VIRTUAL REALITY ENVIRONMENT-BASED IDENTITY AUTHENTICATION METHOD AND APPARATUS

TECHNICAL FIELD

[0001] The present application relates to the field of computer applications, and in particular, to a virtual reality environment-based identity authentication method and apparatus.

BACKGROUND

[0002] A virtual reality (VR) technology is a technology that generates an interactive three-dimensional interaction environment on a computer by using a computer graphics system and various control interfaces, and that provides an immersion sense for a user. With the development of the VR technology and hardware, application scenarios of the VR technology are increasingly abundant.

[0003] However, although the VR technology can provide a user with a lifelike immersion sense, if the user needs to perform a target service that requires security authentication in a VR scene when the user experiences immersion by wearing a VR terminal device, quickly performing security authentication on the target service (such as a payment service) is of great significance in improving user experience.

SUMMARY

[0004] The present application proposes a virtual reality environment-based identity authentication method, where the method is applied to a virtual reality terminal device and includes the following: receiving a user identity authentication request; outputting a prompt interface that is used to notify a user to complete collection of an eye physiological feature in a virtual reality environment, where the prompt interface includes a virtual eye model, and when the user's eye moves, the virtual eye model simulates an eye action of the user; collecting the eye physiological feature of the user; and performing identity authentication on the user based on the

collected eye physiological feature.

[0005] The present application further proposes a virtual reality environment-based identity authentication apparatus, where the apparatus is applied to a virtual reality terminal device and includes the following: a receiving module, configured to receive a user identity authentication request; an output module, configured to output a prompt interface that is used to notify a user to complete collection of an eye physiological feature in a virtual reality environment, where the prompt interface includes a virtual eye model, and when the user's eye moves, the virtual eye model simulates an eye action of the user; a first collection module, configured to collect the eye physiological feature of the user; and an authentication module, configured to perform identity authentication on the user based on the collected eye physiological feature.

[0006] In the present application, after receiving the user identity authentication request, the virtual reality terminal device can output the prompt interface that is used to notify the user to complete collection of the eye physiological feature in the virtual reality environment. The prompt interface includes the virtual eye model that simulates the eye action of the user. The virtual reality terminal device collects the eye physiological feature of the user, and performs identity authentication on the user based on the collected eye physiological feature.

[0007] In one aspect, the virtual eye model that simulates the eye action of the user in real time is output in the virtual reality environment. As such, the user can view an eye action of the user in real time in the virtual reality environment in a process of collecting the eye physiological feature, and further, under a prompt of the virtual eye model, the user can adjust an eye posture in a timely way to improve precision of collecting the eye physiological feature.

[0008] In another aspect, the eye physiological feature of the user is collected, and identity authentication is performed on the user based on the collected eye physiological feature. As such, user identity authentication can be quickly completed in the virtual reality environment, and interaction complexity during user identity authentication is reduced.

BRIEF DESCRIPTION OF DRAWINGS

[0009] FIG. 1 is a flowchart illustrating a VR environment-based identity

authentication method, according to an implementation of the present application;

[0010] FIG. 2 is a schematic diagram illustrating a prompt interface output in a VR environment, according to an implementation of the present application;

[0011] FIG. 3 is a schematic interaction diagram illustrating an example that a user completes quick payment by using an eye physiological feature in a VR environment, according to an implementation of the present application;

[0012] FIG. 4 is a logical block diagram illustrating a VR environment-based identity authentication apparatus, according to an implementation of the present application; and

[0013] FIG. 5 is a structural diagram illustrating hardware of a VR terminal device including a VR environment-based identity authentication apparatus, according to an implementation of the present application.

DESCRIPTION OF IMPLEMENTATIONS

[0014] The present application is intended to propose a technical solution for outputting a virtual eye model that simulates an eye action of a user in real time in a VR environment, so as to notify the user to complete collection of an eye physiological feature, and perform identity authentication on the user based on the collected eye physiological feature.

[0015] After receiving a user identity authentication request, a virtual reality terminal device can output a prompt interface that is used to notify a user to complete collection of an eye physiological feature in a virtual reality environment. The prompt interface includes a virtual eye model that simulates an eye action of the user. The virtual reality terminal device collects the eye physiological feature of the user, and performs identity authentication on the user based on the collected eye physiological feature.

[0016] In one aspect, the virtual eye model that simulates the eye action of the user in real time is output in the virtual reality environment. As such, the user can view an eye action of the user in real time in the virtual reality environment in a process of collecting the eye physiological feature, and further, under a prompt of the virtual eye model, the user can adjust an eye posture in a timely way to improve precision of collecting the eye physiological feature.

[0017] In another aspect, the eye physiological feature of the user is collected, and

identity authentication is performed on the user based on the collected eye physiological feature. As such, user identity authentication can be quickly completed in the virtual reality environment, and interaction complexity during user identity authentication is reduced.

[0018] For example, the technical solutions of the present application are applied to quick payment in a VR environment. After the user triggers a quick payment service in the VR environment, a user identity authentication request can be initiated to a VR terminal device by using a payment client device. After receiving the user identity authentication request, the VR terminal device can output a virtual eye model that simulates an eye action of the user in real time in the VR environment, to notify the user to complete collection of an eye physiological feature. The eye physiological feature of the user is collected by using the eye identification hardware carried in the VR terminal device (such as an eye print feature and an iris feature), and then identity authentication is performed on the user by using the collected eye physiological feature, so that the user no longer needs to enter a payment password in a complex interaction way in the VR environment to perform identity authentication on the user. In addition, in a process of collecting an eye physiological feature, the user can view an eye action of the user in real time, and then the user can adjust an eye posture in a timely way under a prompt of the virtual eye model to improve precision of collecting the eye physiological feature.

[0019] The following describes the present application by using specific implementations with reference to specific application scenarios.

[0020] FIG. 1 illustrates a virtual reality environment-based identity authentication method, according to an implementation of the present application. The method is applied to a VR terminal device, and includes the following steps:

[0021] Step 101: Receive a user identity authentication request.

[0022] Step 102: Output a prompt interface that is used to notify a user to complete collection of an eye physiological feature in a virtual reality environment, where the prompt interface includes a virtual eye model, and when the user's eye moves, the virtual eye model simulates an eye action of the user.

[0023] Step 103: Collect the eye physiological feature of the user.

[0024] Step 104: Perform identity authentication on the user based on the collected eye physiological feature.

[0025] The VR terminal device includes any form of terminal device that can

provide VR three-dimensional immersion experience for a user, for example, a head-mounted VR terminal device.

[0026] In practice, client software (such as an APP) or an operating system developed based on the VR technology can be carried on the previous VR terminal device in advance. The VR terminal device can output a VR scene model developed by a developer in advance to the user by using the carried client software or operating system, so that a user wearing the VR terminal device can experience three-dimensional immersion in the VR environment.

[0027] The eye can include at least one of an eyelid, an eye corner, an iris, a sclera, etc. of the user. The eye action can include at least one of an eyeball rotation action, an eye blinking action, or an eye opening action of the user.

[0028] The user identity authentication request is a request message that is initiated by the user in the VR environment and used to authenticate an identity of the user. In practice, after the user triggers a target service that requires authentication on the identity of the user in the VR environment, an identity authentication request can be initiated by using the client software or operating system carried in the VR terminal device.

[0029] The target service can include a local task of authenticating the identity of the user that is initiated by the user in the VR environment, or can include an online task of authenticating the identity of the user that is initiated by the user in the VR environment.

[0030] For example, in practice, the previous target service can be a quick payment service in some specific VR scenes, for example, order payment in a VR shopping scenario, rewarding in a VR live broadcasting scenario, recharging in a VR game scenario, and video on demand payment in a VR video scenario. Alternatively, target services can include other types of local services than the quick payment service that require authentication on the identity of the user, for example, an unlocking service of the user for the VR terminal device.

[0031] The following describes the technical solutions of the present application in detail in four phases: creation of a VR scene model, initiation of identity authentication, collection and registration of an eye physiological feature, and authentication on a user identity.

[0032] (1) Creation of a VR scene model

[0033] In this implementation, a developer can complete creation of a VR scene

model by using a specific modeling tool. The modeling tool is not limited in this implementation. For example, a developer can use relatively mature modeling tools such as Unity, 3dsMax, and Photoshop to complete creation of a VR scene model.

[0034] In a process that a developer creates a VR scene model by using a modeling tool, the VR scene model, a texture of the VR scene, and a map of the VR scene can be derived from a real scene in a real life. For example, a material, a texture, and a map and a plane model of a real environment can be collected in advance through video shooting. Then, a modeling tool such as Photoshop or 3dmax is used to process a texture and construct a three-dimensional model of a real environment, and then is imported to a unity3D platform (U3D for short). Image rendering is performed in a plurality of dimensions such as a sound effect, a graphical interface, plug-ins, and light, and then interaction code is written. Finally, modeling of a VR scene model is completed.

[0035] In this implementation, to enable a user to execute the previous target service in the VR environment, the developer can further create a 2D or 3D service interface that corresponds to the previous target service in the VR scene model by using the previous modeling tool in addition to creating a VR environment model.

[0036] For example, in a shown implementation, the previous service interface can be a quick payment interface created based on the modeling tool, for example, a virtual checkout counter interface. The user can interact with the payment interface with a specific interaction operation (for example, locating the operation focus in the payment interface), to trigger quick payment in the VR environment.

[0037] (2) Initiation of identity authentication

[0038] In this implementation, after the developer completes the modeling of the VR scene model and the service interface, the VR client device can output the VR scene model and the service interface to the user by using the client software or the operating system carried in the VR terminal device.

[0039] It is worthwhile to note that, by default, the VR terminal device can output only the VR scene model to the user. In a process that the user experiences immersion in the VR scene, the user can interact with the VR terminal device to trigger the VR terminal device to output the service interface in the VR scene.

[0040] In this implementation, a predetermined virtual element used to trigger the previous target service can be provided in the VR scene model. In a process that the user experiences immersion in the VR scene, if the target service needs to be executed,

the user can manipulate sensing hardware, such as a gyroscope carried in the VR terminal device, in a specific interaction way and select the virtual element to trigger the target service.

[0041] The specific interaction way used when the user triggers the previous target service in the VR scene is not limited in the present application. In practice, a person skilled in the art can select an appropriate interaction way based on an actual requirement.

[0042] For example, in practice, the user can control motion of a visual focus in an interaction way such as a three-dimensional gesture, a head posture, or eyeball movement (eye movement tracking) or by using an external control apparatus of a VR terminal device, keep a visual focus in an area where the virtual element is located, and select the virtual element, to trigger the previous target service. Alternatively, the user can select the target service by passing the moving track of the visual focus in a specific way through the area where the virtual element is located, to trigger the target service.

[0043] A specific implementation process of selecting the previous virtual element in the previous interaction way to control motion of the visual focus is omitted in the present application for simplicity. For the process, a person skilled in the art can make references to records in the related technology.

[0044] Certainly, in addition to the interaction way shown above, if the user is expected to trigger the previous target service more naturally, the previous VR client device can also carry a voice recognition module. In this case, in a process that the user experiences immersion in a VR scene, the previous target service can be triggered by directly sending a voice instruction used to trigger the previous target service.

[0045] After the user triggers the previous target service in the VR scene, because the target service is a service that requires security authentication on the user identity, in this case, the user can initiate a user identity authentication request to the VR terminal device by using client software or an operating system carried in the VR terminal device.

[0046] (3) Collection and registration of an eye physiological feature

[0047] In this implementation, to more quickly perform security authentication on an identity of a user in a VR scene environment, eye recognition hardware carried in the VR terminal device can be used to collect an eye physiological feature of the user,

and quickly complete identity authentication on the user by using the collected eye physiological feature.

[0048] In practice, there can be a plurality of eye physiological features collected by the VR terminal device. For example, in a shown implementation, both eye print features and iris features of the user can be included. Iris recognition and eye print recognition are organically combined, so the iris recognition and the iris recognition are complementary to each other. Therefore, precision of authenticating an identity of a user can be significantly improved.

[0049] The following uses an example that the previous eye physiological feature includes an iris feature and an eye print feature for description.

[0050] In this case, the eye recognition hardware can include lenses that are carried in a VR terminal device and that correspond to positions of the user's eyes, a visual module that is used to collect an eye print feature, and a visual module that is used to collect an iris feature.

[0051] The visual module that is used to collect an eye print feature can include an RGB camera used with a lens and an LED light source that is used to perform light compensation on the RGB camera and that is used with the RGB camera. The visual module that is used to collect an iris feature can include an infrared camera used with a lens and an infrared LED light source used to perform light compensation on the infrared camera and that is used with the infrared camera. That is, in the present application, the VR terminal device can simultaneously carry an RGB camera used to collect an eye print feature and an infrared camera used to collect an iris feature (for example, the RGB camera and the infrared camera can be separately installed at one of the positions of the VR terminal device that correspond to the user's eyes).

[0052] It is worthwhile to note that the previous eye recognition hardware carried in the VR terminal device can be built-in hardware in a hardware architecture of the VR terminal device or external hardware, or can be built-in hardware in a third-party mobile device (such as a smartphone) interconnected to the VR terminal device. Implementations are not limited in the present application.

[0053] In this implementation, in an initial status, the user can register the eye print feature and the iris feature of the user in advance by using the VR client device, and establish a binding relationship between the user identifier of the user and each of the eye print feature and the iris feature of the user on a service server.

[0054] The user identifier of the user can include account information used by the

user when the user executes the previous target service. For example, when the target service is a payment service, the user identifier of the user can be a payment account of the user. The user can register an eye print and an iris, to bind the payment account to the eye print feature and the iris feature of the user on the service server.

[0055] After the user completes eye print and iris registration, when the user subsequently initiates a target service that requires identity authentication in the VR environment, identity authentication on the user can be performed by using the eye print feature and the iris feature of the user. As such, information such as a service password no longer needs to be entered for identity authentication on the user.

[0056] It is worthwhile to note that, the user can register the eye print feature and the iris feature in advance by using the VR terminal device and establish a binding relationship between the account information of the user and each of the eye print feature and the iris feature of the user by using the VR terminal device, as described above, and in addition, the user can customize an associated user by using the VR client device, and bind the eye print feature and the iris feature of the associated user to the user identifier of the user. For example, in practice, the user can also set a family member as an associated user, and can further bind an eye print feature and an iris feature of the family member to the account information of the user.

[0057] Certainly, in practice, to improve security of the eye print and iris registration process, before an eye print feature and an iris feature of the user are collected, identity authentication can be further performed for a registration behavior of the user. For example, the user can be prompted to enter a login password or other information that can represent an identity of a user, and authenticate an identity of a user who performs registration this time. After the authentication succeeds, the VR client device sends a registration message to a service server to complete eye print and iris registration.

[0058] As such, an unauthorized user can be prevented from using an eye print or iris feature of the user to complete binding to a login account of another authorized user, so that eye print and iris registration security can be improved.

[0059] In this implementation, in a process that the VR terminal device invokes the previous eye recognition hardware to collect an eye physiological feature of the user, to optimize precision of collecting the eye physiological feature, the VR terminal device can output a prompt interface that is used to notify the user to complete eye feature collection in a VR environment. The previous prompt interface can be a 2D

interface, or can be a 3D interface. Implementations are not limited in the present application.

[0060] FIG. 2 is a schematic diagram illustrating the previous prompt interface output in a VR environment, according to this implementation.

[0061] As shown in FIG. 2, the previous prompt interface output by the VR terminal device in the VR environment can include the following two parts of content:

[0062] In one aspect, the previous prompt interface can include prompt information used to notify the user to complete collection of an eye physiological feature. The previous prompt information can include text prompt information that is output by the VR terminal device.

[0063] In practice, in the text prompt information, an eye action or a gaze direction that needs to be maintained by the user during collection of an eye physiological feature can be specified. Under a prompt of the text prompt information output by the VR terminal device, the user can maintain a specific eye action or gaze in a specific direction in a way specified in the text prompt information, to better complete eye physiological feature collection.

[0064] For example, as shown in FIG. 2, in practice, the previous prompt information can be text prompt information "The system will start to collect data in N seconds. Please gaze straight ahead".

[0065] In another aspect, the previous prompt interface can further include a virtual eye model in addition to the prompt information used to notify the user to complete collection of an eye physiological feature. The virtual eye model can simulate the eye action of the user in real time when the user’s eye moves.

[0066] The previous virtual eye model can be created by using a modeling tool carried in the VR terminal device. During implementation, the VR terminal device can extract several feature points from the eye image of the user, and then input the extracted feature point as an input parameter into the modeling tool carried in the VR terminal device to perform modeling, so as to complete creation of the virtual eye model.

[0067] A specific form of the virtual eye model is not limited in the present application.

[0068] For example, in practice, the previous modeling tool can be a 2D or 3D graphical modeling tool, and the previous virtual model can be a graphical modeling tool. Based on an input eye feature point of the user, a 2D or 3D eye image is drawn

in a form of cartoon animation or image processing.

[0069] It is worthwhile to note that, because the virtual eye model is obtained through modeling based on feature points collected from the eye image of the user, created eye feature points in the virtual eye model are mapped to the feature points of the user's eye. That is, for each extracted eye feature point, one eye feature point that is mapped to the feature point can be identified in the virtual eye model.

[0070] In this implementation, after the VR terminal device outputs the previous prompt interface in the VR environment, the user can complete collection of an eye physiological feature under a prompt of the previous prompt interface.

[0071] In a process of collecting an eye physiological feature of the user, to enable a virtual eye model in the previous prompt interface to simulate an eye action of the user in real time, the VR terminal device can further collect eye action data of the user in real time, and adjust the virtual eye model based on the collected eye action data.

[0072] It is worthwhile to note that, in practice, eye actions of the user generally include an eyeball rotation action, an eye blinking action, an eye opening action, etc. The eye action data can include coordinate change data of eye feature points that are extracted from the collected eye image of the user and that correspond to an eyeball rotation action, an eye blinking action, and an eye opening action of the user.

[0073] For example, for the eyeball rotation action of the user, in the industry, motion tracking can usually be performed on the feature points extracted from an iris or a sclera of the user, to obtain the coordinate change data of these feature points to restore the eyeball rotation action of the user. Therefore, an eye feature point that corresponds to the eyeball rotation action of the user can be an iris feature point or a sclera feature point of the user.

[0074] For another example, for the eye blinking action or the eye opening action of the user, in the industry, motion tracking can usually be performed on the feature points extracted from an eyelid or an eye corner of the user, to obtain the coordinate change data of these feature points to restore the eye blinking action or the eye opening action of the user. Therefore, eye feature points that correspond to the eye blinking action and the eye opening action of the user can be eyelid feature points or eye corner feature points of the user.

[0075] In an implementation, during collection of an eye physiological feature of the user, the VR terminal device can invoke the camera to collect an eye image of the user in real time, and then extract an eye feature point that corresponds to the eye

action of the user from the collected eye image.

[0076] For example, for the eyeball rotation action of the user, an iris feature point or a sclera feature point of the user can be extracted. For the eye blinking action and the eye opening action of the user, an eyelid feature point or an eye corner feature point of the user can be extracted.

[0077] After a corresponding eye feature point is extracted from the collected eye image, the VR terminal device can perform motion tracking on each extracted eye feature point based on a carried eye feature point tracking algorithm, collect coordinate data of each eye feature point in real time, and record a coordinate data change of each eye feature point in a back end, to obtain coordinate change data of each eye feature point.

[0078] After the VR terminal device collects the coordinate change data that corresponds to each extracted eye feature point, because the feature points in the virtual eye model are mapped to each other, the VR terminal device can further search the virtual eye model for the mapping feature points that correspond to the extracted eye feature points, and then synchronously adjust the positions of the identified mapping feature points based on the collected coordinate change data, to ensure that an eye action of the user simulated by the virtual eye model is completely consistent with an eye action actually generated by the user.

[0079] As such, it can be seen that in a process of collecting an eye physiological feature of the user, the user can view an eye action of the user in real time in a VR environment.

[0080] In one aspect, in a conventional biometric feature collection process, there is usually a delay of initialization of the collection hardware, that is, after the collection starts, the user may need to wait for a period of time. However, in such a waiting period, the user cannot determine whether the collection has started, and an eye posture deviation of the user easily occurs, causing poor precision of a collected feature point. Therefore, if the user can view an eye action of the user in real time in a collection process, the user can adjust an eye posture in a timely way based on the virtual eye model under a prompt of the text prompt information, so that a feature point of the eye can be more accurately obtained, and precision of collecting an eye physiological feature is improved.

[0081] In another aspect, because the virtual model completely simulates a real-time eye action of the user, the VR client device can directly perform liveness

detection based on the output virtual eye model on the user from which an eye physiological feature is collected, so as to alleviate a problem that an unauthorized user uses a user identity through a fraud means such as an eye image.

[0082] Certainly, the created virtual model can be output to the user from which an eye physiological feature is collected in the VR environment, as described above, and in addition, in practice, user assistance from a third party may exist for eye physiological feature collection performed on the user.

[0083] Therefore, in this case, the VR terminal device can be associated with the third-party terminal device in advance, and the VR terminal device can also transmit the created virtual model to the associated third-party terminal device to synchronously output the virtual model.

[0084] The previous associated third-party terminal device can be a local terminal device that is in the same network as the VR terminal device worn by the user, or can be a remote device that is connected to the VR terminal device worn by the user by using the Internet. In practice, the associated third-party terminal device can be customized by the user through the user interface of the VR terminal device. Details are omitted in this implementation for simplicity.

[0085] For example, the third-party terminal device can be a PC terminal device. In a process that the VR terminal device invokes the carried biometric recognition camera to collect the iris feature and the eye print feature of the user, the VR terminal device can output the virtual model in the VR environment, and send the virtual model to the PC terminal device through a communication link with the PC terminal device to synchronously output the virtual model.

[0086] As such, a third-party user other than the user (for example, a person who assists the user in completing eye physiological feature collection) can also view an eye action of the user in real time.

[0087] (4) Authentication on a user identity

[0088] In this implementation, when the VR terminal device receives the user identity authentication request that is initiated by the user by triggering the target service in the VR environment, the VR terminal device can first initiate a query to the service server based on the user identifier of the user, and query whether the user identifier of the user has been bound to an eye print feature sample and an iris feature sample.

[0089] If the identifier information of the user is currently not bound to any form

of eye physiological feature sample, or is bound to one of an eye print characteristic sample and an iris characteristic sample, it indicates that the user has not completed a complete registration procedure. The VR client device can output prompt information indicating "whether to register an eye print and iris" through a user interface to the user, and provide a corresponding user option, so that the user chooses to determine whether to enable the eye print and iris registration procedure or not.

[0090] When the user chooses to enable the eye print and iris registration procedure, the VR client device can repeat the eye print and iris registration procedure shown above, and output the previous prompt interface in the VR environment, to notify the user to complete collection and registration of the eye print feature and the iris feature. Details are omitted in this implementation for simplicity.

[0091] Certainly, if the identifier information of the user has been successfully bound to the eye print feature sample and the iris feature sample, the following operations are performed.

[0092] In one aspect, in this case, the VR terminal device can still output the previous prompt interface used to notify the user to complete collection of an eye physiological feature in the VR environment, to notify the user to complete precise collection of an eye print feature and an iris feature. The prompt interface can still include the previous prompt information and the previous virtual eye model. Details are omitted for simplicity.

[0093] In another aspect, the VR terminal device can invoke eye recognition hardware to collect an eye print feature and an iris feature of the user. In a process that the VR terminal device invokes the previous eye recognition hardware to collect an eye physiological feature of the user, the VR terminal device can further invoke predetermined brightness detection hardware (such as a light sensor) to perform brightness detection on a collection environment in the VR terminal device to obtain a brightness value, and determine whether the detected brightness value is lower than a predetermined threshold. If the detected brightness value is lower than the predetermined threshold, it indicates that the brightness value of the collection environment in the VR terminal device is relatively low. The relatively low brightness value may affect collection precision. In this case, the VR terminal device can immediately enable the LED light source to perform light compensation on the camera.

[0094] In this implementation, when the VR terminal device successfully collects

the eye print feature and the iris feature of the user by invoking the eye recognition hardware, the VR terminal device can interact with the service server based on the collected eye print feature to complete identity authentication for the user.

[0095] In a shown implementation, the previous service server can enable eye print and iris recognition services, and provide an identification interface for a VR client device.

[0096] For example, when the service server is a service platform built based on a server cluster, an identification server that provides an eye print recognition service and an iris recognition service for the VR terminal device can be enabled, and an access interface is provided for the VR client device.

[0097] After successfully collecting the eye print feature and the iris feature of the user, the VR terminal device can construct an eye print verification request based on the account information currently used by the user to log in to the VR client device, and the collected eye print feature and iris feature of the user, then access the eye print identification interface provided by the service server, and submit the eye print verification request to the service server.

[0098] After receiving the eye print verification request from the VR client device, the service server can parse the eye print verification request, obtain the eye print feature, iris feature, and account information of the user that are carried in the request, query the eye print feature sample and the iris feature sample that are registered by the user in the previous feature database based on the account information, and then compare the eye print feature and the iris feature with the eye print feature sample and the iris feature sample that are stored in the previous predetermined feature database and that are registered by the user.

[0099] In this implementation, by default, the service server can compare one of an eye print feature and an iris feature of the user with a corresponding feature sample in the previous feature database, and perform authentication on the identity of the user based on a comparison result.

[0100] In practice, a default type of an eye physiological feature that is used by the service server and a default comparison sequence may not be limited. By default, an eye print feature can be compared with an eye print feature sample that is registered by the user in the previous feature database, or by default, an iris feature can be compared with an iris feature that is registered by the user in the previous feature database.

[0101] When the service server compares one of an eye print feature and an iris feature of the user with a corresponding feature sample in the previous feature database, it is determined that one of the eye physiological features is completely consistent with a corresponding eye physiological feature sample that is registered by the user. In this case, the service server can determine that identity authentication on the user succeeds, and then return an authentication result to the VR terminal device.

[0102] Otherwise, when the service server compares one of an eye print feature and an iris feature of the user with a corresponding feature sample in the previous feature database, it is determined that one of the eye physiological features is inconsistent with a corresponding eye physiological feature sample that is registered by the user (in this case, the inconsistency may be caused by distortion of a collected eye physiological feature). The service server can continue to compare the other eye physiological feature in the eye print feature and the iris feature of the user with a corresponding feature sample in the previous feature database, perform identity authentication on the user again based on a comparison result, and then return a corresponding identity authentication result to the VR terminal device.

[0103] It is worthwhile to note that the authentication result returned by the service server to the VR terminal device can be a return value of a Boolean type (that is, false and true).

[0104] For example, when identity authentication on the previous user succeeds, the service server can return a return value "true" to the VR terminal device. Otherwise, if the security authentication fails, the service server can return a return value "false" to the VR terminal device.

[0105] In a shown implementation, comparison results between the previous plurality of types of collected eye physiological features and corresponding eye physiological features that are registered by the user can all be used as references to perform identity authentication on the user. In addition, in an application scenario with a higher security requirement, at least some of the comparison results can be used as references to perform identity authentication on the user.

[0106] That at least some of the comparison results can be used as references means that the comparison results can be used as the only factor for determining whether identity authentication on the user succeeds, or used as one of a plurality of factors for determining whether the identity authentication on the user succeeds, when it is determined whether the identity authentication on the user succeeds.

[0107] It is worthwhile to note that, the VR terminal device can upload the collected eye print feature and the collected iris feature of the user to the service server, and the service server performs identity authentication on the user based on the eye print feature and the iris feature, in practice, the previous identity authentication process can also be locally completed by the VR terminal device.

[0108] In this case, the user can locally reserve an eye print feature and an iris feature on the VR terminal device, and bind the eye print feature and the iris feature to the user's account information locally. When receiving the user identity authentication request, the VR terminal device can collect an eye print feature and an iris feature of the user, and perform identity authentication on the user based on the previously described implementation process that is the same as that of the service server. Details are omitted for simplicity in a specific implementation process.

[0109] In this implementation, after identity authentication on the user succeeds, the VR terminal device can execute the target service.

[0110] When the target service is an online service, the VR terminal device can execute the service by performing further service interaction with the service server.

[0111] In this case, after the VR terminal device receives the security authentication result that is returned by the service server for the target service, if the security authentication succeeds (for example, a return value "true" is returned), the VR terminal device can output a service interface that corresponds to the target service in the VR environment, and collect a service parameter related to the target service through the service interface to construct a service request. The VR terminal device can submit the service request to the service server by accessing a service access interface provided by the service server for the VR terminal device, and perform further service interaction with the service server to complete the target service.

[0112] For example, when the previous target service is a quick payment service in a VR environment, the VR terminal device can output a payment interface, collect service parameters related to the payment service such as user information, order information, and price information through the payment interface, then construct a corresponding payment request, and send the payment request to the service server. The service server processes the payment request to complete a payment procedure.

[0113] Certainly, if the target service is a local service of the VR terminal device, the service can be executed locally in response to a result that security authentication

of the local service succeeds.

[0114] For example, when the previous target service is a local unlocking service for the VR terminal device, if the VR terminal device finds that the collected eye print feature of the user is completely consistent with the eye print feature sample registered by the user after comparison, the VR terminal device can be directly unlocked.

[0115] The following describes the technical solutions of the present application with reference to an application environment in which a user performs quick and secure payment in a VR environment by using an eye print feature and an iris feature of the user that are collected by eye recognition hardware carried in the VR terminal device when experiencing VR shopping.

[0116] Certainly, it is worthwhile to note that the previous application scenario is merely an example and is not intended to the present application. Apparently, in practice, the technical solutions of the present application can also be applied to other similar service scenarios.

[0117] For example, in a VR game scenario, the user can quickly complete game coin recharging by using an eye print and an iris. In a VR live broadcasting scenario, the user can quickly complete rewarding by using an eye print and iris. In a VR video scenario, the user can quickly complete video on demand payment by using an eye print and an iris. The user can quickly unlock the VR terminal device in a VR scene by using an eye print, an iris, etc. Examples are omitted in this implementation for simplicity.

[0118] FIG. 3 is a schematic interaction diagram illustrating an example that a user completes quick payment by using an eye physiological feature in a VR environment, according to an implementation.

[0119] As shown in FIG. 3, in this scenario, the previous target service can be a quick payment service in the VR environment. The previous VR terminal device can be a head-mounted VR terminal device that carries payment client software (for example, VR PAY in ALIPAY) developed based on the VR technology. The service server can be a payment server, for example, the ALIPAY platform constructed based on a server cluster.

[0120] In an initial status, the user can log in to the VR terminal device by using the payment account, complete registration of the eye print and the iris by using the VR terminal device, bind the eye print and the iris of the user to the payment account,

and store the eye print and the iris in a feature database on the side of the cloud payment server.

[0121] In a registration process, the VR client device can output a prompt interface used to notify the user to complete collection of an eye print feature and an iris feature in the VR environment.

[0122] In one aspect, the prompt interface can include text prompt information used to notify the user to complete collection of an eye physiological feature. For example, in the previous prompt interface shown in FIG. 3, the previous text prompt information is "The system will start to collect data in N seconds. Please gaze straight ahead".

[0123] In another aspect, the prompt interface can further include a virtual eye model. The virtual eye model can simulate the eye action of the user in real time when the user's eye moves.

[0124] Under a prompt of the prompt interface, the user can view an eye action of the user in real time in a process that the VR terminal device collects an eye print feature and an iris feature of the user. As such, an eye posture can be adjusted in a timely way under a prompt of the prompt interface, and it is ensured that in a registration process, an iris feature sample and an eye print feature sample that are collected by an RGB camera and an infrared camera that are invoked by the VR terminal device can be collected relatively precisely.

[0125] When the user wears the VR terminal device to experience VR shopping, the user can present several merchandises that can be selected by the user in the VR environment. The user can view a list of merchandises provided in the VR environment to buy a desirable merchandise.

[0126] Still referring to FIG. 3, after selecting a satisfactory merchandise from the previous merchandise list, the user can control a position of a visual focus in a VR environment in a natural interaction way such as eyeball rotation, and can trigger the VR client device to start a payment procedure for the merchandise by suspending, for N seconds, the visual focus above an area where a "Buy now" button provided in advance in the VR environment is located.

[0127] Still referring to FIG. 3, after the payment procedure for the merchandise is started, the user can initiate a user identity authentication request to the VR terminal device by using the payment client device. After receiving the user identity authentication request, the VR terminal device can output the previous prompt

interface in the VR environment.

[0128] Under a prompt of the prompt interface, the user can view an eye action of the user in real time in a process that the VR terminal device collects an eye print feature and an iris feature of the user. As such, an eye posture can be adjusted in a timely way under a prompt of the prompt interface, and it is ensured that an iris feature and an eye print feature that are collected by an RGB camera and an infrared camera that are invoked by the VR terminal device can be collected relatively precisely.

[0129] After collection of the eye print and the iris of the user is completed, the VR terminal device can construct a verification request based on the collected eye print feature and iris feature, and the payment account used by the user, and submit the verification request to a payment server. The payment server compares one of the eye print feature and the iris feature of the user with a corresponding eye physiological feature sample that is registered by the user. If one of the eye print feature and the iris feature of the user is consistent with a corresponding eye physiological feature sample that is registered by the user, identity authentication on the user succeeds, and the payment server can return a return value "true" of a Boolean type to the VR terminal device.

[0130] If one of the eye print feature and the iris feature of the user is inconsistent with a corresponding eye physiological feature sample that is registered by the user, the payment server can further compare the other eye physiological feature in the eye print feature and the iris feature with a corresponding eye physiological feature sample registered by the user. If the other eye physiological feature in the eye print feature and the iris feature is consistent with a corresponding eye physiological feature sample registered by the user, identity authentication on the user succeeds, and the payment server can return a return value "true" of a Boolean type to the VR terminal device.

[0131] After receiving the security authentication success result returned by the payment server, the VR terminal device can output a payment interface, collect parameters related to the payment service such as user information, order information, and price information through the payment interface, then construct a corresponding payment request, and send the payment request to the payment server. The payment server processes the payment request to complete quick payment for the merchandise.

[0132] It is worthwhile to additionally note that, the technical carriers involved in

the payment in this implementation of the present application can include, for example, a Near Field Communication (NFC) technology, a WIFI technology, a 3G/4G/5G technology, a POS card reading technology, a two-dimensional barcode scanning technology, a barcode scanning technology, a Bluetooth technology, an infrared technology, a short message service (SMS), and a multimedia messaging service (MMS).

[0133] The present application further provides an apparatus implementation that corresponds to the previous method implementation.

[0134] Referring to FIG. 4, the present application provides a VR environment-based identity authentication apparatus 40 applied to a VR terminal device.

[0135] Referring to FIG. 5, a hardware architecture involved in the VR terminal device that carries the VR environment-based identity authentication apparatus 40 usually includes a CPU, a memory, a non-volatile memory, a network interface, an internal bus, etc. In an example of a software implementation, the VR environment-based identity authentication apparatus 40 can usually be understood as a logical apparatus of a software and hardware combination obtained after the CPU runs a computer program loaded in the memory. The apparatus 40 includes the following: a receiving module 401, configured to receive a user identity authentication request; an output module 402, configured to output a prompt interface that is used to notify a user to complete collection of an eye physiological feature in a virtual reality environment, where the prompt interface includes a virtual eye model, and when the user's eye moves, the virtual eye model simulates an eye action of the user; a first collection module 403, configured to collect the eye physiological feature of the user; and an authentication module 404, configured to perform identity authentication on the user based on the collected eye physiological feature.

[0136] In this implementation, the apparatus 40 further includes the following: a second collection module 405 (not shown in FIG. 4), configured to collect eye action data of the user; and an adjustment module 406 (not shown in FIG. 4), configured to adjust the virtual eye model based on the collected eye action data.

[0137] In this implementation, the second collection module 405 is configured to: invoke a predetermined camera to collect an eye image of the user; extract an eye feature point that corresponds to the eye action of the user from the collected eye image; perform motion tracking on the eye feature point; and collect coordinate

change data of the eye feature point.

[0138] In this implementation, the virtual reality terminal device is associated with a third-party terminal device.

[0139] The output module 402 is further configured to: send the prompt interface including the virtual eye model to the associated third-party terminal device, to synchronously output the prompt interface on the third-party terminal device.

[0140] In this implementation, the eye physiological feature includes an eye print feature and an iris feature.

[0141] In this implementation, the eye includes an eyelid, an eye corner, an iris, and a sclera.

[0142] In this implementation, the eye action includes at least one of an eyeball rotation action, an eye blinking action, or an eye opening action.

[0143] In this implementation, an eye feature point that corresponds to an eyeball rotation action of the user includes an iris feature point or a sclera feature point, and eye feature points that correspond to an eye blinking action and an eye opening action of the user include an eyelid feature point or an eye corner feature point.

[0144] A person skilled in the art can easily figure out another implementation solution of the present application after considering the present specification and practicing the disclosed invention here. The present application is intended to cover any variations, functions, or adaptive changes of the present application. These variations, functions, or adaptive changes comply with general principles of the present application, and include common knowledge or a commonly used technical means in the technical field that is not disclosed in the present application. The present specification and the implementations are merely considered as examples. The actual scope and the spirit of the present application are pointed out by the following claims.

[0145] It should be understood that the present application is not limited to the accurate structures described above and shown in the accompanying drawings, and modifications and changes can be made without departing from the scope of the present application. The scope of the present application is limited only by the appended claims.

[0146] The previous descriptions are merely examples of implementations of the present application, but are not intended to limit the present application. Any modification, equivalent replacement, or improvement made without departing from

the spirit and principle of the present application should fall within the protection scope of the present application.

CLAIMS

1. A method for identity authentication in a virtual reality environment, the method comprising:

receiving (101), by a head-mounted virtual reality terminal device worn by a user, a user identity authentication request;

outputting (102), by the terminal device, a prompt interface in a virtual reality environment, wherein the prompt interface is used to notify the user to complete collection of an eye physiological feature, wherein the prompt interface displays prompt information and a virtual eye model displayed as a 2D or 3D drawing of an eye, to the user, and wherein the prompt information includes a collection time when the eye physiological feature will be collected;

collecting, by the terminal device, eye images of the user;

creating the virtual eye model by a modeling tool carried in the terminal device, the terminal device extracting feature points from the eye images of the user and then inputting the extracted feature points into the modeling tool to create the virtual eye model, whereby each eye feature point in the virtual eye model is mapped to a corresponding feature point of the user's eye;

performing, by the terminal device, motion tracking on the extracted eye feature points, to collect coordinate data of each eye feature point in real time, and to record a coordinate data change of each eye feature point to obtain coordinate change data of each eye feature point;

searching, by the terminal device, the virtual eye model for the mapping feature points that correspond to extracted eye feature points, and then synchronously adjusting the positions of the identified mapping feature points based on the collected coordinate change data, to ensure that an eye action of the user simulated by the virtual eye model is completely consistent with an eye action actually generated by the user, thereby directly performing liveness detection by the terminal device based on the virtual eye model of the user;

collecting (103) the eye physiological feature of the user from the eye images of the user by using eye recognition hardware built into the virtual reality terminal device, the eye

recognition hardware comprising an RGB camera with an LED light source for performing light compensation for the RGB camera and an infrared camera with an infrared LED light source for performing light compensation for the infrared camera, wherein the eye physiological feature comprises an eye print feature and an iris feature, the RGB camera collecting the eye print feature and the infrared camera collecting the iris feature, and wherein the RGB camera and the infrared camera are installed at respective positions of the VR terminal device that correspond to the user's eyes; and

performing (104) an identity authentication on the user based on the eye physiological feature.

2. The method according to claim 1, further comprising:

associating the virtual reality terminal device with a third-party terminal device; and

sending the prompt interface comprising the virtual eye model to the associated third-party terminal device, to synchronously output the prompt interface on the third-party terminal device.

3. The method according to claim 1, wherein the eye comprises at least one of an eyelid, an eye corner, an iris, and a sclera.

4. The method according to claim 3, wherein an eye feature point that corresponds to an eyeball rotation action of the user comprises an iris feature point or a sclera feature point.

5. The method according to claim 4, wherein the eye feature point that corresponds to an eye blinking action and an eye opening action of the user comprises an eyelid feature point or an eye corner feature point.

6. The method according to claim 1, further comprising:

receiving a voice instruction to trigger a target service configured to generate the user identity authentication request.

7. The method according to claim 1, further comprising:

processing the eye images to determine a brightness value;

determining whether the brightness value is lower than a predetermined threshold; and

in response to determining that the brightness value is lower than a predetermined threshold causing a light source to perform light compensation on at least one of the two cameras.

8. An apparatus for identity authentication in a virtual reality environment, the apparatus comprising a plurality of modules configured to perform the method of any one of claims 1 to 7.