured simultaneously, then three liveness detection models may be pre-trained, the front face image is inputted into one of the liveness detection models for processing, the side face image of the left side is inputted into

one of the liveness detection models for processing input for a process model, and the side face image of the right side is inputted into one of the liveness detection models for processing to obtain three probabilities.

**[0069]** A process of inputting the front face image into the first liveness detection model for processing is the same as a process of inputting the side face image into the second liveness detection model for processing. A specific process of obtaining the first probability from the first liveness detection model will be introduced below by taking inputting the front face image into the first liveness detection model as an example.

**[0070]** In a specific implementation, the first liveness detection model and the second liveness detection model may each be a Convolutional Neural Network (CNN) model. In the embodiments of the present specification, a CNN binary classification model may be employed. The above CNN binary classification model may be trained by pre-collecting a face image sample of a live user and a face image sample of a non-live representation of a user, and annotating the face image sample of the live user and the face image sample of the non-live representation of a user, respectively.

**[0071]** After inputting the front face image of the target user into a CNN, convolution processing is performed on the front face image using a pre-trained convolutional kernel, a sum of a value obtained by convolution and an offset parameter is inputted into an activation function, and an output of the activation function is used as a value of a node in a next layer; convolution processing is continued in the next layer, a sum of a value obtained by convolution and the offset parameter is inputted into the activation function to obtain an output value of the activation function until the last layer, and the output value of the activation function is used as the first probability.

**[0072]** The output value of the activation function may be the probability that the target user is a live user, or the probability that the target user is a non-live representation of a user, and specifically may be set based on an actual application scenario.

**[0073]** The identifying whether the target user is a live user based on the first probability and the second probability in the above step II includes the following processes: performing fusion calculation on the first probability and the second probability to obtain a fusion result corresponding to the first probability and the second probability; and identifying whether the target user is a live user based on the fusion result and a set probability threshold.

**[0074]** In the embodiments of the present specification, the first probability is denoted as $P_1$, the second probability is denoted as $P_2$, and fusion calculation may be performed on the first probability and the second probability based on the following formula.

$$P = W_1 * P_1 + W_2 * P_2$$

In the above formula, $W_1$ is a weight coefficient corresponding to the first probability, $W_2$ is a weight coefficient corresponding to the second probability, and P is the fusion result of the first probability and the second probability.

**[0075]** If the first probability and the second probability are each the probability that the target user is a live user, then after calculating the fusion result of the first probability and the second probability, the fusion result is compared with the set probability threshold. If the fusion result is greater than or equal to the set probability threshold, then the target user can be determined as a live user, and if the fusion result is less than the set probability threshold, then the target user can be determined as a non-live representation of a user.

**[0076]** If the first probability and the second probability are each the probability that the target user is a non-live representation of a user, then after calculating the fusion result of the first probability and the second probability, the fusion result is compared with the set probability threshold. If the fusion result is greater than or equal to the set probability threshold, then the target user can be determined as a non-live representation of a user, and if the fusion result is less than the set probability threshold, then the target user can be determined as a live user.

**[0077]** In a specific implementation, when the first probability and the second probability are each the probability that the target user is a live user, and when the first probability and the second probability are each the probability that the target user is a non-live representation of a user, specific values of the set probability threshold may be identical or different, i.e., the specific values of the set probability threshold may be set based on an actual application scenario. This is not limited in the embodiment of the present specification.

**[0078]** A schematic flowchart of identifying whether the target user is a live user by this approach is shown in FIG. 3(a). In the flowchart shown in FIG. 3(a), the first liveness detection model and the second liveness detection model are each a CNN model, the first liveness detection model uses a CNN model 1, and the second liveness detection model uses a CNN model 2. The front face image of the target user may be inputted into the CNN model 1, and the CNN model 1 processes the front face image. The side face image of the target user may be inputted into the CNN model 2, and the CNN model 2 processes the side face image. The first probability that the target user is a non-live representation of a user is acquired from the CNN model 1, and the second probability that the target user is a non-live representation of a user is acquired from the CNN model 2. Fusion calculation is performed on the first probability and the second probability, and the fusion result is compared with the set probability threshold. If the fusion result is greater than or equal to the set probability threshold, then the target user is considered as a non-live representation of a user, and if the fusion result is less than the set probability threshold, then the target user is considered as a live user.

**[0079]** In a specific implementation, when the service is in a stage of just coming online, whether the target user is a live user can be identified by this approach. In the above approach I, there are low requirements for training sample data during model training, and an initial model can be fast trained, thereby helping the service to quickly live through a cold start stage after coming online.

**[0080]** Approach II

**[0081]** The performing liveness detection on the target user based on the front face image and the side face image includes the following steps:

**[0082]** inputting the front face image and the side face image into a pre-trained third liveness detection model for processing to acquire a third probability outputted from the third liveness detection model; where the third probability is a probability that the target user is a live user, or the third probability is a probability that the target user is a non-live representation of a user; and identifying whether the target user is a live user based on the third probability and the set probability threshold.

**[0083]** In this approach, the front face image and the side face image are inputted into the same liveness detection model for processing. Specifically, after the front face image and the side face image are inputted into the liveness detection model, the third probability is obtained by first preprocessing the front face image and the side face image, and then processing the preprocessed images.

**[0084]** Specifically, the preprocessing the front face image and the side face image may be fusion processing of the front face image and the side face image, i.e., fusing the front face image and the side face image into one image. For example, a size of the front face image is 640×480×3RGB, a size of the side face image is also 640×480×3RGB, and the fused image is 640×480×6RGB, as shown in FIG. 3(b); or the front face image and the side face image may also be laterally spliced, and the spliced image is 1280×480×3RGB, as shown in FIG. 3(c); or the front face image and the side face image may also be longitudinally spliced, and the spliced image is 640×960×3RGB, as shown in FIG. 3(d); where 640 represents a number of row pixels in the image, 480 represents a number of column pixels in the image, and the RGB represents an R value, a G value, and a B value corresponding to each pixel. R represents red, G represents green, and B represents blue.

**[0085]** It should be noted that “3” in the above 640×480×3RGB represents a total of three values, i.e., an R value, a B value, and a G value corresponding to each pixel point in the image;

and "6" in the above 640×480×6RGB represents a total of six values, two R values, two B values, and two G values corresponding to each pixel point in the image.

**[0086]** Of course, the above description is merely illustrative, and does not constitute a limitation to sizes of the front face image and the side face image in the embodiment of the present specification.

**[0087]** Then, after preprocessing the front face image and the side face image, a process of processing the preprocessed image is the same as the process of processing the front face image or processing the side face image in the above approach I. Reference can be made to the above approach I for specific content, which will not be repeated here.

**[0088]** The above specific implementation process of identifying whether the target user is a live user based on the third probability and the set probability threshold is the same as the specific implementation process of identifying whether the target user is a live user based on the fusion result and the set probability threshold in the approach I. Reference can be made to the disclosure in approach I, which will not be repeated here.

**[0089]** A schematic flowchart of identifying whether the target user is a live user by this approach is shown in FIG. 3(e). In the flowchart shown in FIG. 3(e), the third liveness detection model uses a CNN model. After inputting the front face image and the side face image of the target user into the CNN model, first an image is obtained by fusion processing of the front face image and the side face image, and then the fused image is processed to output the third probability that the target user is a non-live representation of a user. The third probability is compared with the set probability threshold. If the third probability is greater than or equal to the set probability threshold, then the target user is considered as a non-live representation of a user, and if the fusion result is less than the set probability threshold, then the target user is considered as a live user.

**[0090]** In a specific implementation, a relatively high amount of training sample data needs to be collected during the model training in this approach, i.e., there are high requirements for the

training sample data. Therefore, this approach may be adopted after the service comes on-line for a period of time.

**[0091]** Specifically, in another specific implementation, after the service comes on-line for a period of time, there is not only the liveness detection model in approach I, but also the liveness detection model in approach II. In this case, the fusion result obtained in approach I is re-fused with the third probability obtained in approach II (linearly weighted), and whether the target user is a live user is determined based on the final fusion result this time.

**[0092]** In the above step (2) of the embodiment of the present specification, the performing identity recognition on the target user based on the front face image and the side face image at least includes step (A) and step (B) as follows.

**[0093]** Step (A): performing a similarity comparison between the front face image and a recorded front face image corresponding to the target electronic account; and performing a similarity comparison between the side face image and a recorded side face image corresponding to the target electronic account.

**[0094]** Step (B): performing identity recognition on the target user based on a front face similarity and a side face similarity.

**[0095]** Specifically, the performing identity recognition on the target user based on a front face similarity and a side face similarity in the above step (B) specifically includes:

**[0096]** determining the target user as an authorized user of the target electronic account if the front face similarity is greater than a first set threshold and the side face similarity is greater than a second set threshold.

**[0097]** The first set threshold and the second set threshold are similarities that are set based on an actual application scenario. For example, a value of the first set threshold may be 95%, a value of the second set threshold may be 90%, and the like. Of course, the description here is merely illustrative and does not limit specific values of the first set threshold and the second set threshold. The embodiment of the present specification does not limit the specific values of the

first set threshold and the second set threshold. The specific values of the first set threshold and the second set threshold can be set based on an actual application scenario. In addition, the value of the first set threshold may be equal to, or different from, the value of the second set threshold.

**[0098]** In the embodiments of the present specification, after performing similarity comparison on the front face image and the recorded front face image, and performing similarity comparison on the side face image and the recorded side face image, the front face similarity is compared with the first set threshold, and the side face similarity is compared with the second set threshold. If the front face similarity is greater than the first set threshold, and the side face similarity is greater than the second set threshold, then the target user identification is considered successful, i.e., the target user can be determined as an authorized user of the target electronic account.

**[0099]** In another embodiment, linear weighting on the front face similarity and the side face similarity can also be calculated, i.e., calculating a first product of the front face similarity and a weight coefficient of the front face similarity, calculating a second product of the side face similarity and a weight coefficient of the side face similarity, then calculating a sum of the first product and the second product, comparing the sum with a set threshold, determining the target user as an authorized user of the target electronic account if the sum is greater than or equal to the set threshold, and determining the target user as not an authorized user of the target electronic account if the sum is less than the set threshold.

**[0100]** The performing a similarity comparison between the front face image and a recorded front face image corresponding to the target electronic account in the above step (A) specifically may be implemented through the following processes:

**[0101]** Key points on the front face image are detected using a pre-trained key point detection model, where in a specific implementation, the key points may be both eyes, a nose tip, lips, eyebrows, and the like of the target user. After detecting the key points on the front face image, the front face image is calibrated based on positions of the key points. For example, the original

face may be biased and in a posture different from a facial posture on a pre-stored recorded front face image. The facial posture on the front face image may be adjusted by affine transformation based on these key points, or the front face image may also be zoomed, stretched, rotated, and the like, so that the adjusted front face image has the same size as the recorded front face image, and has a facial posture consistent with the facial posture in the recorded front face image.

**[0102]** Then, convolution operation is performed on the adjusted front face image through the convolutional neural network to calculate a first front face feature vector of the target user. In addition, if a database directly stores a second front face feature vector corresponding to the recorded front face image, then the second front face feature vector corresponding to the target electronic account is acquired directly from the database. If the database only stores the recorded front face image, then convolution operation is performed on the recorded front face image through the convolutional neural network to obtain the second front face feature vector corresponding to the target electronic account.

**[0103]** Finally, a Euclidean distance between the first front face feature vector and the second feature vector is calculated. The Euclidean distance is determined as a similarity between the front face image and the recorded front face image of the target user.

**[0104]** Since the calculating the Euclidean distance between two vectors belongs to the prior art, the description of the specific calculation process will not be repeated here.

**[0105]** The performing a similarity comparison between the side face image and a recorded side face image corresponding to the target electronic account in the above step (A) specifically may be implemented through step (A1), step (A2), and step (A3) as follows:

**[0106]** Step (A1): standardizing the side face image to obtain a standard side face image; where a size of the standard side face image is a set size, and a side face posture in the standard side face image is a set posture.

**[0107]** Step (A2): extracting a first side face feature vector of the target user based on the standard side face image; and acquiring a second side face feature vector corresponding to the recorded side face image.

**[0108]** Step (A3): calculating a similarity between the side face image and the recorded side face image based on the first side face feature vector and the second side face feature vector.

**[0109]** Specific implementation processes of the above step (A1), step (A2), and step (A3) will be introduced in detail below.

**[0110]** A specific implementation process of the above step (A1) may be: determining positions of key points on the side face image; where the key points at least include: an ear hole center, and a nose tip; and adjusting the side face image based on a position of the ear hole center on the side face image, a position of the nose tip on the side face image, and relative positions of the ear hole center and the nose tip to obtain the standard side face image.

**[0111]** Prior to executing the method provided in the embodiments of the present specification, a large number of side face images of users may be captured, and then the key points on the side face images are manually annotated. Side face images annotated with the key points are used as training samples, and then a key point detection model is obtained by training using the Convolutional Neural Network (CNN).

**[0112]** In a specific implementation, feature vectors of the key points may be trained through the convolutional neural network to obtain the key point detection model. During key point detection, feature vectors of areas on the side face image can be matched with the feature vectors of the above key points to determine the positions of the key points on the side face image.

**[0113]** Specifically, in the embodiments of the present specification, the key point detection model training and the key point detection of the side face image are the same as those of the front face image, except for the key point selection, which is different.

**[0114]** Accordingly, in the embodiments of the present specification, the key points on the side face image may be detected using the key point detection model obtained by training, and the key points are annotated on the side face image.

**[0115]** In a specific implementation, the employed key points may be an ear hole center, a midpoint between eyebrows, a nose tip, a chin tip, and a jawbone joint. The positions of the above key points on the side face are shown in FIG. 4(a). Of course, the selected key points on the side face image may also be other key points, and a merely illustrative description is provided here.

**[0116]** After determining the positions of the key points on the side face image, the side face image may be calibrated using any two or more key points thereof.

**[0117]** A specific process of adjusting the side face image to obtain a standard side face image will be introduced below by taking adjusting the side face image based on two key points (the ear hole center and the nose tip) as an example.

**[0118]** First, a coordinate system is established with a top left corner of the side face image as the origin, a horizontal side edge as the horizontal axis, and a vertical side face as the longitudinal axis, and the side face image is compressed, stretched, cut, etc., so that coordinates of the ear hole center in the coordinate system are (W/2, H/2), i.e., causing the ear hole center to be at a center point of the side face image, where W represents length of the side face image, and H represents height of the side face image. Then, the side face image begins to rotate with the ear hole center as the center point, until a connection line between the ear hole center and the nose tip is parallel to the horizontal axis in the coordinate system. Finally, the side face image is compressed or stretched again, so that coordinates of the nose tip in the coordinate system are (3W/4, H/2), and the standard side face image obtained after adjustment is shown in FIG. 4(b).

**[0119]** Of course, the above description merely shows a specific embodiment of standardizing the side face image. In addition, the side face image may also be standardized using other key points. Of course, the above standard side face image is not in a unique specific form, and may also be in other forms.

**[0120]** An object of the standardizing the side face image is to keep the size of and a facial posture in the side face image consistent with the size of and the facial posture in the recorded side face image, i.e., in the embodiments of the present specification, the recorded side face image is stored in a form of the standard side face image. In the embodiments of the present specification, when performing similarity comparison on the side face image, the side face image is adjusted to have the same size and posture as the recorded side face image, in order to improve the accuracy of the side face similarity comparison.

**[0121]** In the above step (A2), after obtaining the standard side face image, it is necessary to process the side face image, and perform convolution operation on the standard side face image through the convolutional neural network to obtain the first side face feature vector of the side face image.

**[0122]** In the embodiments of the present specification, the database may only pre-store the recorded side face image corresponding to the authorized user of the target electronic account, where the recorded side face image is stored in the form of the standard side face image. Therefore, in the above step (A2), convolution operation may be performed on the recorded side face image through the convolutional neural network to extract the second side face feature vector; or the second side face feature vector corresponding to the recorded side face image may be pre-acquired, and the second side face feature vector is stored in the database together with the recorded side face image. In this case, in the above step (A2), it is only necessary to acquire the second side face feature vector from the database.

**[0123]** Specifically, the calculating a similarity between the side face image and the recorded side face image based on the first side face feature vector and the second side face feature vector in the above step (A3) specifically includes: calculating a Euclidean distance between the first side face feature vector and the second side face feature vector; and determining the Euclidean distance as a similarity between the side face image and the recorded side face image. Since the

calculating the Euclidean distance between two vectors belongs to the prior art, the description of the specific calculation process will not be repeated here.

**[0124]** FIG. 5 is a second one of the flowcharts of the method for resource transfer provided in an embodiment of the present specification. An executing entity of the method is a server side. The method shown in FIG. 5 at least includes the following steps:

**[0125]** Step 502: acquiring a front face image, and a side face image from at least one side, of a target user.

**[0126]** In the embodiments of the present specification, the front face image and the side face image of the target user are captured by a client terminal device. Therefore, the server acquires the front face image and the side face image of the target user from the client terminal device.

**[0127]** Step 504: inputting the front face image into a pre-trained first liveness detection model for processing to acquire a first probability outputted from the first liveness detection model; and inputting the side face image into a pre-trained second liveness detection model for processing to acquire a second probability outputted from the second liveness detection model.

**[0128]** The first probability and the second probability may be a probability that the target user is a live user; or a probability that the target user is a non-live representation of a user. In the embodiment corresponding to FIG. 5, the description is provided by taking the first probability and the second probability being a probability that the target user is a non-live representation of a user as an example.

**[0129]** Step 506: performing fusion calculation on the first probability and the second probability to obtain a fusion result corresponding to the first probability and the second probability.

**[0130]** Step 508: determining whether the fusion result is greater than or equal to a set probability threshold; and executing step 516 if the fusion result is greater than or equal to the set probability threshold; otherwise, executing step 510.

**[0131]** Step 510: performing a similarity comparison between the front face image and a recorded front face image corresponding to a target electronic account; and performing a similarity comparison between the side face image and a recorded side face image corresponding to the target electronic account.

**[0132]** Step 512: determining whether the front face similarity is greater than a first similarity, and whether the side face similarity is greater than a second similarity; and executing step 514 if the front face similarity is greater than the first similarity, and the side face similarity is greater than the second similarity; otherwise, executing step 518.

**[0133]** Step 514: executing resource transfer on the target electronic account.

**[0134]** Step 516: determining the target user as a non-live representation of a user, and sending a prompt message of resource transfer failure to a client terminal device.

**[0135]** Step 518: sending a prompt message of re-capturing face images or resource transfer failure to the client terminal device.

**[0136]** Specific implementation processes of the steps in the embodiment corresponding to FIG. 5 are the same as the specific implementation processes of the steps in the method corresponding to the above embodiments. Therefore, reference can be made to the specific implementation processes of the steps in the above embodiments, which will not be repeated here.

**[0137]** FIG. 6 is a third one of the flowcharts of the method for resource transfer provided in an embodiment of the present specification. The method shown in FIG. 6 takes the resource transfer being a payment operation as an example, and a specific application scenario is that a user is to make a payment when purchasing goods on a vending machine. The vending machine is provided with a front face image capturing device and a side face image capturing device, and is provided with a payment client terminal. Therefore, the vending machine may also become a client terminal device. The method shown in FIG. 6 at least includes the following steps:

**[0138]** Step 602: the client terminal device sending a request for logging in to an electronic account to a server, the request carrying a mobile phone number.

**[0139]** When a user selects goods and is to make a payment through the vending machine, the user sends the request for logging in to the electronic account number to the server through the client terminal device provided on the vending machine.

**[0140]** Step 604: the server finding whether there is an electronic account corresponding to the mobile phone number; and executing step 606 if there is the electronic account corresponding to the mobile phone number; otherwise, executing step 622.

**[0141]** Step 606: the server sending an identity recognition instruction to the client terminal.

**[0142]** Step 608: the client terminal device controlling an image capturing device provided on a vending machine to capture a front face image and a side face image of a target user after receiving the identity recognition instruction sent by the server.

**[0143]** A front face image capturing device and a side face image capturing device are provided at corresponding positions on the vending machine, and the client terminal device controls the front face image capturing device to capture a front face image of the target user and the side face image capturing device to capture a side face image of the target user simultaneously.

**[0144]** Step 610: the client terminal device sending the captured front face image and side face image of the target user to the server.

**[0145]** Step 612: the server inputting the front face image and the side face image into a pre-trained liveness detection model to process the images, and acquiring a probability outputted from the liveness detection model.

**[0146]** The probability may be a probability that the target user is a live user.

**[0147]** Step 614: the server determining whether the probability is greater than or equal to a set probability threshold; and executing step 616 if the probability is greater than or equal to the set probability threshold; otherwise, executing step 624.

**[0148]** Step 616: the server calculating a similarity between the front face image and a recorded front face image corresponding to the electronic account, and calculating a similarity

between the side face image and a recorded side face image corresponding to the electronic account.

**[0149]** Step 618: the server detecting whether the front face similarity is greater than a first set threshold, and whether the side face similarity is greater than a second set threshold; and executing step 620 if the front face similarity is greater than the first set threshold, and the side face similarity is greater than the second set threshold, otherwise, executing step 626.

**[0150]** Step 620: the server executing a deducting operation on the electronic account.

**[0151]** Step 622: the server sending a prompt message of registering an electronic account or re-entering the mobile phone number to the client terminal device.

**[0152]** Step 624: the server determining the target user as a non-live representation of a user, and sending a prompt message of payment failure to the client terminal device.

**[0153]** Step 626: the server sending a prompt message of re-capturing face images or payment failure to the client terminal device.

**[0154]** Specific implementation processes of the steps in the embodiment corresponding to FIG. 6 are the same as the specific implementation processes of the steps in the embodiments corresponding to the above FIG. 1 to FIG. 4(b). Therefore, reference can be made to the specific implementation processes of the steps in the above embodiments, which will not be repeated here.

**[0155]** FIG. 7 shows a fourth one of the flowcharts of the method for resource transfer provided in an embodiment of the present specification. The method shown in FIG. 7 takes the resource transfer being a payment operation as an example, and a specific application scenario is that a user is to make a payment through a terminal device, such as a mobile phone or a tablet computer. The method shown in FIG. 7 at least includes the following steps:

**[0156]** Step 702: a terminal device sending a payment request to a server, where the payment request carries a payment amount.

**[0157]** After completing shopping offline or online, a user opens a payment application program installed on the terminal device to make a payment.

**[0158]** Step 704: the server sending an identity recognition instruction to the terminal device.

**[0159]** Step 706: the terminal device capturing a front face image of a target user through a camera provided on the terminal device after receiving the identity recognition instruction sent by the server.

**[0160]** Specifically, in step 706, the terminal device may display a front face contour on its display screen, prompt the target user to put his/her front face within the front face contour area, and capture the front face image of the target user through the camera after the target user puts his/her front face within the above area.

**[0161]** Step 708: capturing a side face image of the target user through the camera provided on the terminal device after completing capturing of the front face image.

**[0162]** Specifically, in step 708, the terminal device may display a side face contour on its display screen, prompt the target user to put his/her side face within the side face contour area, and capture the side face image of the target user through the camera after the target user puts his/her side face within the above area.

**[0163]** Step 710: the terminal device sending the captured front face image and side face image of the target user to the server.

**[0164]** Step 712: the server inputting the front face image into a pre-trained first liveness detection model for processing to acquire a first probability outputted from the first liveness detection model; and inputting the side face image into a pre-trained second liveness detection model for processing to acquire a second probability outputted from the second liveness detection model.

**[0165]** The first probability and the second probability may be a probability that the target user is a live user; or a probability that the target user is a non-live representation of a user. In the embodiment corresponding to FIG. 7, the description is provided by taking the first probability and the second probability being a probability that the target user is a live user as an example.

**[0166]** Step 714: the server performing fusion calculation on the first probability and the second probability to obtain a fusion result corresponding to the first probability and the second probability.

**[0167]** Step 716: the server determining whether the fusion result is greater than or equal to a set probability threshold; and executing step 718 if the fusion result is greater than or equal to the set probability threshold; otherwise, executing step 724.

**[0168]** Step 718: the server calculating a similarity between the front face image and a recorded front face image corresponding to the electronic account, and calculating a similarity between the side face image and a recorded side face image corresponding to the electronic account.

**[0169]** Step 720: the server detecting whether the front face similarity is greater than a first set threshold, and whether the side face similarity is greater than a second set threshold; and executing step 722 if the front face similarity is greater than the first set threshold, and the side face similarity is greater than the second set threshold, otherwise, executing step 726.

**[0170]** Step 722: the server executing a deducting operation on the electronic account.

**[0171]** Step 724: the server determining the target user as a non-live representation of a user, and sending a prompt message of payment failure to the terminal device.

**[0172]** Step 726: the server sending a prompt message of re-capturing face images or payment failure to the terminal device.

**[0173]** Specific implementation processes of the steps in the embodiment corresponding to FIG. 7 are the same as the specific implementation processes of the steps in the embodiments corresponding to the above FIG. 1 to FIG. 4(b). Therefore, reference can be made to the specific implementation processes of the steps in the above embodiments, which will not be repeated here.

**[0174]** In the method for resource transfer provided in the embodiments of the present specification, whether a target user is an authorized user of a target electronic account is verified by identity recognition based on a front face image and a side face image of the target user during

resource transfer, and resource transfer can be carried out without entering a password by a user, thereby avoiding a situation that resource transfer cannot be carried out because the user forgets the password; in addition, whether the target user is a live user is verified by liveness detection based on the front face image and the side face image, avoiding the problem of security risks in electronic accounts caused by face images of users being acquired by others, thereby improving the security of the electronic accounts; moreover, more feature information is added by combining a front face image and a side face image during liveness detection and identity recognition, thereby improving the accuracy of the liveness detection and the identity recognition, and further protecting the security of users' electronic accounts.

**[0175]** Corresponding to the method for resource transfer shown in FIG. 1 to FIG. 7, and based on the same idea, the embodiment of the present specification further provides an apparatus for resource transfer configured to execute the method for resource transfer provided in the embodiments of the present specification. The apparatus for resource transfer provided in the embodiment of the present specification may be applied to a server side. FIG. 8 is a schematic diagram of a module structure of an apparatus for resource transfer provided in an embodiment of the present specification. The apparatus shown in FIG. 8 includes:

**[0176]** an acquiring module 801 configured to acquire a front face image, and a side face image from at least one side, of a target user; an identifying module 802 configured to perform liveness detection and identity recognition on the target user based on the front face image and the side face image; and an executing module 803 configured to execute, if the liveness detection result is that the target user is a live user and the identity recognition result is that the target user is an authorized user of a target electronic account, resource transfer on the target electronic account.

**[0177]** Alternatively, the identifying module 802 includes: a first identifying unit configured to perform liveness detection on the target user based on the front face image and the side face image; and a second identifying unit configured to perform identity recognition on the

target user based on the front face image and the side face image if the liveness detection result is that the target user is a live user.

**[0178]** Alternatively, the first identifying unit is specifically configured to: input the front face image into a pre-trained first liveness detection model for processing to acquire a first probability outputted from the first liveness detection model; and input the side face image into a pre-trained second liveness detection model for processing to acquire a second probability outputted from the second liveness detection model; where the first probability and the second probability are each a probability that the target user is a live user; or the first probability and the second probability are each a probability that the target user is a non-live representation of a user; and identify whether the target user is a live user based on the first probability and the second probability.

**[0179]** Alternatively, the first identifying unit is further specifically configured to: perform fusion calculation on the first probability and the second probability to obtain a fusion result corresponding to the first probability and the second probability; and identify whether the target user is a live user based on the fusion result and a set probability threshold.

**[0180]** Alternatively, the first identifying unit is further specifically configured to: input the front face image and the side face image into a pre-trained third liveness detection model for processing to acquire a third probability outputted from the third liveness detection model; where the third probability is a probability that the target user is a live user, or the third probability is a probability that the target user is a non-live representation of a user; and identify whether the target user is a live user based on the third probability and the set probability threshold.

**[0181]** Alternatively, the second identifying unit is specifically configured to: perform a similarity comparison between the front face image and a recorded front face image corresponding to the target electronic account; and perform a similarity comparison between the side face image and a recorded side face image corresponding to the target electronic account; and perform identity recognition on the target user based on a front face similarity and a side face similarity.

**[0182]** Alternatively, the second identifying unit is further specifically configured to: standardize the side face image to obtain a standard side face image; where a size of the standard side face image is a set size, and a side face posture in the standard side face image is a set posture; extract a first side face feature vector of the target user based on the standard side face image; and acquire a second side face feature vector corresponding to the recorded side face image; and calculate a similarity between the side face image and the recorded side face image based on the first side face feature vector and the second side face feature vector.

**[0183]** Alternatively, the second identifying unit is further specifically configured to: determine the target user as an authorized user of the target electronic account if the front face similarity is greater than a first set threshold and the side face similarity is greater than a second set threshold.

**[0184]** Specific implementation processes of the functions corresponding to the modules and units in the embodiment of the present specification are the same as the specific implementation processes of the steps in the method embodiments corresponding to FIG. 1 to FIG. 7. Therefore, the method embodiments corresponding to FIG. 1 to FIG. 7 may be referred to for the specific implementation processes of the functions corresponding to the above modules and units. The description will not be repeated here.

**[0185]** In the apparatus for resource transfer provided in the embodiments of the present specification, whether a target user is an authorized user of a target electronic account is verified by identity recognition based on a front face image and a side face image of the target user during resource transfer, and resource transfer can be carried out without entering a password by a user, thereby avoiding a situation that resource transfer cannot be carried out because the user forgets the password; in addition, whether the target user is a live user is verified by liveness detection based on the front face image and the side face image, avoiding the problem of security risks in electronic accounts caused by face images of users being acquired by others, thereby improving the security of the electronic accounts; moreover, more feature information is added by combining

a front face image and a side face image during liveness detection and identity recognition, thereby improving the accuracy of the liveness detection and the identity recognition, and further protecting the security of users' electronic accounts.

**[0186]** Corresponding to the method for resource transfer shown in FIG. 1 to FIG. 7, based on the same idea, an embodiment of the present specification further provides a system for resource transfer. FIG. 9 shows a schematic structural diagram of a system for resource transfer provided in an embodiment of the present specification. The system shown in FIG. 9 includes: a client terminal device 901 and a resource transfer server 902. The client terminal device 901 is provided with a front face image capturing device 9011 and at least one side face image capturing device 9012.

**[0187]** The client terminal device 901 is configured to control, when a target user intends to make a payment using a target electronic account, the front face image capturing device 9011 to capture a front face image of the target user and the side face image capturing device 9012 to capture a side face image of the target user simultaneously; and send the captured front face image and side face image to the resource transfer server 902.

**[0188]** The resource transfer server 902 is configured to acquire the front face image and the side face image of the target user; perform liveness detection and identity recognition on the target user based on the front face image and the side face image; and execute, if the liveness detection result is that the target user is a live user and the identity recognition result is that the target user is an authorized user of the target electronic account, resource transfer on the target electronic account.

**[0189]** The client terminal device 901 may be provided with a side face image capturing device or two side face image capturing devices. In the system shown in FIG. 9, a situation of providing one side face image capturing device on the client terminal device 901 is shown. FIG. 9 is merely illustrative and does not constitute a limitation to a number of side face image capturing devices.

**[0190]** Specifically, in the embodiments of the present specification, in order to achieve the client terminal device being capable of controlling the front face image capturing device 9011 to capture the front face image of the target user and the side face image capturing device 9012 to capture the side face image of the target user simultaneously, the client terminal device may also be provided with an image capture controller 9013, as shown in FIG. 10. The image capture controller 9013 is connected to the front face image capturing device 9011 and the side face image capturing device 9012, and is configured to control the front face image capturing device 9011 to capture the front face image of the target user and the side face image capturing device 9012 to capture the side face image of the target user simultaneously.

**[0191]** FIG. 10 merely shows a situation of providing two side face image capturing devices on the client terminal device 901. FIG. 10 is merely illustrative, and does not constitute a limitation to the number of side face image capturing devices.

**[0192]** Alternatively, the resource transfer server 902 is specifically configured to: perform liveness detection on the target user based on the front face image and the side face image; and perform identity recognition on the target user based on the front face image and the side face image if the liveness detection result is that the target user is a live user.

**[0193]** Alternatively, the resource transfer server 902 is further specifically configured to: input the front face image into a pre-trained first liveness detection model for processing to acquire a first probability outputted from the first liveness detection model; and input the side face image into a pre-trained second liveness detection model for processing to acquire a second probability outputted from the second liveness detection model; where the first probability and the second probability are each a probability that the target user is a live user; or the first probability and the second probability are each a probability that the target user is a non-live representation of a user; and identify whether the target user is a live user based on the first probability and the second probability.

**[0194]** Alternatively, the resource transfer server 902 is further specifically configured to: perform fusion calculation on the first probability and the second probability to obtain a fusion result corresponding to the first probability and the second probability; and identify whether the target user is a live user based on the fusion result and a set probability threshold.

**[0195]** Alternatively, the resource transfer server 902 is further specifically configured to: input the front face image and the side face image into a pre-trained third liveness detection model for processing to acquire a third probability outputted from the third liveness detection model; where the third probability is a probability that the target user is a live user, or the third probability is a probability that the target user is a non-live representation of a user; and identify whether the target user is a live user based on the third probability and the set probability threshold.

**[0196]** Alternatively, the resource transfer server 902 is further specifically configured to: perform a similarity comparison between the front face image and a recorded front face image corresponding to the target electronic account; and perform a similarity comparison between the side face image and a recorded side face image corresponding to the target electronic account; and perform identity recognition on the target user based on a front face similarity and a side face similarity.

**[0197]** Alternatively, the resource transfer server 902 is further specifically configured to: standardize the side face image to obtain a standard side face image; where a size of the standard side face image is a set size, and a side face posture in the standard side face image is a set posture; extract a first side face feature vector of the target user based on the standard side face image; and acquire a second side face feature vector corresponding to the recorded side face image; and calculate a similarity between the side face image and the recorded side face image based on the first side face feature vector and the second side face feature vector.

**[0198]** Alternatively, the resource transfer server 902 is further specifically configured to:

determine the target user as an authorized user of the target electronic account if the front face similarity is greater than a first set threshold and the side face similarity is greater than a second set threshold.

**[0199]** Specific implementation processes of the functions corresponding to the resource transfer server 902 in the embodiment of the present specification are the same as the specific implementation processes of the steps in the method embodiments corresponding to FIG. 1 to FIG. 7. Therefore, the method embodiments corresponding to FIG. 1 to FIG. 7 may be referred to for the specific implementation processes of the functions corresponding to the resource transfer server 902. The description will not be repeated here.

**[0200]** For the ease of understanding, a specific structure of the client terminal device will be introduced below by taking the resource transfer being a payment operation and the client terminal device being a vending machine as an example.

**[0201]** FIG. 11 shows a schematic structural diagram of a vending machine, which includes, in a situation shown in FIG. 11, three image capturing devices, respectively being a left-side face image capturing device, a right-side face image capturing device, and a front face image capturing device. Specifically, in general, the front face image capturing device is placed in the center, the left-side face image capturing device is placed on a left side of the front face image capturing device, and the right-side face image capturing device is placed on a right side of the front face image capturing device.

**[0202]** Specifically, in the machine shown in FIG. 11, the left-side face image capturing device, the front face image capturing device, and the right-side face image capturing device may be cameras, and the three image capturing devices need to be connected to an image capture controller, so that the image capture controller controls the three image capturing devices to capture face images of the target user simultaneously.

**[0203]** Specifically, the left-side face image capturing device, the right-side face image capturing device, the front face image capturing device, and the image capture controller shown in

FIG. 11 are integrated onto the vending machine provided with a payment client terminal to obtain a specific payment system; where the image capture controller may be a control circuit board.

**[0204]** When making a payment using the machine shown in FIG. 11, generally a human face exactly faces to the front face image capturing device.

**[0205]** In the system for resource transfer provided in the embodiments of the present specification, whether a target user is an authorized user of a target electronic account is verified by identity recognition based on a front face image and a side face image of the target user during resource transfer, and resource transfer can be carried out without entering a password by a user, thereby avoiding a situation that resource transfer cannot be carried out because the user forgets the password; in addition, whether the target user is a live user is verified by liveness detection based on the front face image and the side face image, avoiding the problem of security risks in electronic accounts caused by face images of users being acquired by others, thereby improving the security of the electronic accounts; moreover, more feature information is added by combining a front face image and a side face image during liveness detection and identity recognition, thereby improving the accuracy of the liveness detection and the identity recognition, and further protecting the security of users' electronic accounts.

**[0206]** Further, based on the method shown in the above FIG. 1 to FIG. 7, an embodiment of the present specification further provides a device for resource transfer, as shown in FIG. 12.

**[0207]** The resource transfer device may be greatly different due to different configurations or performances and may include one or more processors 1201 and a memory 1202. The memory 1202 may store one or more storage application programs or data. The memory 1202 may be temporary storage or persistent storage. An application program stored in the memory 1202 may include one or more modules (not shown in the figure). Each module may include a series of computer executable instructions in the resource transfer device. Still further, the processor 1201 may be provided in communication with the memory 1202 to execute the series of computer executable instructions in the memory 1202 on the resource transfer device. The resource transfer

device may further include one or more power sources 1203, one or more wired or wireless network interfaces 1204, one or more input and output interfaces 1205, one or more keyboards 1206, and the like.

**[0208]** In a specific implementation, the resource transfer device includes a memory, and one or more programs, where the one or more programs are stored in the memory, and the one or more programs may include one or more modules. Each module may include a series of computer executable instructions in the resource transfer device, and is configured to execute by one or more processors the one or more programs including performing the following computer executable instructions: acquiring a front face image, and a side face image from at least one side, of a target user; performing liveness detection and identity recognition on the target user based on the front face image and the side face image; and executing, if the liveness detection result is that the target user is a live user and the identity recognition result is that the target user is an authorized user of a target electronic account, resource transfer on the target electronic account.

**[0209]** Alternatively, when the computer executable instructions are executed, the performing liveness detection and identity recognition on the target user based on the front face image and the side face image includes: performing liveness detection on the target user based on the front face image and the side face image; and performing identity recognition on the target user based on the front face image and the side face image if the liveness detection result is that the target user is a live user.

**[0210]** Alternatively, when the computer executable instructions are executed, the performing liveness detection on the target user based on the front face image and the side face image includes: inputting the front face image into a pre-trained first liveness detection model for processing to acquire a first probability outputted from the first liveness detection model; and inputting the side face image into a pre-trained second liveness detection model for processing to acquire a second probability outputted from the second liveness detection model; where the first probability and the second probability are each a probability that the target user is a live user; or

the first probability and the second probability are each a probability that the target user is a non-live representation of a user; and identifying whether the target user is a live user based on the first probability and the second probability.

**[0211]** Alternatively, when the computer executable instructions are executed, the identifying whether the target user is a live user based on the first probability and the second probability includes: performing fusion calculation on the first probability and the second probability to obtain a fusion result corresponding to the first probability and the second probability; and identifying whether the target user is a live user based on the fusion result and a set probability threshold.

**[0212]** Alternatively, when the computer executable instructions are executed, the performing liveness detection on the target user based on the front face image and the side face image includes: inputting the front face image and the side face image into a pre-trained third liveness detection model for processing to acquire a third probability outputted from the third liveness detection model; where the third probability is a probability that the target user is a live user, or the third probability is a probability that the target user is a non-live representation of a user; and identifying whether the target user is a live user based on the third probability and the set probability threshold.

**[0213]** Alternatively, when the computer executable instructions are executed, the performing identity recognition on the target user based on the front face image and the side face image includes: performing a similarity comparison between the front face image and a recorded front face image corresponding to the target electronic account; and performing a similarity comparison between the side face image and a recorded side face image corresponding to the target electronic account; and performing identity recognition on the target user based on a front face similarity and a side face similarity.

**[0214]** Alternatively, when the computer executable instructions are executed, the performing a similarity comparison between the side face image and a recorded side face image

corresponding to the target electronic account includes: standardizing the side face image to obtain a standard side face image; where a size of the standard side face image is a set size, and a side face posture in the standard side face image is a set posture; extracting a first side face feature vector of the target user based on the standard side face image; and acquiring a second side face feature vector corresponding to the recorded side face image; and calculating a similarity between the side face image and the recorded side face image based on the first side face feature vector and the second side face feature vector.

**[0215]** Alternatively, when the computer executable instructions are executed, the performing identity recognition on the target user based on a front face similarity and a side face similarity includes: determining the target user as an authorized user of the target electronic account if the front face similarity is greater than a first set threshold and the side face similarity is greater than a second set threshold.

**[0216]** In the device for resource transfer provided in the embodiments of the present specification, whether a target user is an authorized user of a target electronic account is verified by identity recognition based on a front face image and a side face image of the target user during resource transfer, and resource transfer can be carried out without entering a password by a user, thereby avoiding a situation that resource transfer cannot be carried out because the user forgets the password; in addition, whether the target user is a live user is verified by liveness detection based on the front face image and the side face image, avoiding the problem of security risks in electronic accounts caused by face images of users being acquired by others, thereby improving the security of the electronic accounts; moreover, more feature information is added by combining a front face image and a side face image during liveness detection and identity recognition, thereby improving the accuracy of the liveness detection and the identity recognition, and further protecting the security of users' electronic accounts.

**[0217]** Further, based on the method shown in the above FIG. 1 to FIG. 7, an embodiment of the present specification further provides a storage medium configured to store computer

executable instructions. In a specific implementation, the storage medium may be a USB flash disk, an optical disk, a hard disk, or the like. The computer executable instruction stored in the storage medium, when executed by a processor, can implement the following processes: acquiring a front face image, and a side face image from at least one side, of a target user; performing liveness detection and identity recognition on the target user based on the front face image and the side face image; and executing, if the liveness detection result is that the target user is a live user and the identity recognition result is that the target user is an authorized user of a target electronic account, resource transfer on the target electronic account.

**[0218]** Alternatively, when the computer executable instruction stored in the storage medium is executed by a processor, the performing liveness detection and identity recognition on the target user based on the front face image and the side face image includes: performing liveness detection on the target user based on the front face image and the side face image; and performing identity recognition on the target user based on the front face image and the side face image if the liveness detection result is that the target user is a live user.

**[0219]** Alternatively, when the computer executable instruction stored in the storage medium is executed by a processor, the performing liveness detection on the target user based on the front face image and the side face image includes: inputting the front face image into a pre-trained first liveness detection model for processing to acquire a first probability outputted from the first liveness detection model; and inputting the side face image into a pre-trained second liveness detection model for processing to acquire a second probability outputted from the second liveness detection model; where the first probability and the second probability are each a probability that the target user is a live user; or the first probability and the second probability are each a probability that the target user is a non-live representation of a user; and identifying whether the target user is a live user based on the first probability and the second probability.

**[0220]** Alternatively, when the computer executable instruction stored in the storage medium is executed by a processor, the identifying whether the target user is a live user based on

the first probability and the second probability includes: performing fusion calculation on the first probability and the second probability to obtain a fusion result corresponding to the first probability and the second probability; and identifying whether the target user is a live user based on the fusion result and the set probability threshold.

5 **[0221]** Alternatively, when the computer executable instruction stored in the storage medium is executed by a processor, the performing liveness detection on the target user based on the front face image and the side face image includes: inputting the front face image and the side face image into a pre-trained third liveness detection model for processing to acquire a third probability outputted from the third liveness detection model; where the third probability is a 10 probability that the target user is a live user, or the third probability is a probability that the target user is a non-live representation of a user; and identifying whether the target user is a live user based on the third probability and the set probability threshold.

**[0222]** Alternatively, when the computer executable instruction stored in the storage medium is executed by a processor, the performing identity recognition on the target user based on 15 the front face image and the side face image includes: performing a similarity comparison between the front face image and a recorded front face image corresponding to the target electronic account; and performing a similarity comparison between the side face image and a recorded side face image corresponding to the target electronic account; and performing identity recognition on the target user based on a front face similarity and a side face similarity.

20 **[0223]** Alternatively, when the computer executable instruction stored in the storage medium is executed by a processor, the performing a similarity comparison between the side face image and a recorded side face image corresponding to the target electronic account includes: standardizing the side face image to obtain a standard side face image; where a size of the standard side face image is a set size, and a side face posture in the standard side face image is a set posture; 25 extracting a first side face feature vector of the target user based on the standard side face image; and acquiring a second side face feature vector corresponding to the recorded side face image; and

calculating a similarity between the side face image and the recorded side face image based on the first side face feature vector and the second side face feature vector.

**[0224]** Alternatively, when the computer executable instruction stored in the storage medium is executed by a processor, the performing identity recognition on the target user based on a front face similarity and a side face similarity includes: determining the target user as an authorized user of the target electronic account if the front face similarity is greater than a first set threshold and the side face similarity is greater than a second set threshold.

**[0225]** When the computer executable instructions stored in the storage medium provided in the embodiments of the present specification is executed by a processor, whether a target user is an authorized user of a target electronic account is verified by identity recognition based on a front face image and a side face image of the target user during resource transfer, and resource transfer can be carried out without entering a password by a user, thereby avoiding a situation that resource transfer cannot be carried out because the user forgets the password; in addition, whether the target user is a live user is verified by liveness detection based on the front face image and the side face image, avoiding the problem of security risks in electronic accounts caused by face images of users being acquired by others, thereby improving the security of the electronic accounts; moreover, more feature information is added by combining a front face image and a side face image during liveness detection and identity recognition, thereby improving the accuracy of the liveness detection and the identity recognition, and further protecting the security of users' electronic accounts.

**[0226]** In the 1990s, it can be obviously distinguished whether improvements of a technology are improvements in hardware (e.g., improvement on circuit configuration, such as a diode, a transistor, or a switch) or improvements in software (improvement on a process). However, with the development of technologies, many improvements of processes at present can be considered as direct improvements of hardware circuit configurations. Almost all designers program improved processes into hardware circuits to obtain corresponding hardware circuit

configurations. Therefore, it cannot be said that improvements of one process cannot be implemented by a hardware entity module. For example, a Programmable Logic Device (PLD) (e.g., a Field Programmable Gate Array (FPGA)) is such an integrated circuit that its logic function is determined by a user through programming the device. A designer "integrates" a digital system onto a piece of PLD by independent programming without the need for requesting a chip manufacturer to design and make an application specific integrated circuit chip. Moreover, at present, instead of manually making an integrated circuit chip, this programming is also mostly implemented using "logic compiler" software, which is similar to a software compiler used for program development and writing. However, original code before the compilation needs to be written using a specific programming language, which is known as a Hardware Description Language (HDL). There is not just one, but many kinds of HDLs, such as ABEL (Advanced Boolean Expression Language), AHDL (Altera Hardware Description Language), Confluence, CUPL (Cornell University Programming Language), HDCal, JHDL (Java Hardware Description Language), Lava, Lola, MyHDL, PALASM, and RHDL (Ruby Hardware Description Language). At present, VHDL (Very-High-Speed Integrated Circuit Hardware Description Language) and Verilog are most widely used. Those skilled in the art should also be clear that, just by simple logic programming of a process using the above hardware description languages and programming the process into an integrated circuit, it will be very easy to obtain a hardware circuit implementing the logical process.

**[0227]** The controller can be implemented by any suitable approach. For example, the controller can take a form of, e.g., a microprocessor or processor, a computer readable medium storing a computer readable program code (e.g., software or firmware) that can be executed by the (micro)processor, a logic gate, a switch, an Application Specific Integrated Circuit (ASIC), a programmable logic controller, or an embedded microcontroller. Examples of the controller include, but are not limited to, the following microcontrollers: ARC 625D, Atmel AT91SAM, Microchip PIC18F26K20, and Silicone Labs C8051F320. The memory controller may also be

implemented as a part of control logic of the memory. Those skilled in the art also know that, in addition to implementing the controller by a pure computer readable program code, the controller can also be caused to implement identical functions in the form of the logic gate, the switch, the application specific integrated circuit, the programmable logic controller, the embedded microcontroller, or the like completely by logic programming of process steps. Therefore, such a controller may also be considered as a hardware component, and an apparatus configured to implement various functions within the controller may also be considered as a structure within the hardware component. Or even, the apparatus configured to implement various functions may be considered as not only a software module implementing a method, but also a structure within the hardware component.

**[0228]** The system, apparatus, modules or units illustrated in the above-described embodiments may be specifically implemented by a computer chip or entity, or by a product having a certain function. A typical implementing device is a computer. Specifically, for example, the computer may be a personal computer, a laptop computer, a cell phone, a camera phone, a smart phone, a personal digital assistant, a media player, a navigation device, an e-mail device, a game console, a tablet computer, a wearable device, or a combination of any devices of these devices.

**[0229]** For ease of description, the above apparatus is described by dividing it into various units based on functions, and then the units are described respectively. Of course, the present application may be implemented by implementing functions of the units in a given piece or more pieces of software and/or hardware.

**[0230]** It should be appreciated by those skilled in the art that the embodiments of the present application may be provided as a method, system, or computer program product. Accordingly, the present application may take the form of complete hardware embodiments, complete software embodiments, or embodiments combining software and hardware. Further, the present application may take a form of one or more computer program products implemented on a

computer usable storage medium (including but not limited to a disk storage, a CD-ROM, an optical memory, etc.) containing a computer usable program code.

**[0231]** The present application is described with reference to the flowcharts and/or block diagrams of the method, device (system), and computer program product according to the embodiments of the present specification. It should be understood that each process and/or block in the flowcharts and/or block diagrams, and a combination of processes and/or blocks in the flowcharts and/or block diagrams may be implemented by computer program instructions. The computer program instructions can be provided to a general purpose computer, a special purpose computer, an embedded processor, or a processor of another programmable data processing device to produce a machine, causing the instructions executed by a computer or the processor of another programmable data processing device to produce an apparatus configured to implement functions specified in one or more processes of the flowcharts and/or one or more blocks of the block diagrams.

**[0232]** These computer program instructions may also be stored in a computer readable memory capable of directing the computer or another programmable data processing device to function in a particular manner, such that the instructions stored in the computer readable memory produce an article of manufacture including an instructing apparatus. The instructing apparatus implements the functions specified in one or more processes of the flowcharts and/or one or more blocks of the block diagrams.

**[0233]** The computer program instructions can also be loaded into the computer or another programmable data processing device, causing a series of operation steps to be executed on the computer or another programmable device, to produce computer-implemented processing. Therefore, the instructions executed on the computer or another programmable device provide steps used for implementing the functions specified in one or more processes of the flowcharts and/or one or more blocks of the block diagrams.

**[0234]** In a typical configuration, a computing device includes one or more processors (CPU), an input/output interface, a network interface, and an internal memory. The internal memory may include forms in a computer readable medium, such as a volatile memory, a random access memory (RAM), and/or a nonvolatile memory, e.g., a read only memory (ROM) or a flash RAM. The internal memory is an example of the computer readable medium.

**[0235]** The computer readable medium includes permanent/non-permanent media and removable/non-removable media that can achieve information storage by any method or technology. The information may be a computer readable instruction, a data structure, a program module, or other data. Examples of the computer storage medium include, but are not limited to, a phase-change random access memory (PRAM), a static random access memory (SRAM), a dynamic random access memory (DRAM), a random access memory (RAM) of other types, a read only memory (ROM), an electrically erasable programmable read only memory (EEPROM), a flash RAM or other internal memory technologies, a compact disc read only memory (CD-ROM), a digital versatile disc (DVD) or other optical storage, a magnetic cassette tape, and a magnetic tape or magnetic disk storage or other magnetic storage device, or any other non-transmission medium, which can be configured to store information that can be accessed by the computing device. As defined herein, the computer readable medium excludes transitory media, e.g., a modulated data signal or a carrier wave.

**[0236]** It should also be noted that the terms “include,” “comprise,” or any other variations thereof are intended to cover a non-exclusive inclusion, such that a process, method, article, or device that comprises a list of elements not only includes those elements but further includes other elements not expressly listed, or further includes elements inherent to such process, method, article, or device. An element defined by “comprising . . . a” does not, without more constraints, preclude the existence of additional identical elements in the process, method, article, or device that comprises the element.

**[0237]** It should be appreciated by those skilled in the art that the embodiments of the present application may be provided as a method, system, or computer program product. Accordingly, the present application may take a form of complete hardware embodiments, complete software embodiments, or embodiments combining software with hardware. Further, the present application may take a form of one or more computer program products implemented on a computer usable storage medium (including but not limited to a disk storage, a CD-ROM, an optical memory, etc.) containing a computer usable program code.

**[0238]** The present application may be described in a general context of a computer executable instruction executed by the computer, such as a program module. Generally, the program module includes a routine, a program, an object, a component, a data structure, and the like executing particular tasks or implementing particular abstract data types. The present application may also be practiced in distributed computing environments. In the distributed computing environments, tasks are executed by remote processing devices that are linked through a communication network. In the distributed computing environments, the program module may be located in local and remote computer storage media including a storage device.

**[0239]** Various embodiments in the present specification are described in a progressive manner, and identical or similar portions between the various embodiments may be referred to mutually. Each embodiment mainly describes differences from other embodiments. In particular, since the system embodiments are substantially similar to the method embodiments, the description is relatively simple, and for the relevant part, reference may be made to the description of the part of the method embodiments.

**[0240]** The above description is merely embodiments of the present application, and is not intended to limit the present application. For those skilled in the art, the present application may have various modifications and variations. Any modification, equivalent replacement, improvement, or the like made within the spirit and principles of the present application should be included within the scope of the appended claims of the present application.

## CLAIMS

1. A method for resource transfer, comprising:

acquiring a front face image, and a side face image from at least one side, of a target user;

performing a liveness detection and an identity recognition on the target user based on the front face image and the side face image; and

executing, if the liveness detection result is that the target user is a live user and the identity recognition result is that the target user is an authorized user of a target electronic account, resource transfer on the target electronic account.

2. The method according to claim 1, wherein the performing the liveness detection and the identity recognition on the target user based on the front face image and the side face image comprises:

performing the liveness detection on the target user based on the front face image and the side face image; and

performing the identity recognition on the target user based on the front face image and the side face image if the liveness detection result is that the target user is a live user.

3. The method according to claim 2, wherein the performing the liveness detection on the target user based on the front face image and the side face image comprises:

inputting the front face image into a pre-trained first liveness detection model for processing to acquire a first probability outputted from the first liveness detection model; and

inputting the side face image into a pre-trained second liveness detection model for processing to acquire a second probability outputted from the second liveness detection model, wherein the first probability and the second probability are each a probability that the target user is a live user; or the first probability and the second probability are each a probability that the target user is a non-live representation of a user; and

identifying whether the target user is a live user based on the first probability and the second probability.

4. The method according to claim 3, wherein the identifying whether the target user is a live user based on the first probability and the second probability comprises:

performing a fusion calculation on the first probability and the second probability to obtain a fusion result corresponding to the first probability and the second probability; and

identifying whether the target user is a live user based on the fusion result and a set probability threshold.

5. The method according to claim 2, wherein the performing liveness detection on the target user based on the front face image and the side face image comprises:

inputting the front face image and the side face image into a pre-trained third liveness detection model for processing to acquire a third probability outputted from the third liveness detection model, wherein the third probability is a probability that the target user is a live user, or the third probability is a probability that the target user is a non-live representation of a user; and

identifying whether the target user is a live user based on the third probability and a set probability threshold.

6. The method according to claim 2, wherein the performing identity recognition on the target user based on the front face image and the side face image comprises:

performing a similarity comparison between the front face image and a recorded front face image corresponding to the target electronic account; and performing a similarity comparison between the side face image and a recorded side face image corresponding to the target electronic account; and

performing identity recognition on the target user based on a front face similarity and a side

face similarity.

7. The method according to claim 6, wherein the performing a similarity comparison between the side face image and a recorded side face image corresponding to the target electronic account comprises:

standardizing the side face image to obtain a standard side face image; wherein a size of the standard side face image is a set size, and a side face posture in the standard side face image is a set posture;

extracting a first side face feature vector of the target user based on the standard side face image; and acquiring a second side face feature vector corresponding to the recorded side face image; and

calculating a similarity between the side face image and the recorded side face image based on the first side face feature vector and the second side face feature vector.

8. The method according to claim 6, wherein the performing identity recognition on the target user based on a front face similarity and a side face similarity comprises:

determining the target user as an authorized user of the target electronic account if the front face similarity is greater than a first set threshold and the side face similarity is greater than a second set threshold.

9. An apparatus for resource transfer, comprising:

an acquiring module configured to acquire a front face image, and a side face image from at least one side, of a target user;

an identifying module configured to perform liveness detection and identity recognition on the target user based on the front face image and the side face image; and

an executing module configured to execute, if the liveness detection result is that the target

user is a live user and the identity recognition result is that the target user is an authorized user of a target electronic account, resource transfer on the target electronic account.

10. The apparatus according to claim 9, wherein the identifying module comprises:

a first identifying unit configured to perform liveness detection on the target user based on the front face image and the side face image; and

a second identifying unit configured to perform identity recognition on the target user based on the front face image and the side face image if the liveness detection result is that the target user is a live user.

11. The apparatus according to claim 10, wherein the first identifying unit is specifically configured to:

input the front face image into a pre-trained first liveness detection model for processing to acquire a first probability outputted from the first liveness detection model; and input the side face image into a pre-trained second liveness detection model for processing to acquire a second probability outputted from the second liveness detection model; wherein the first probability and the second probability are each a probability that the target user is a live user; or the first probability and the second probability are each a probability that the target user is a non-live representation of a user; and

identify whether the target user is a live user based on the first probability and the second probability.

12. The apparatus according to claim 10, wherein the first identifying unit is further specifically configured to:

input the front face image and the side face image into a pre-trained third liveness detection model for processing to acquire a third probability outputted from the third liveness detection

model; wherein the third probability is a probability that the target user is a live user, or the third probability is a probability that the target user is a non-live representation of a user; and

identify whether the target user is a live user based on the third probability and a set probability threshold.

13. The apparatus according to claim 10, wherein the second identifying unit is specifically configured to:

perform a similarity comparison between the front face image and a recorded front face image corresponding to the target electronic account; and perform a similarity comparison between the side face image and a recorded side face image corresponding to the target electronic account; and

perform identity recognition on the target user based on a front face similarity and a side face similarity.

14. The apparatus according to claim 13, wherein the second identifying unit is further specifically configured to:

standardize the side face image to obtain a standard side face image, wherein a size of the standard side face image is a set size, and a side face posture in the standard side face image is a set posture; extract a first side face feature vector of the target user based on the standard side face image;

acquire a second side face feature vector corresponding to the recorded side face image; and

calculate a similarity between the side face image and the recorded side face image based on the first side face feature vector and the second side face feature vector.

15. A system for resource transfer, comprising: a client terminal device and a resource transfer server, the client terminal device being provided with a front face image capturing device and at least one side face image capturing device; wherein

the client terminal device is configured to control, when a target user intends to make a payment using a target electronic account, the front face image capturing device to capture a front face image of the target user and the side face image capturing device to capture a side face image of the target user simultaneously; and send the front face image and the side face image to the resource transfer server; and

the resource transfer server is configured to acquire the front face image and the side face image of the target user; perform liveness detection and identity recognition on the target user based on the front face image and the side face image; and execute, if the liveness detection result is that the target user is a live user and the identity recognition result is that the target user is an authorized user of the target electronic account, resource transfer on the target electronic account.

16. The system according to claim 15, wherein the resource transfer server is specifically configured to:

perform liveness detection on the target user based on the front face image and the side face image; and

perform identity recognition on the target user based on the front face image and the side face image if the liveness detection result is that the target user is a live user.

17. The system according to claim 16, wherein the resource transfer server is further specifically configured to:

input the front face image into a pre-trained first liveness detection model for processing to acquire a first probability outputted from the first liveness detection model; and input the side face image into a pre-trained second liveness detection model for processing to acquire a second probability outputted from the second liveness detection model; wherein the first probability and the second probability are each a probability that the target user is a live user; or the first probability and the second probability are each a probability that the target user is a non-live representation of

a user; and identify whether the target user is a live user based on the first probability and the second probability.

18. The system according to claim 16, wherein the resource transfer server is further specifically configured to:

input the front face image and the side face image into a pre-trained third liveness detection model for processing to acquire a third probability outputted from the third liveness detection model, wherein the third probability is a probability that the target user is a live user, or the third probability is a probability that the target user is a non-live representation of a user; and identify whether the target user is a live user based on the third probability and a set probability threshold.

19. The system according to claim 16, wherein the resource transfer server is further specifically configured to:

perform a similarity comparison between the front face image and a recorded front face image corresponding to the target electronic account;

perform a similarity comparison between the side face image and a recorded side face image corresponding to the target electronic account; and

perform identity recognition on the target user based on a front face similarity and a side face similarity.

20. A device for resource transfer, comprising:

a processor; and

a memory configured to store computer executable instructions, wherein the executable instructions, when being executed, enable the processor to:

acquire a front face image, and a side face image from at least one side, of a target user;

perform liveness detection and identity recognition on the target user based on the front face

image and the side face image; and

execute, if the liveness detection result is that the target user is a live user and the identity recognition result is that the target user is an authorized user of a target electronic account, resource transfer on the target electronic account.

21. A storage medium configured to store computer executable instructions, the executable instructions, when being executed, implementing the following processes:

acquiring a front face image, and a side face image from at least one side, of a target user;

performing liveness detection and identity recognition on the target user based on the front face image and the side face image; and

executing, if the liveness detection result is that the target user is a live user and the identity recognition result is that the target user is an authorized user of a target electronic account, resource transfer on the target electronic account.

FIGURES

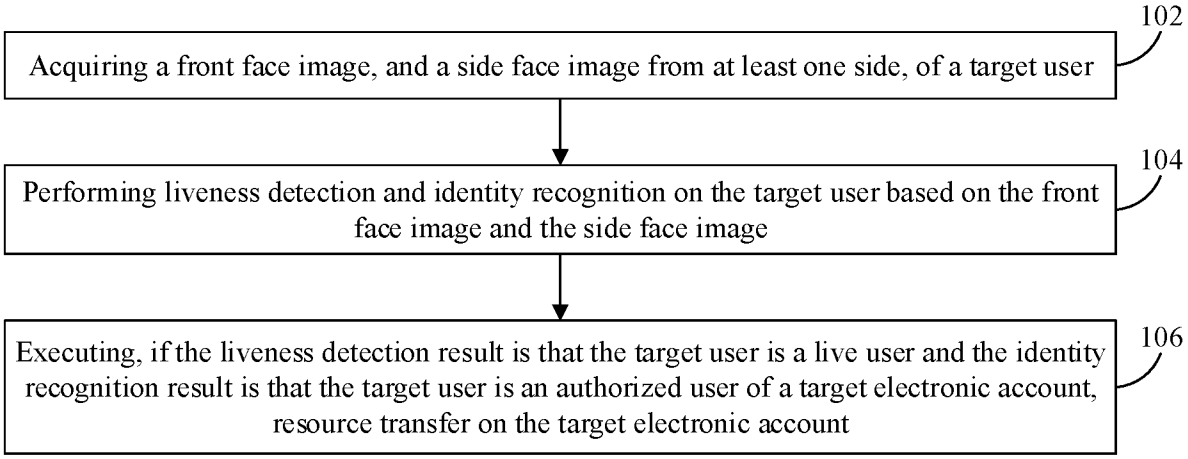


**FIG. 1**

**FIG. 2(a)**

**FIG. 2(b)**

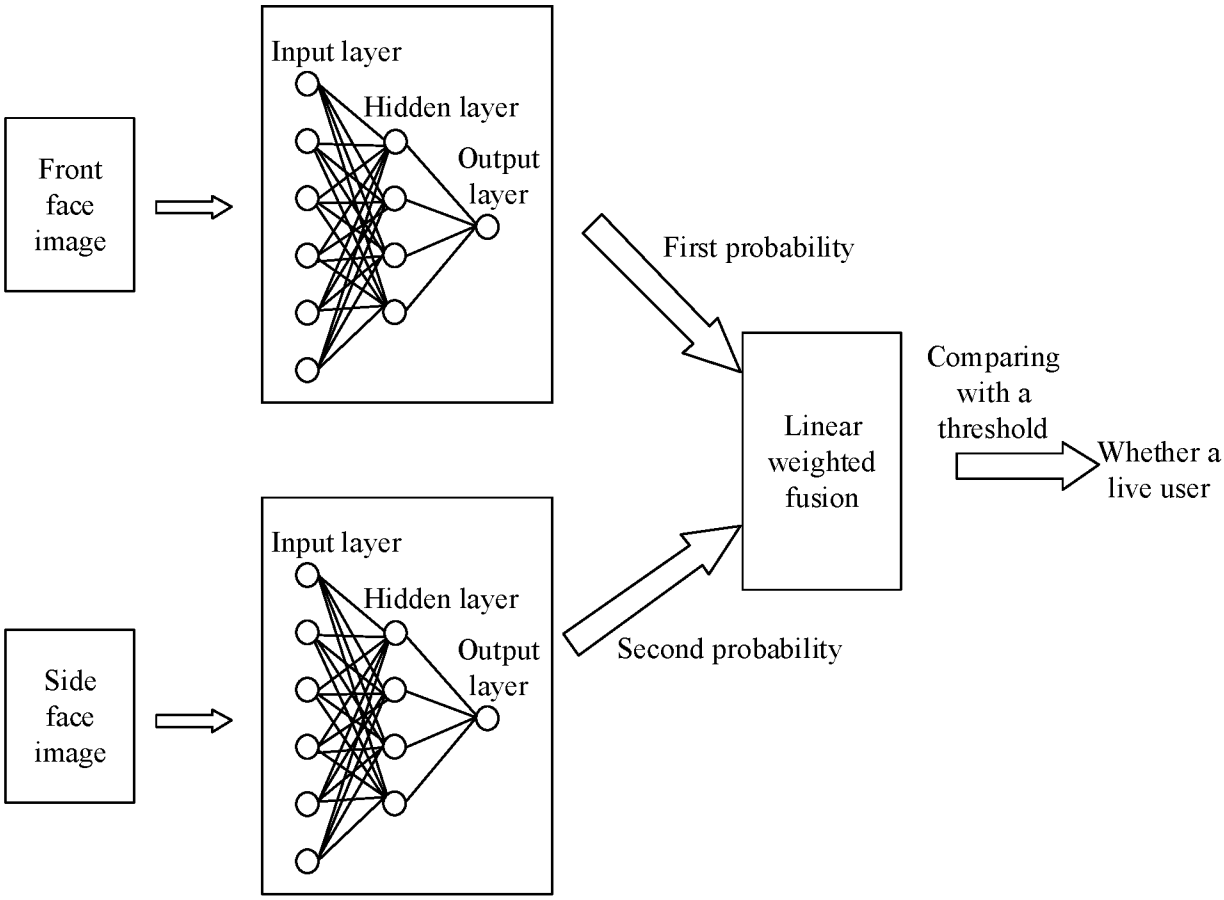
Front face image
Input layer
Hidden layer
Output layer
First probability
Side face image
Input layer
Hidden layer
Output layer
Second probability
Linear weighted fusion
Comparing with a threshold
Whether a live user

FIG. 3(a)

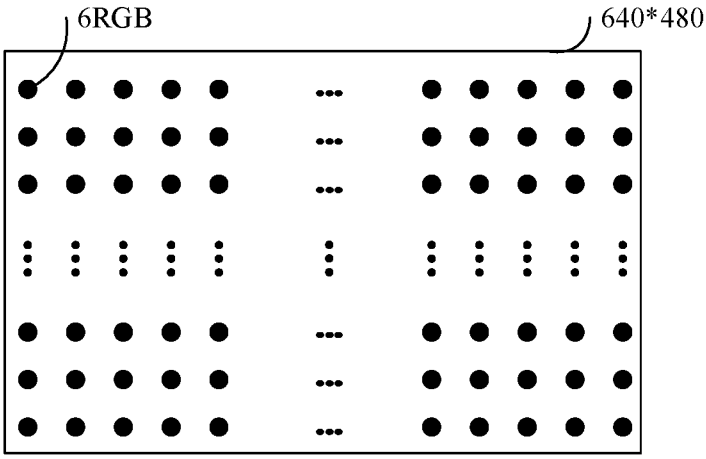
6RGB
640*480

FIG. 3(b)

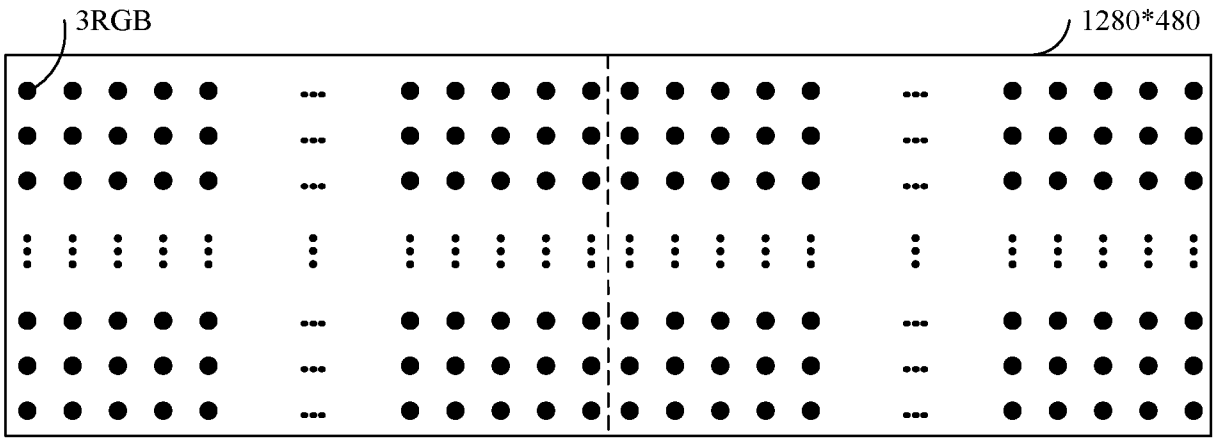


FIG. 3(c)

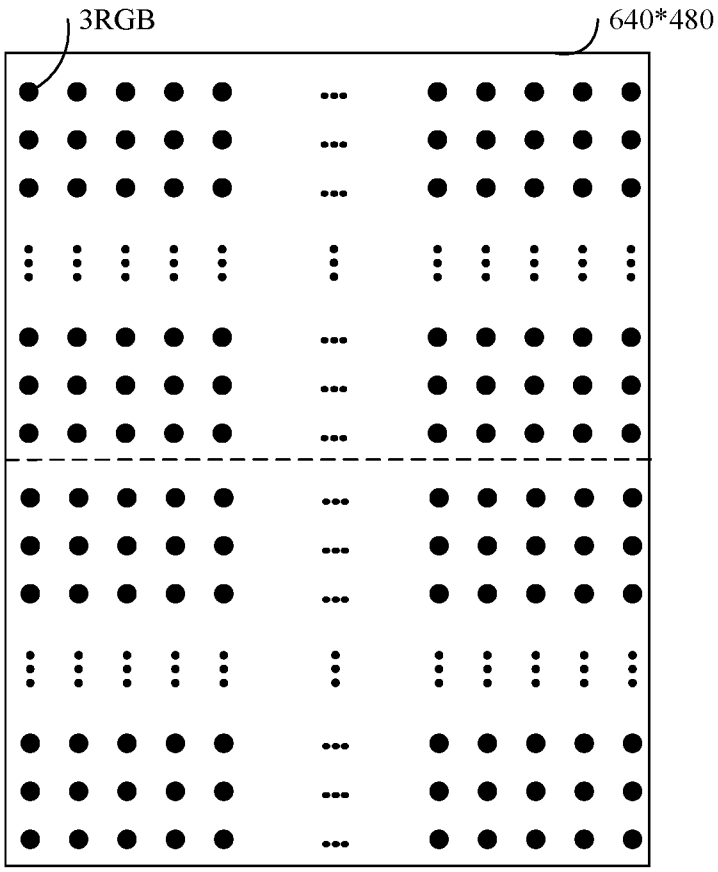


FIG. 3(d)

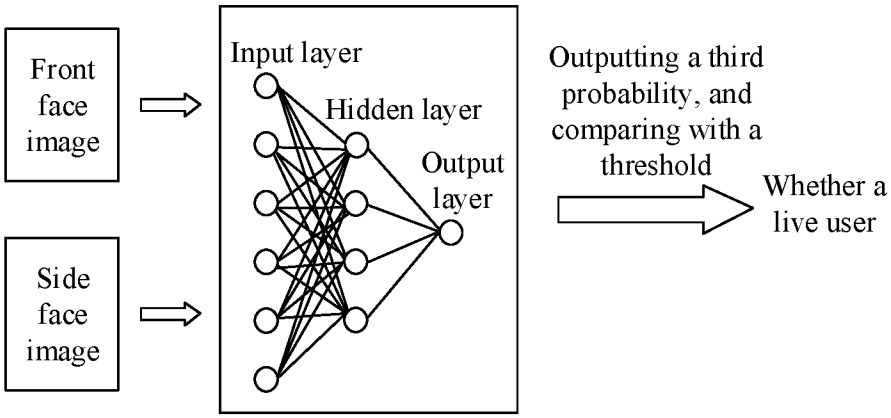


FIG. 3(e)

FIG. 4(a)

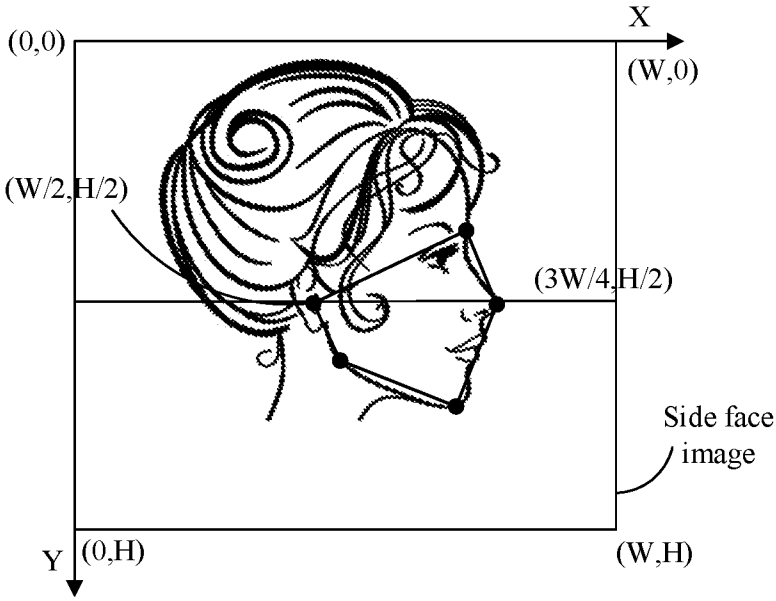


FIG. 4(b)

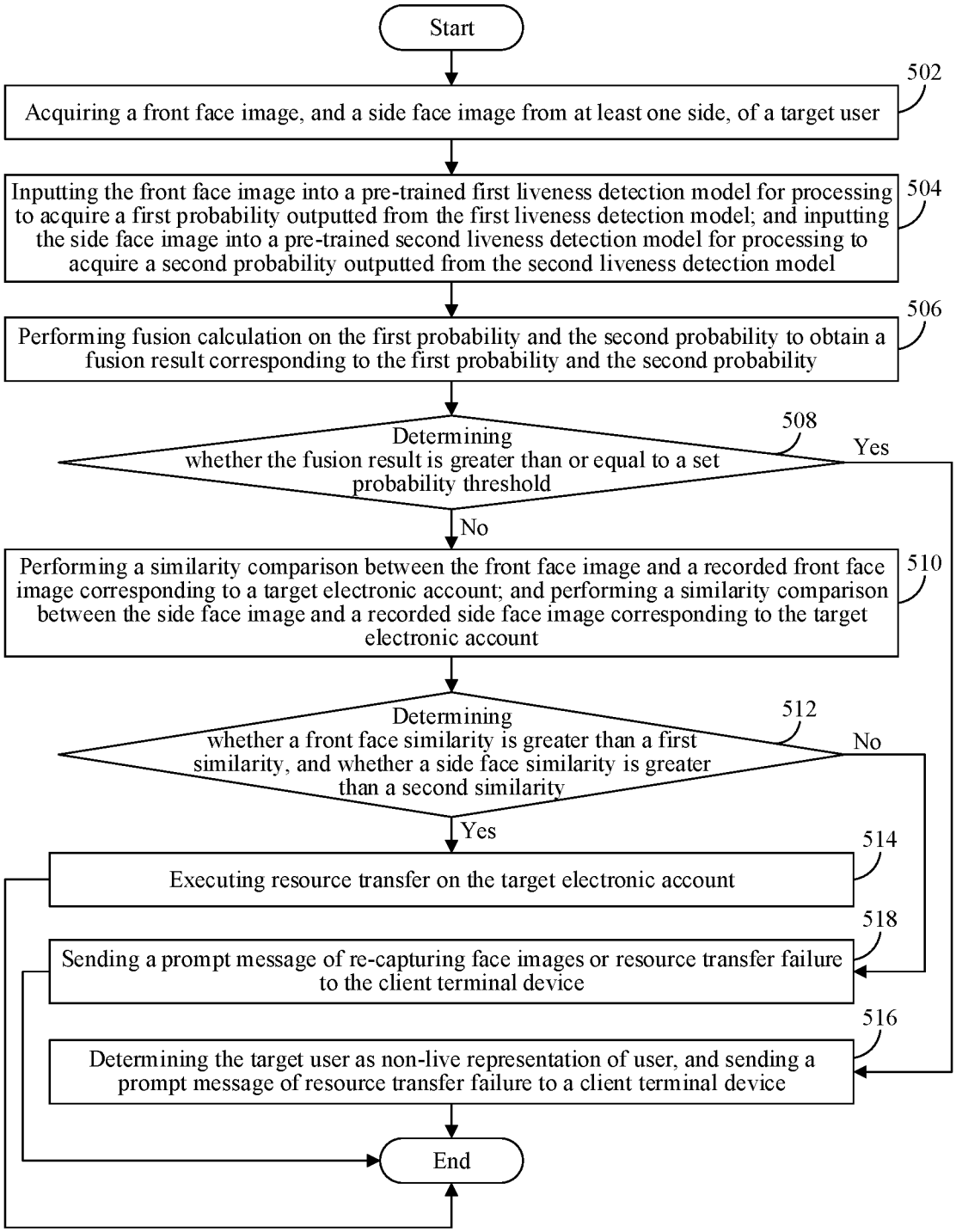
Start
502
Acquiring a front face image, and a side face image from at least one side, of a target user
504
Inputting the front face image into a pre-trained first liveness detection model for processing to acquire a first probability outputted from the first liveness detection model; and inputting the side face image into a pre-trained second liveness detection model for processing to acquire a second probability outputted from the second liveness detection model
506
Performing fusion calculation on the first probability and the second probability to obtain a fusion result corresponding to the first probability and the second probability
508
Determining whether the fusion result is greater than or equal to a set probability threshold
Yes
No
510
Performing a similarity comparison between the front face image and a recorded front face image corresponding to a target electronic account; and performing a similarity comparison between the side face image and a recorded side face image corresponding to the target electronic account
512
Determining whether a front face similarity is greater than a first similarity, and whether a side face similarity is greater than a second similarity
No
Yes
514
Executing resource transfer on the target electronic account
518
Sending a prompt message of re-capturing face images or resource transfer failure to the client terminal device
516
Determining the target user as non-live representation of user, and sending a prompt message of resource transfer failure to a client terminal device
End

**FIG. 5**

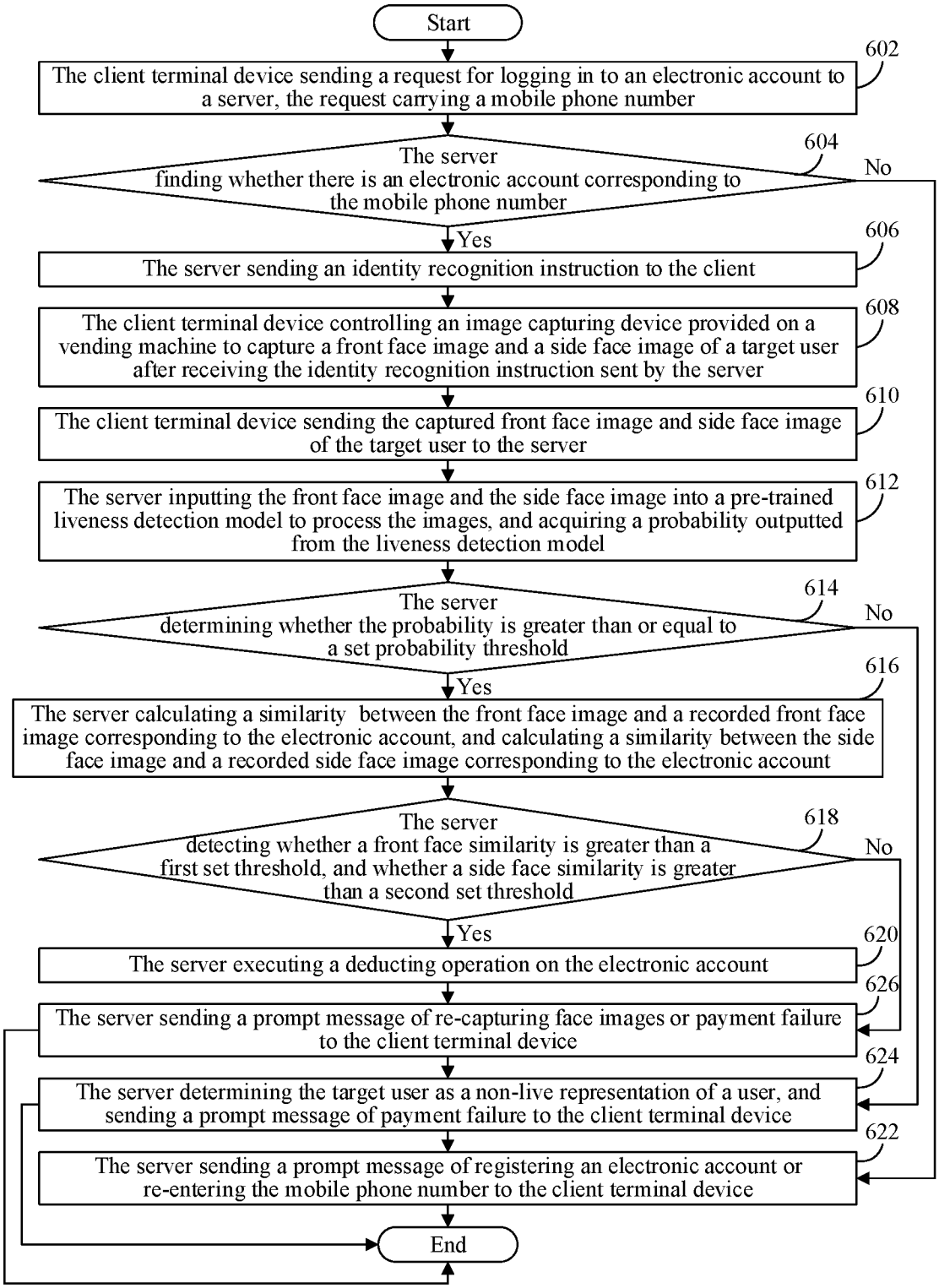
Start
602
The client terminal device sending a request for logging in to an electronic account to a server, the request carrying a mobile phone number
604
The server finding whether there is an electronic account corresponding to the mobile phone number
No
Yes
606
The server sending an identity recognition instruction to the client
608
The client terminal device controlling an image capturing device provided on a vending machine to capture a front face image and a side face image of a target user after receiving the identity recognition instruction sent by the server
610
The client terminal device sending the captured front face image and side face image of the target user to the server
612
The server inputting the front face image and the side face image into a pre-trained liveness detection model to process the images, and acquiring a probability outputted from the liveness detection model
614
The server determining whether the probability is greater than or equal to a set probability threshold
No
Yes
616
The server calculating a similarity between the front face image and a recorded front face image corresponding to the electronic account, and calculating a similarity between the side face image and a recorded side face image corresponding to the electronic account
618
The server detecting whether a front face similarity is greater than a first set threshold, and whether a side face similarity is greater than a second set threshold
No
Yes
620
The server executing a deducting operation on the electronic account
626
The server sending a prompt message of re-capturing face images or payment failure to the client terminal device
624
The server determining the target user as a non-live representation of a user, and sending a prompt message of payment failure to the client terminal device
622
The server sending a prompt message of registering an electronic account or re-entering the mobile phone number to the client terminal device
End

FIG. 6

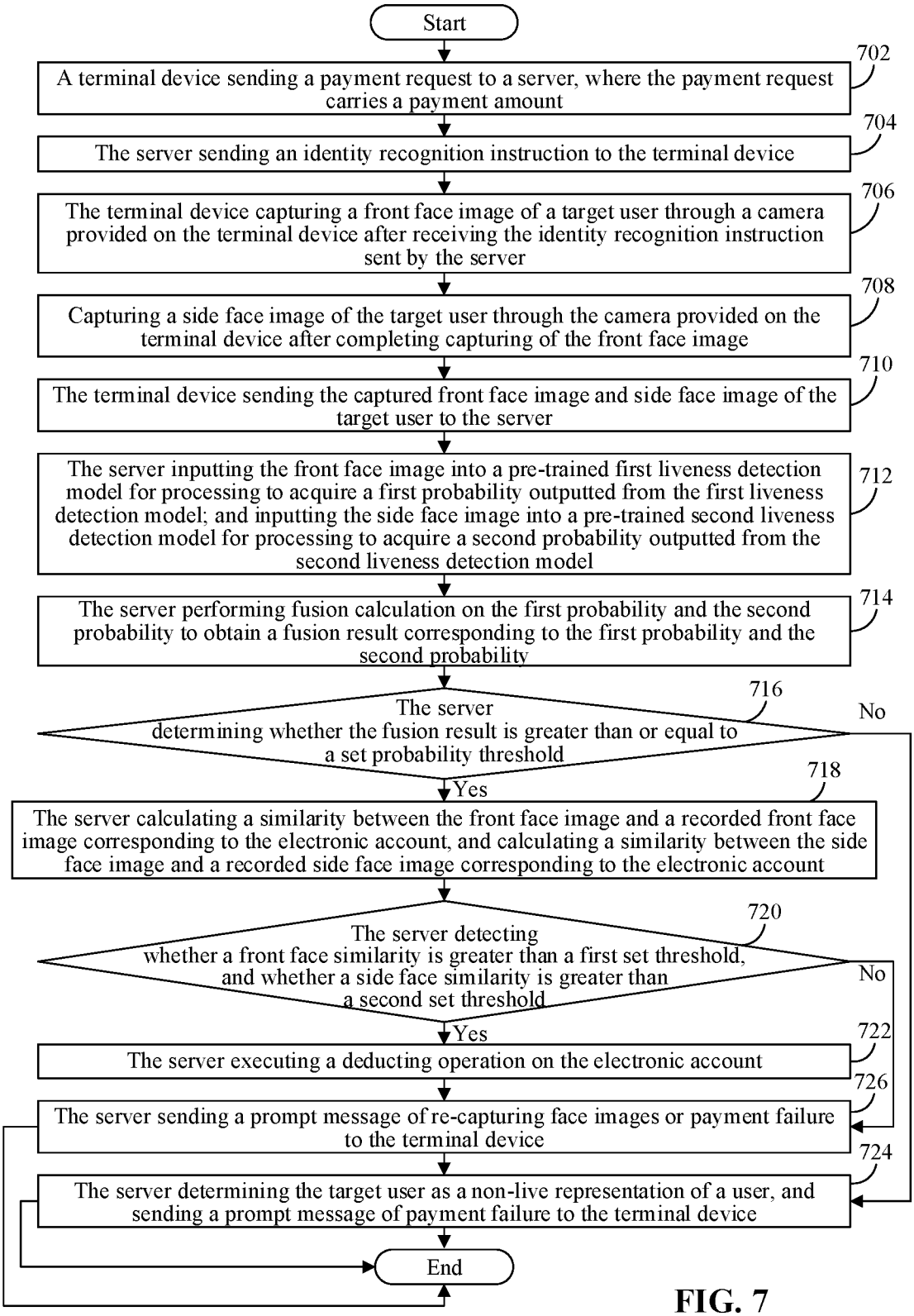
Start
A terminal device sending a payment request to a server, where the payment request carries a payment amount
702
The server sending an identity recognition instruction to the terminal device
704
The terminal device capturing a front face image of a target user through a camera provided on the terminal device after receiving the identity recognition instruction sent by the server
706
Capturing a side face image of the target user through the camera provided on the terminal device after completing capturing of the front face image
708
The terminal device sending the captured front face image and side face image of the target user to the server
710
The server inputting the front face image into a pre-trained first liveness detection model for processing to acquire a first probability outputted from the first liveness detection model; and inputting the side face image into a pre-trained second liveness detection model for processing to acquire a second probability outputted from the second liveness detection model
712
The server performing fusion calculation on the first probability and the second probability to obtain a fusion result corresponding to the first probability and the second probability
714
The server determining whether the fusion result is greater than or equal to a set probability threshold
716
No
Yes
The server calculating a similarity between the front face image and a recorded front face image corresponding to the electronic account, and calculating a similarity between the side face image and a recorded side face image corresponding to the electronic account
718
The server detecting whether a front face similarity is greater than a first set threshold, and whether a side face similarity is greater than a second set threshold
720
No
Yes
The server executing a deducting operation on the electronic account
722
The server sending a prompt message of re-capturing face images or payment failure to the terminal device
726
The server determining the target user as a non-live representation of a user, and sending a prompt message of payment failure to the terminal device
724
End

FIG. 7

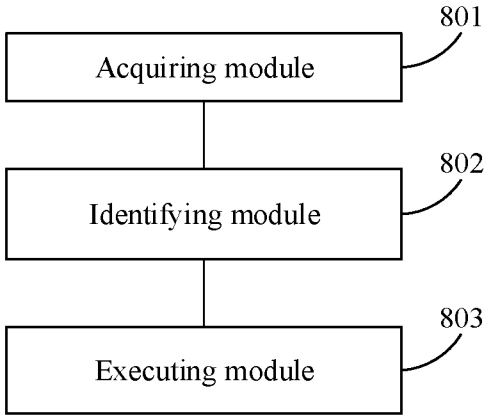


FIG. 8

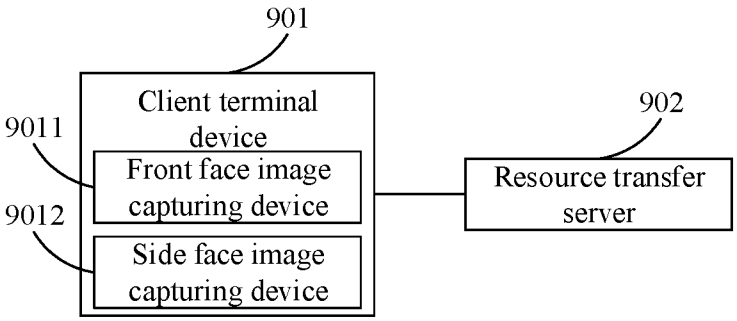


FIG. 9

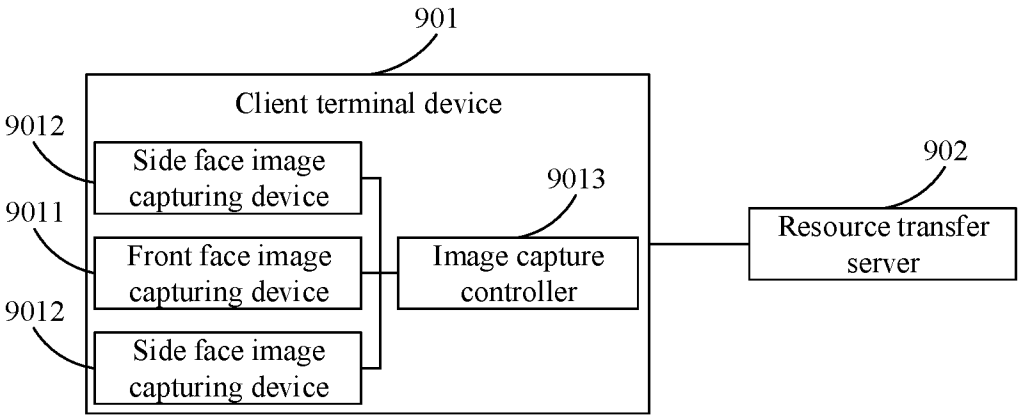


FIG. 10

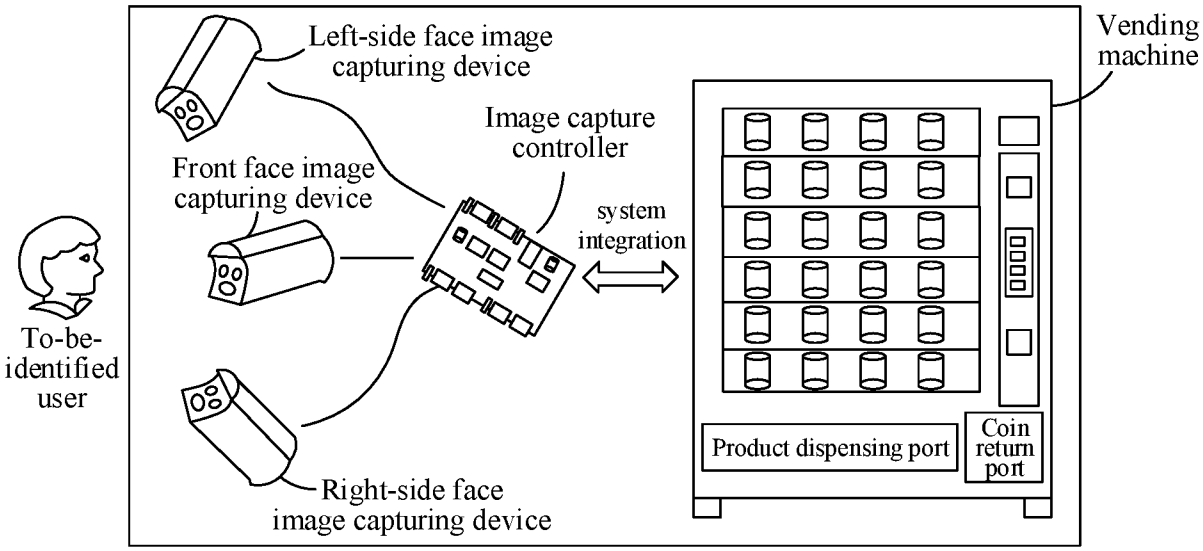
Left-side face image capturing device
Vending machine
Image capture controller
Front face image capturing device
system integration
To-be-identified user
Product dispensing port
Coin return port
Right-side face image capturing device

FIG. 11

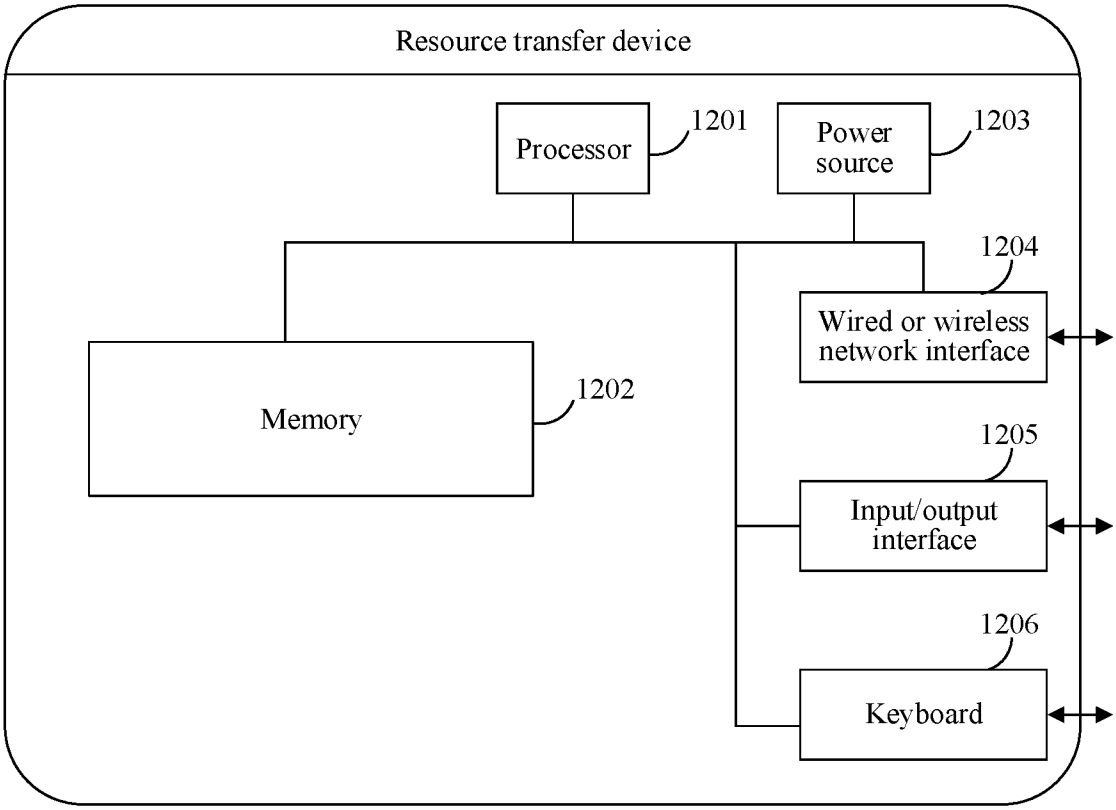
Resource transfer device
Processor
1201
Power source
1203
1204
Wired or wireless network interface
Memory
1202
1205
Input/output interface
1206
Keyboard

FIG. 12

# INTERNATIONAL SEARCH REPORT

International application No
PCT/US2019/048259

**A. CLASSIFICATION OF SUBJECT MATTER**
INV. G06K9/00
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)
G06K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| X | CN 107 590 463 A (GUANGDONG OPPO MOBILE TELECOMMUNICATIONS CORP LTD) 16 January 2018 (2018-01-16) paragraph [0048] - paragraph [0072] figures 5,6 ----- | 1-21 |
| X | ANNU ET AL: "Liveness Detection in Face Recognition Using Euclidean Distances", INTERNATIONAL JOURNAL FOR ADVANCE RESEARCH IN ENGINEERING AND TECHNOLOGY, vol. 1, no. IV, 1 May 2013 (2013-05-01), pages 1-5, XP055630238, ISSN: 2320-6802 section 3 section 4 figure 2 ----- | 1,2, 6-10, 13-16, 19-21 |

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

| Date of the actual completion of the international search | Date of mailing of the international search report |
|---|---|
| 9 October 2019 | 17/10/2019 |

| Name and mailing address of the ISA/ | Authorized officer |
|---|---|
| European Patent Office, P.B. 5818 Patentlaan 2<br>NL - 2280 HV Rijswijk<br>Tel. (+31-70) 340-2040,<br>Fax: (+31-70) 340-3016 | Angelopoulou, Maria |

# INTERNATIONAL SEARCH REPORT

**Information on patent family members**

International application No
PCT/US2019/048259

| Patent document cited in search report | Publication date | Patent family member(s) | Publication date |
|---|---|---|---|
| CN 107590463 A | 16-01-2018 | CN 107590463 A | 16-01-2018 |
| | | EP 3454255 A1 | 13-03-2019 |
| | | US 2019080188 A1 | 14-03-2019 |
| | | WO 2019052418 A1 | 21-03-2019 |