

AUTHENTICATION METHOD, DEVICE, VR TERMINAL, AND VR SERVER BASED ON VR SCENE

TECHNICAL FIELD

[0001] The present specification relates to the field of computer applications, and in particular, to a virtual reality scenario-based authentication method and apparatus, a VR (virtual reality) terminal device, and a VR server device.

BACKGROUND

[0002] In the virtual reality (VR) technology, a computer graphics system and various control interfaces are comprehensively used to generate a three-dimensional interactive environment on a computer, and provide an immersion feeling for users. VR interaction is characterized by being able to take over a full field of view of a user and provide "immersion experience" for the user. Therefore, currently, the VR technology is a user-machine interaction method that draws much attention, and many Internet enterprises are actively expanding their own related VR service scenarios, such as VR shopping, VR payment, and VR entertainment.

SUMMARY

[0003] The present specification provides a virtual reality scenario-based authentication method, applied to a virtual reality terminal, where the method includes: calculating interactive environment authentication information based on random information delivered by a virtual reality server, obtaining password information entered by a user in a virtual reality scenario, and sending the password information and the interactive environment authentication information to the virtual reality server, so that the virtual reality server obtains random information through reverse calculation based on the interactive environment authentication information after the password information is verified, and matches the random information obtained through reverse calculation against the random information delivered to the virtual reality client, to perform security authentication on an

interactive environment of the virtual reality scenario.

[0004] The present specification further provides a virtual reality scenario-based authentication method, applied to a virtual reality server, where the method includes: obtaining interactive environment authentication information and password information entered by a user in a virtual reality scenario that are sent by a virtual reality terminal, where the interactive environment authentication information is generated through calculation based on random information delivered to the virtual reality terminal, verifying the password information, and if the password information is verified, obtaining random information through reverse calculation based on the interactive environment authentication information, and verifying whether the random information obtained through reverse calculation matches the random information delivered by the virtual reality server, and determining that security authentication on an interactive environment of the virtual reality scenario succeeds if the random information obtained through reverse calculation matches the random information delivered to the virtual reality terminal.

[0005] The present specification further provides a virtual reality scenario-based authentication apparatus, applied to a virtual reality terminal, where the apparatus includes: a calculation module, configured to calculate interactive environment authentication information based on random information delivered by a virtual reality server, a first acquisition module, configured to obtain password information entered by a user in a virtual reality scenario, and a sending module, configured to send the password information and the interactive environment authentication information to the virtual reality server, so that the virtual reality server obtains random information through reverse calculation based on the interactive environment authentication information after the password information is verified, and matches the random information obtained through reverse calculation against the random information delivered to the virtual reality client, to perform security authentication on an interactive environment of the virtual reality scenario.

[0006] The present specification further provides a virtual reality scenario-based authentication apparatus, applied to a virtual reality server, where the apparatus includes: a second acquisition module, configured to obtain interactive environment authentication information and password information entered by a user in a virtual reality scenario that are sent by a virtual reality terminal, where the interactive environment authentication information is generated through calculation based on random information delivered to the

virtual reality terminal, a verification module, configured to verify the password information, and if the password information is verified, obtain random information through reverse calculation based on the interactive environment authentication information, and verify whether the random information obtained through reverse calculation matches the random information delivered by the virtual reality server, and a determining module, configured to determine that security authentication on an interactive environment of the virtual reality scenario succeeds if the random information obtained through reverse calculation matches the random information delivered to the virtual reality terminal.

[0007] The present specification further provides a virtual reality terminal device, including: a processor, and a storage, configured to store a machine-executable instruction, where a machine-executable instruction that is stored in the storage and that corresponds to control logic of virtual reality scenario-based authentication is read and executed, to prompt the processor to: calculate interactive environment authentication information based on random information delivered by a virtual reality server, obtain password information entered by a user in a virtual reality scenario, and send the password information and the interactive environment authentication information to the virtual reality server, so that the virtual reality server obtains random information through reverse calculation based on the interactive environment authentication information after the password information is verified, and matches the random information obtained through reverse calculation against the random information delivered to a virtual reality client, to perform security authentication on an interactive environment of the virtual reality scenario.

[0008] The present specification further provides a virtual reality server device, including: a processor, and a storage, configured to store a machine-executable instruction, where a machine-executable instruction that is stored in the storage and that corresponds to control logic of virtual reality scenario-based authentication is read and executed, to prompt the processor to: obtain interactive environment authentication information and password information entered by a user in a virtual reality scenario that are sent by a virtual reality terminal, where the interactive environment authentication information is generated through calculation based on random information delivered to the virtual reality terminal, verify the password information, and if the password information is verified, obtain random information through reverse calculation based on the interactive environment authentication information, and verify whether the random information obtained through reverse

calculation matches the random information delivered by the virtual reality server, and determine that security authentication on an interactive environment of the virtual reality scenario succeeds if the random information obtained through reverse calculation matches the random information delivered to the virtual reality terminal.

[0009] In the present specification, the virtual reality server not only completes user identity authentication based on the password information entered by the user, the virtual reality server can also further perform security authentication on the interactive environment of the virtual reality scenario based on the interactive environment authentication information that is sent in synchronization with the password information, to determine whether the current interactive environment is a legal interactive environment, thereby alleviating a security risk that the user faces when performing service interaction in an illegal VR interactive environment.

BRIEF DESCRIPTION OF DRAWINGS

[0010] FIG. 1 is a flowchart illustrating a VR scenario-based authentication method, according to an implementation of the present specification;

[0011] FIG. 2 is a schematic diagram illustrating offsetting an operation focus by a user after the user enters a password character, according to an implementation of the present specification;

[0012] FIG. 3 is a schematic interaction diagram illustrating completing fast payment by a user in a VR scenario, according to an implementation of the present specification;

[0013] FIG. 4 is a schematic diagram illustrating completing security authentication on a VR payment environment through interaction between a VR server and a VR terminal, according to an implementation of the present specification;

[0014] FIG. 5 is a structural hardware diagram illustrating a VR terminal that a VR scenario-based authentication apparatus is mounted on, according to an implementation of the present specification;

[0015] FIG. 6 is a logical block diagram illustrating a VR scenario-based authentication apparatus, according to an implementation of the present specification;

[0016] FIG. 7 is a structural hardware diagram illustrating a VR server that another VR scenario-based authentication apparatus is mounted on, according to an implementation of

the present specification; and

[0017] FIG. 8 is a logical block diagram illustrating another VR scenario-based authentication apparatus, according to an implementation of the present specification.

DESCRIPTION OF IMPLEMENTATIONS

[0018] In practice, although the VR technology can provide a lifelike immersion feeling for a user, it is usually difficult for the user to complete information input in a VR scenario when the user wears a VR terminal for immersion experience. Therefore, more VR terminal devices start to provide some more humanized information input methods for users.

[0019] For example, for a head-mounted VR terminal device, when a user needs to enter password information in a VR scenario, the head-mounted VR terminal device usually can output an input interface that includes input characters in the VR scenario, and the user can interact with the VR scenario by using a head movement, to control a visual focus (name, an operation focus) in the VR scenario, and trigger to select a related input character in the input interface by using the visual focus, and then complete an input operation of the input character. For example, in an implementation, the user can select the input character by keeping the visual focus at the related input character in the input interface for specific duration (or the user can select the input character by using another interaction method, where a selection method is not limited in the present specification), and then trigger to complete the input operation of the input character.

[0020] With constant popularization of the VR technology, when the VR technology provides "immersion experience" for a user, because the VR technology is characterized by taking over a full field of view of the user, once a user field of view of a VR terminal (namely, a visual 3D interface output to the user when the user wears the VR terminal) is hijacked by a malicious program, privacy information, such as password information, entered by the user in a VR scenario may be leaked. In addition, because the user field of view in the VR scenario is different from a screen interaction interface of a conventional APP, if the user field of view is hijacked, the user cannot perceive the hijacking in the VR scenario at all. Therefore, it is of great significance to accurately identify whether a VR interactive environment of a VR scenario is legal to ensure security of information (in particular, some privacy information such as a payment password) entered by a user in the

VR scenario.

[0021] In view of this, the present specification provides a technical solution for further performing security authentication on an interactive environment of a current VR scenario of a user based on password information entered by the user in the VR scenario.

[0022] During implementation, a VR terminal can calculate interactive environment authentication information based on random information delivered by a VR server, and obtain password information entered by a user in a virtual reality scenario, and then send the password information together with the interactive environment authentication information to the VR server.

[0023] After receiving the password information and the interactive environment authentication information that are sent by the VR terminal, the VR server can first verify the password information, and obtain random information through reverse calculation based on the interactive environment authentication information after the password information is verified, and then match the random information obtained through reverse calculation against the random information delivered to the virtual reality client, to perform security authentication on an interactive environment of the virtual reality scenario. If the random information obtained through reverse calculation matches the random information delivered to the virtual reality client, it indicates that the interactive environment of the current VR scenario is a legal interactive environment, and there is no security risk for a service operation of the user in the current VR scenario. On the contrary, if the random information obtained through reverse calculation does not match the random information delivered to the virtual reality client, it indicates that the interactive environment of the current VR scenario is an illegal interactive environment, and there is a security risk for a service operation of the user in the current VR scenario.

[0024] In this method, on a basis that the virtual reality server completes user identity authentication based on the password information entered by the user, the virtual reality server can further perform, based on the interactive environment authentication information that is sent in synchronization with the password information, security authentication on the interactive environment of the virtual reality scenario in which the user enters the password information, to determine whether the current interactive environment is a legal interactive environment, thereby alleviating a security risk that the user faces when performing service interaction in an illegal VR interactive environment.

[0025] For example, for a fast payment service in a VR scenario, when a user completes a fast payment transaction in the VR scenario by entering a payment password, if a VR terminal worn by the user is hijacked by a malicious program (for example, VR scenario-based attack behavior such as phishing, fraud, or page hijacking), the payment transaction initiated by the user in the VR scenario may be at a security risk. For example, the payment password entered by the user may be leaked, or a transaction fund may be transferred to an illegal account, resulting in a financial loss. In this case, if the VR server can accurately identify, in the background based on the interactive environment authentication information sent by the VR terminal, whether the interactive environment of the current VR scenario is legal, the payment transaction initiated by the user in the VR scenario can be terminated in time, thereby alleviating a security risk of the payment transaction initiated by the user in the VR scenario.

[0026] The following describes the present specification by using specific implementations with reference to specific application scenarios.

[0027] FIG. 1 illustrates a virtual reality scenario-based authentication method, according to an implementation of the present specification. The following steps are performed.

[0028] Step 102: A VR terminal calculates interactive environment authentication information based on random information delivered by a VR server.

[0029] Step 104: The VR terminal obtains password information entered by a user in a VR scenario.

[0030] It is worthwhile to note that an execution sequence of step 102 and an execution sequence of step 104 may be interchanged.

[0031] The VR terminal includes any form of terminal device that can provide three-dimensional VR immersion experience for a user, such as a head-mounted VR terminal device.

[0032] Client software (such as an APP) or an operating system developed based on the VR technology can be installed on the VR terminal, and the VR terminal can output a VR scenario model developed by a developer to the user by using the installed client software or operating system, so that the user wearing the VR terminal can obtain three-dimensional immersion experience in the VR scenario.

[0033] In addition, related sensors can be further mounted on the VR terminal, and the

VR terminal can detect, by using the mounted sensors, an interaction operation performed by the user in the VR scenario, and then can understand an intention of the user based on the sensed interaction operation, thereby implementing interaction between the user and the VR scenario.

[0034] For example, in practice, a gravity sensor and an acceleration sensor can be built in the VR terminal, and the VR terminal can track and identify a head movement of the user by using the built-in gravity sensor and acceleration sensor, and then can understand an intention of the user and interact with the user. For the user, in a process of wearing the VR terminal, the user can control movement of an operation focus (namely, a visual focus) in the VR scenario by using a head action, and trigger a corresponding action in the VR scenario to interact with the VR scenario. For example, the user can control movement of a visual focus by using a head action, and keep, for specific duration, the visual focus on a virtual element (for example, a virtual button) provided in the VR scenario, to select the virtual element and trigger an execution action corresponding to the virtual element.

[0035] In the present specification, in a process of performing immersion experience in the VR scenario, the user can perform a specific interaction operation in the VR scenario, to interact with the VR scenario and trigger a target service. The target service can specifically include a service that needs user identity authentication. For example, the target service can include any form of security service that requires the user to enter the password information to authenticate an identity of the user.

[0036] The VR terminal can pre-define several predetermined interaction operations used to trigger the target service in the VR scenario. When the user interacts with the VR scenario, the VR terminal can detect, by using a mounted sensor, an interaction operation performed by the user, and determine whether the detected interaction operation matches a predetermined interaction operation. If the detected interaction operation matches the predetermined interaction operation, the target service can be immediately triggered in the VR scenario.

[0037] It is worthwhile to note that the previously described predetermined interaction operations used to trigger the target service in the VR scenario can be included in any type of interaction method in the VR field, and are not particularly limited in the present specification.

[0038] For example, in an implementation, the target service can be specifically a VR

scenario-based fast payment service. In this case, a "payment" button for initiating payment can be provided in the VR scenario, and the predetermined interaction operation can be an operation of selecting the "payment" button by the user by controlling movement of the operation focus. For example, in a common interaction method, the user can control movement of the visual focus by using a head action, and keep the visual focus at the "payment" button for specific duration, to select the "payment" button and then trigger the fast payment service in the VR scenario.

[0039] In the present specification, when detecting that the user triggers the target service in the virtual reality scenario, the VR terminal can send a service request to the VR server. A random algorithm for generating random information can be preloaded on the VR server. After receiving a service request sent by the VR terminal, the VR server can generate random information based on the random algorithm, and then encrypt the random information and deliver encrypted random information to the VR client.

[0040] After receiving the encrypted random information delivered by the VR server: the VR client can decrypt the encrypted random information and store the random information, and then use the random information as a calculation parameter to calculate the interactive environment authentication information; and the VR client can output a password input interface in the VR scenario, so that the user can interact with the VR scenario to control displacement of the operation focus (for example, the user can interact with the VR scenario by using a head action, to control displacement of the operation focus), to trigger to select an input character in the password input interface, and then complete an input operation of the input character.

[0041] To ensure password input security, the password input interface can be specifically a password input interface dynamically delivered by the VR server.

[0042] For example, the password input interface can be specifically a random password input interface delivered by the VR server. For example, the random password input interface can be specifically an input interface that includes random input characters, an input interface of a random interface size, an input interface that includes input characters of random sizes, an input interface displayed at a random location in the virtual reality scenario, or an input interface that tilts at a random angle in the virtual reality scenario.

[0043] It is worthwhile to note that an interaction method used by the user to interact

with the VR scenario to select an input character in the password input interface is not particularly limited. In practice, any form of interaction method can be used. For example, in an implementation, the user can keep the operation focus at a related input character in the input interface for specific duration to select the input character, and then trigger to complete an input operation of the input character.

[0044] In the present specification, the interactive environment authentication information can be specifically a hidden non-forged security mark used to mark an officially trusted VR interactive environment. The random information can specifically include any form of random information. Correspondingly, the interactive environment authentication information can specifically include any form of non-forged security information generated through calculation based on the random information delivered by the VR server.

[0045] In a shown implementation, the random information can be a random number string of a predetermined length, and the interactive environment authentication information can be a coordinate sequence generated through mapping calculation based on the random number string. The coordinate sequence can be specifically a set of a series of coordinates generated when the operation focus is displaced during interaction between the user and the VR scenario.

[0046] In this case, a mapping algorithm used to perform mapping calculation on the random number string can be preloaded on the VR terminal. After decrypting the random number string delivered by the VR server, the VR terminal can separately perform mapping calculation on random numbers in the random number string based on the random algorithm, to generate all sets of mapping coordinates respectively corresponding to the random numbers in the random number string.

[0047] Each set of generated mapping coordinates can correspond to one password character in the password information that the user needs to enter in the VR scenario. For example, the target service is a fast payment service, and the password information is a 6-digit payment password. In this case, the random numbers in the random number string can be mapped to six sets of mapping coordinates corresponding to password characters by using the mapping algorithm.

[0048] It is worthwhile to note that calculation logic of the mapping algorithm is not particularly limited in the present specification, and can be specified by a person skilled in

the art based on an actual demand.

[0049] In a shown implementation, for example, the target service is a fast payment service in the VR scenario, and the password information is a payment password. In this case, the mapping algorithm can be an algorithm for mapping every two random numbers in the random number string to one set of mapping coordinates corresponding to one password character in the payment password. That is, in the present specification, the length of the random number string used to generate the sets of mapping coordinates depends on a character length of the password information, and a relative relationship is maintained between the two lengths.

[0050] In this case, the mapping algorithm can be specifically represented by using the following equations:

$$x=(\text{int}(\text{challenge}[i*2])-4)/10; \text{ and}$$

$$y=(\text{int}(\text{challenge}[i*2+1])-4)/10, \text{ where}$$

x represents an x-axis coordinate value of a set of mapping coordinates; y represents a y-axis coordinate value of the set of mapping coordinates; challenge represents the random number string; challenge[N] represents the Nth number in the random number string, for example, challenge[i*2] represents the (i*2)th random number in the random number string; a value range of i is [0, M-1]; challenge[0] represents the first random number in the random number string; and a value of M is one half of a value of the length of the random number string (that is, every two random numbers are mapped to one set of mapping coordinates).

[0051] For example, for a fast payment service of ALIPAY (Alipay) in a VR scenario, if a payment password of ALIPAY in the VR scenario is a short 6-digit password, the random number string can be a 12-digit random number string. In an example, assume that the random number string is 152587660579, based on the previous equations, the value range of i is [0, 5]. In this case, each number of i from 0 to 5 can be substituted into the previous equations for mapping calculation, and mapping calculation can be separately performed on the random numbers in the random number string to obtain sets of mapping coordinates. An obtained calculation result can be shown in the following table:

i	challenge[i*2]	challenge[i*2+1]	result
0	challenge[0]	challenge[1]	[-0.3, 0.1]

1	challenge[2]	challenge[3]	[-0.2, 0.1]
2	challenge[4]	challenge[5]	[0.4, 0.3]
3	challenge[6]	challenge[7]	[0.2, 0.2]
4	challenge[8]	challenge[9]	[-0.4, 0.1]
5	challenge[10]	challenge[11]	[0.3, 0.5]

[0052] In a shown implementation, after separately performing mapping calculation on the random numbers in the random number string based on the mapping algorithm to obtain the sets of mapping coordinates respectively corresponding to the password characters in the password information, the VR terminal can further generate a coordinate sequence based on these sets of mapping coordinates as the interactive environment authentication information.

[0053] In a shown method, specifically, the sets of mapping coordinates obtained through mapping calculation can be combined with the password input interface, and the sets of mapping coordinates can be used as offsets of the operation focus, to construct the coordinate sequence as the interactive environment authentication information.

[0054] During implementation, each time the user enters a password character in the password input interface, the VR terminal can use a set of mapping coordinates corresponding to the password character as an offset, to offset the operation focus in the VR scenario once, and record a set of coordinates generated after the operation focus is offset, until the user enters the complete password information. For example, the password information is a 6-digit payment password of ALIPAY. In this case, the operation focus needs to be offset six times in total. Therefore, the VR terminal needs to record six sets of coordinates generated after the operation focus is offset.

[0055] To ensure that the VR server can restore the offsets through calculation, the VR terminal can define a fixed initial location for the operation focus in the password input interface.

[0056] In this case, after each time the user enters a password character in the password input interface, the VR terminal can determine a set of coordinates of the initial location, and then use a set of mapping coordinates corresponding to the password character entered by the user as an offset, to offset the set of coordinates of the initial location once. For

example, an X-axis coordinate value and a Y-axis coordinate value of the set of coordinates of the initial location can be respectively used as an X-axis offset component and a Y-axis offset component, to offset the set of coordinates of the operation focus. A specific initial location in the password input interface is not specially limited in the present specification. In practice, any location in the password input interface can be specified as the initial location.

[0057] For example, in an implementation, the user keeps the operation focus at a related input character in the input interface for specific duration to select the input character, and then triggers to complete an input operation of the input character. In this case, a center location of a location area of the input character (namely, an area center of an input key corresponding to the input character) in the password input interface or another location easy to extract and recognize can be specified as the initial location. Therefore, after the user triggers input of the input character by controlling the operation focus to keep at the location area of the input character, the VR terminal can immediately keep the operation focus at the initial location, and then use the initial location as a reference offset point to perform offset once, and record a set of coordinates generated after the operation focus is offset.

[0058] An offset direction in which the VR terminal offsets the operation focus is not specially limited in the present specification, either. In practice, a set of mapping coordinates corresponding to a password character entered by the user can be used as an offset, to offset the operation focus in any direction.

[0059] For example, FIG. 2 is a schematic diagram illustrating offsetting an operation focus by a user after the user enters a password character, according to an implementation of the present specification.

[0060] As shown in FIG. 2, for example, the password information is a 6-digit payment password of ALIPAY. Assume that the 6-digit payment password is 123456, the coordinate sequence used as the interactive environment authentication information is as follows:

$\{[-0.3, 0.1], [-0.2, 0.1], [0.4, 0.3], [0.2, 0.2], [-0.4, 0.1], [0.3, 0.5]\}$

[0061] In this case, each set of coordinates in the coordinate sequence corresponds to one password character in the 6-bit payment password.

[0062] Assume that the first password character 1 in the 6-bit payment password corresponds to the set of mapping coordinates $[-0.3, 0.1]$, after the user controls the

operation focus to move to an area of the input character 1 in the password input interface, and triggers to select the input character 1 to complete input of the password character 1, the VR terminal worn by the user can read a set of coordinates of an initial location of the operation focus in the password input interface in the background, and then use the X-axis value -0.3 of the sets of mapping coordinates $[-0.3, 0.1]$ as an X-axis offset component of the operation focus and use the Y-axis value 0.1 of the set of mapping coordinates $[-0.3, 0.1]$ as a Y-axis offset component of the operation focus, to offset the set of coordinates of the initial location once in a coordinate system in the VR scenario, that is, to offset an X-axis value of the set of coordinates of the initial location by 0.3 unit in a negative direction of an X axis in the coordinate system of the VR scenario, and offset a Y-axis value of the set of coordinates of the initial location by 0.1 unit in a positive direction of a Y axis in the coordinate system of the VR scenario. Subsequently, when continuing to input the second password character 2 in the 6-digit payment password, the user can continue to control the operation focus to move from a location that the operation focus is offset to after the password character 1 is entered to an area of the input character 2 in the password input interface, and continue to complete input of the password character 2, and so on, until input of the 6-digit payment password is completed.

[0063] In the present specification, after the user completes input of the password information in the password input interface, the VR terminal can splice all recorded sets of coordinates generated after the operation focus is offset, to obtain a coordinate sequence. For example, the VR terminal can directly splice all the sets of coordinates generated after the operation focus is offset in a sequence of the password characters in the password information that correspond to all the sets of coordinates generated after the operation focus is offset. In this case, the generated coordinate sequence is the interactive environment authentication information that ultimately needs to be submitted to the server for verification.

[0064] In this method, because the sets of mapping coordinates are generated through calculation based on the random number string delivered by the server, after the user enters a password character in the password input interface, a set of mapping coordinates corresponding to the password character is used as an offset, to offset the operation focus once, which is equivalent that the operation focus is randomly offset once. Therefore, the password information entered by the user in the password input interface can be prevented

from being stolen by an illegal user by initiating a reconstruction attack.

[0065] For example, the reconstruction attack is an attack method in which an illegal user illegally steals interaction data (for example, head action data of the user) generated when the user enters information in the VR scenario, to restore a location and a track of the operation focus in the VR scenario, and then can restore the password characters entered by the user based on already-known layout information of the input characters in the password input interface. Each time the user enters a password character in the password input interface, the operation focus is randomly offset once. Therefore, even if an illegal user successfully steals interaction data generated when the user enters information in the VR scenario, a finally restored location of the visual focus is still different from an actual location of the visual focus, and therefore the illegal user cannot restore a real moving track of the visual focus based on the stolen interaction data. It can significantly reduce a success rate of obtaining the password information entered by the user by using a reconstruction attack.

[0066] In addition, the sets of mapping coordinates are used as offsets of the operation focus to offset the operation focus, and the coordinate sequence is constructed as the interactive environment authentication information based on the recorded sets of coordinates generated after the operation focus is offset. It can alleviate a security risk caused by directly constructing a coordinate sequence as the interactive environment authentication information based on the generated sets of mapping coordinates.

[0067] For example, directly using the coordinate sequence generated by splicing the generated sets of mapping coordinates as the interactive environment authentication information is equivalent to performing no processing on the calculation result of the mapping algorithm. Therefore, if the coordinate sequence obtained by splicing all the sets of mapping coordinates obtained through calculation by using the mapping algorithm is directly sent to the VR server as the interactive environment authentication information, once the mapping algorithm is leaked and an illegal user knows the mapping algorithm, the illegal user can perform reverse calculation on the interactive environment authentication information by using the mapping algorithm, to restore the random number string delivered by the VR server, causing a security risk.

[0068] An example in which the interactive environment authentication information is a coordinate sequence generated through mapping calculation based on the random number

string is used above for detailed description.

[0069] It is worthwhile to further note that, in practice, in addition to the coordinate sequence generated through mapping calculation based on the random number string, the interactive environment authentication information can be another form of security information used to mark an officially trusted VR interactive environment. For example, the interactive environment authentication information can be information, such as an image or a sound, generated through calculation based on the random information. Examples are not listed one by one in the present specification.

[0070] Step 106: The VR terminal sends the password information and the interactive environment authentication information to the virtual reality server.

[0071] In the present specification, after the user enters the password information in the password input interface by interacting with the VR scenario, and the VR terminal generates the interactive environment authentication information through calculation based on the random information delivered by the VR server, the VR terminal can obtain the password information entered by the user and the interactive environment authentication information generated by the VR terminal through calculation in the background, and then send the obtained password information and interactive environment authentication information to the VR server.

[0072] For example, the interactive environment authentication information is a coordinate sequence generated through mapping calculation based on the random information. The VR terminal can combine the obtained password information and coordinate sequence into a coordinate sequence string, add the coordinate sequence string to a constructed response request, and return the response request to the VR server as a response to the random information delivered by the VR server.

[0073] In practice, when sending the obtained password information and interactive environment authentication information to the VR server, the VR terminal can alternatively encrypt the password information and the interactive environment authentication information and send encrypted information, and then the VR server can decrypt the encrypted information. Details of a specific encryption method and encryption algorithm are omitted in the present specification.

[0074] Step 108: The VR server verifies the password information, and if the password information is verified, obtains random information through reverse calculation based on

the interactive environment authentication information, and verifies whether the random information obtained through reverse calculation matches the random information delivered by the virtual reality server.

[0075] Step 110: Determine that security authentication on an interactive environment of the VR scenario succeeds if the random information obtained through reverse calculation matches the random information delivered to the virtual reality terminal.

[0076] In the present specification, after receiving the password information and the interactive environment authentication information that are sent by the VR terminal, the VR server can first verify the password information. For example, the VR server can match the password information with password information reserved by the user on the VR server. If the password information is verified, identity authentication for the user succeeds, and the VR server can further enable verification on the interactive environment authentication information.

[0077] Certainly, if verification on the password information fails, the VR server can directly terminate the target service initiated by the user in the VR scenario, and return a service execution failure response message to the VR terminal.

[0078] Further, after identity authentication for the user succeeds, the VR server can continue to verify the interactive environment authentication information, to perform security authentication on the interactive environment of the VR scenario in which the user initiates the target service. A process in which the VR server verifies the interactive environment authentication information corresponds to the process in which the VR terminal generates the interactive environment authentication information.

[0079] In a shown implementation, the following example is still used: The interactive environment authentication information is a coordinate sequence constructed by combining the password input interface and the sets of mapping coordinates obtained by performing mapping calculation on the random number string delivered by the VR server based on the predetermined mapping algorithm and using the sets of mapping coordinates as offsets of the operation focus.

[0080] In this case, the interactive environment authentication information is a coordinate sequence obtained by using a set of mapping coordinates corresponding to a password character as an offset after the user enters the password character in the virtual reality scenario to offset the operation focus in the virtual reality scenario and splicing all

sets of coordinates generated after the operation focus is offset. The sets of mapping coordinates are generated by the VR terminal by separately performing mapping calculation on the random numbers in the random number string based on the predetermined mapping algorithm and correspond to the random numbers. Each set of mapping coordinates corresponds to one password character in the password information entered by the user.

[0081] First, the VR server can separately calculate offsets corresponding to the sets of coordinates in the coordinate sequence used as the interactive environment authentication information.

[0082] Specifically, the VR terminal can notify the previous pre-specified initial location to the VR server, and when calculating the offsets corresponding to the sets of coordinates in the coordinate sequence used as the interactive environment authentication information, the VR server can determine a set of coordinates corresponding to the initial location in the password input interface based on the initial location and with reference to layout information that is of the password input interface and that is maintained on the VR server. In this case, the set of coordinates is the set of coordinates of the initial location of the operation focus existing before the operation focus is offset in the password input interface on the VR terminal side in the VR scenario.

[0083] For example, in an implementation, the user keeps the operation focus at a related input character in the input interface for specific duration to select the input character, and then triggers to complete an input operation of the input character. In this case, the VR terminal can define a center location of a location area of the input character in the password input interface as the initial location, and notify the VR server of the initial location. When the VR server needs to calculate an offset corresponding to any set of coordinates in the coordinate sequence used as the interactive environment authentication information, the VR server can determine, based on the locally maintained layout information of the password input interface, a location area of a password character (that is, a location area corresponding to an input key corresponding to the input character) corresponding to the set of coordinates in the password input interface, and then further determine a set of coordinates of a center location of the location area, to obtain the set of coordinates of the initial location.

[0084] After determining the set of coordinates of the initial location, the VR server can calculate corresponding offsets based on the set of coordinates of the initial location and the

sets of coordinates in the coordinate sequence used as the interactive environment authentication information. For example, the set of coordinates of the initial location represents a set of coordinates existing before the operation focus is offset, and the sets of coordinates in the coordinate sequence represent coordinates generated after the operation focus is offset. Therefore, an offset of the operation focus relative to the X axis and the Y axis can be obtained by calculating an X-axis coordinate value and a Y-axis coordinate value of a set of coordinates generated after the operation focus is offset and an X-axis coordinate value and a Y-axis coordinate value of a set of coordinates existing before the operation focus is offset.

[0085] The offsets are the sets of mapping coordinates obtained by the VR terminal by performing mapping calculation on the random number string based on the predetermined mapping algorithm. Therefore, after obtaining the offsets corresponding to the sets of coordinates in the coordinate sequence used as the interactive environment authentication information, the VR server can obtain original sets of mapping coordinates obtained by the VR terminal by performing mapping calculation on the random number string based on the predetermined mapping algorithm.

[0086] In the present specification, the same mapping algorithm can also be loaded on the VR server as the VR terminal. After obtaining the original sets of mapping coordinates obtained by the VR terminal by performing mapping calculation on the random number string based on the predetermined mapping algorithm, the VR server can perform reverse calculation on the original sets of mapping coordinates corresponding to the password characters based on the same mapping algorithm, to generate random numbers corresponding to the original sets of mapping coordinates.

[0087] For example, the mapping algorithm is still represented by using the following equations:

$$x=(\text{int}(\text{challenge}[i*2])-4)/10; \text{ and}$$

$$y=(\text{int}(\text{challenge}[i*2+1])-4)/10.$$

[0088] Details of meanings of the parameters in the previous equations are omitted in the present specification. A process of performing reverse calculation on the original sets of mapping coordinates based on the mapping algorithm is a process of substituting x-axis coordinate values and y-axis coordinate values of the original sets of mapping coordinates into the previous equations to inversely obtain $\text{challenge}[i*2]$ and $\text{challenge}[i*2+1]$. A

specific calculation process is omitted in the present specification.

[0089] In the present specification, after obtaining the random numbers corresponding to the original sets of mapping coordinates through reverse calculation, the VR server can splice these random numbers to obtain a random number string, and then match the obtained random number string against the random number string delivered by the VR server to the VR terminal. If the obtained random number string matches the random number string delivered by the VR server to the VR terminal, it indicates that security authentication on the interactive environment of the VR scenario in which the user initiates the target service succeeds, and the interactive environment is an officially trusted VR interactive environment. In this case, the VR server can normally respond to and execute the target service initiated by the VR terminal, and return a service execution result to the VR terminal.

[0090] On the contrary, if the obtained random number string does not match the random number string delivered by the VR server to the VR terminal, it indicates that security authentication on the interactive environment of the VR scenario in which the user initiates the target service fails, and the interactive environment is an illegal VR interactive environment. In this case, a user field of view in the VR scenario may be hijacked by a malicious program, and the VR server can directly terminate the target service initiated by the user in the VR scenario, and return a service execution failure response message to the VR terminal.

[0091] It can be learned that in this method, on a basis that the VR server completes user identity authentication based on the password information entered by the user, the virtual reality server can further perform, based on the interactive environment authentication information that is sent in synchronization with the password information, security authentication on the interactive environment of the VR scenario in which the user enters the password information, to determine whether the current interactive environment is a legal interactive environment, thereby alleviating a security risk that the user faces when performing service interaction in an illegal VR interactive environment.

[0092] The following describes the technical solutions of the present specification by using an example in which the target service is a fast payment service in a VR scenario and with reference to an application scenario in which a user enters a payment password in a password input interface output in the VR scenario during VR shopping experience to

perform fast and secure payment in the VR scenario.

[0093] Certainly, it is worthwhile to note that the shown application scenario is merely an example and is not intended for limitation. Apparently, in practice, the technical solutions of this application can also be applied to another similar service scenario.

[0094] For example, a user quickly completes recharging of a game currency in a VR game scenario, a user quickly completes a reward in a VR live broadcast scenario, a user quickly completes video payment on demand in a VR video scenario, and a user quickly unlocks a VR terminal in a VR scenario. Examples are not listed one by one.

[0095] In this scenario, the VR terminal can be specifically a head-mounted VR terminal that a payment client (such as ALIPAY VR pay) developed based on the VR technology is installed, and the VR server can be a payment server, for example, a payment platform constructed based on a server cluster.

[0096] FIG. 3 is a schematic interaction diagram illustrating completing fast payment by a user in a VR scenario, according to an implementation of the present specification.

[0097] In an initial state, the user can log in to the VR terminal by using a payment account, set a payment password in a VR scenario output by the VR terminal, bind the set payment password to the payment account, and store the set payment password in a secure database on the payment server on the cloud.

[0098] When the user wears the VR terminal for VR shopping experience, optional commodities can be presented to the user in the VR scenario, and the user can view a commodity list provided in the VR scenario, to select a commodity that the user likes for purchasing.

[0099] Still referring to FIG. 3, after the user selects a satisfactory commodity from the commodity list, by using an interaction method of controlling an operation focus by using a head action, the user can suspend and keep, for N seconds, a visual focus at an area of a "Buy Now" button pre-provided in the VR scenario, to trigger the VR client to start a payment procedure for the commodity.

[0100] FIG. 4 is a schematic diagram illustrating completing security authentication on a VR payment environment through interaction between a VR server and a VR terminal, according to an implementation of the present specification.

[0101] As shown in FIG. 4, after the payment procedure for the commodity is started, the VR terminal can initiate a payment request to the VR server by using the mounted

payment client. After receiving the payment request, the VR server can generate a 12-bit random number string for the VR terminal based on a loaded random algorithm, and encrypt the random number string and then deliver an encrypted random number string to the VR terminal.

[0102] After receiving the encrypted random number string, the VR terminal can decrypt the encrypted random number string, and separately perform mapping calculation on random numbers in the random number string based on a loaded mapping algorithm, to obtain six sets of mapping coordinates respectively corresponding to password characters in the payment password (an example in which every two random numbers are mapped to one set of mapping coordinates is still used).

[0103] Still referring to FIG. 4, when completing the mapping calculation, the VR terminal can output, by using the VR scenario, a password input box delivered by the VR server, and obtain a password character entered by the user in the password input box. In addition, the VR terminal can combine the sets of mapping coordinates obtained through calculation with the password input box delivered by the VR server, and use the sets of mapping coordinates as offsets of the operation focus, to construct a coordinate sequence as interactive environment authentication information.

[0104] Specifically, the VR terminal can still use the following method: Each time the user enters a password character in the password input interface, the VR terminal uses a set of mapping coordinates corresponding to the password character as an offset to offset the operation focus in the VR scenario once, and records a set of coordinates generated after the operation focus is offset, and then the VR terminal splices recorded sets of coordinates generated after the operation focus is offset, to obtain a coordinate sequence as the interactive environment authentication information. A detailed implementation process is omitted, and references can be made to the description in the previous implementations.

[0105] Still referring to FIG. 4, after obtaining the payment password entered by the user and constructing the interactive environment authentication information, the VR terminal can send the payment password and the interactive environment authentication information to the server as a response to the random number string delivered by the VR server, for verification by the server.

[0106] On one hand, the server can first verify the payment password. If verification on the payment password fails, the server can directly return a payment failure message to the

VR terminal.

[0107] On the other hand, if the payment password is verified, the server can further verify the interactive environment authentication information. First, the VR server can separately calculate offsets corresponding to the sets of coordinates in the interactive environment authentication information, to eliminate coordinate errors of every set of coordinates in the interactive environment authentication information due to offset of the operation focus, and restore original sets of mapping coordinates corresponding to the password characters in the payment password. In addition, based on the same mapping algorithm as the VR client, the VR server can perform reverse calculation on the original sets of mapping coordinates to obtain corresponding random numbers, and splice the obtained random numbers to obtain a random number string. A detailed implementation process is omitted, and references can be made to the description in the previous implementations.

[0108] After obtaining the random number string by splicing the obtained random numbers, the VR server can match the random number string against the random number string delivered to the VR terminal. Still referring to FIG. 3, if the obtained random number string matches the random number string delivered by the VR server to the VR terminal, it indicates that a VR interactive environment in which the user initiates the fast payment service is an officially trusted VR interactive environment. In this case, the VR server can normally respond to and execute the payment request initiated by the VR terminal, and return a payment result to the VR terminal; and the VR terminal can output the payment result to the user in the VR scenario.

[0109] On the contrary, if the obtained random number string does not match the random number string delivered by the VR server to the VR terminal, it indicates that a VR interactive environment in which the user initiates the fast payment service may be an illegal VR interactive environment. In this case, a user field of view in the VR scenario may be hijacked by an illegal user, and a shopping interface output by the VR terminal by using the VR scenario may be a phishing or fraud interface. In this case, the VR server can directly terminate the fast payment service initiated by the user in the VR scenario, and output a corresponding prompt to the user in the VR scenario by using the VR terminal. For example, the prompt can be a text prompt "The transaction is at a security risk and the system has helped you terminate the transaction".

[0110] It can be learned that, in this method, when the user completes fast payment in the VR scenario, on a basis that the VR server completes user identity authentication based on the password information entered by the user, the VR server can further perform security authentication on the interactive environment of the VR scenario in which the user enters the password information, to quickly discover attack behavior, such as phishing or fraud, that the user may encounter when the user performs fast payment in the VR scenario, thereby maximally ensuring security of a fund of the user.

[0111] Corresponding to the previous method implementations, the present specification further provides an implementation of a virtual reality scenario-based authentication apparatus.

[0112] The implementation of the VR scenario-based authentication apparatus in the present specification can be applied to a VR terminal. The apparatus implementation can be implemented by using software, hardware, or a combination of hardware and software. Software implementation is used as an example. As a logical apparatus, the software is formed by reading a corresponding computer program instruction from a nonvolatile storage to a memory for running by a processor in a VR terminal that the software belongs to. In terms of hardware, FIG. 5 is a structural hardware diagram illustrating a VR terminal that a VR scenario-based authentication apparatus belongs to, according to an implementation of the present specification. In addition to a processor, a memory, a network interface, and a nonvolatile storage shown in FIG. 5, the VR terminal that the apparatus belongs to in this implementation can usually further include other hardware based on an actual function of the VR terminal. Details are omitted.

[0113] FIG. 6 is a block diagram illustrating a VR scenario-based authentication apparatus, according to an example implementation of the present specification.

[0114] Referring to FIG. 6, virtual reality scenario-based authentication apparatus 60 can be applied to the VR terminal shown in FIG. 5, and includes calculation module 601, first acquisition module 602, and sending module 603.

[0115] Calculation module 601 is configured to calculate interactive environment authentication information based on random information delivered by a virtual reality server.

[0116] First acquisition module 602 is configured to obtain password information entered by a user in a virtual reality scenario.

[0117] Sending module 603 is configured to send the password information and the interactive environment authentication information to the virtual reality server, so that the virtual reality server obtains random information through reverse calculation based on the interactive environment authentication information after the password information is verified, and matches the random information obtained through reverse calculation against the random information delivered to a virtual reality client, to perform security authentication on an interactive environment of the virtual reality scenario.

[0118] In this implementation, the random information is a random number string of a predetermined length, and the interactive environment authentication information is a coordinate sequence generated through mapping calculation based on the random number string.

[0119] In this implementation, calculation module 601 is configured to: separately perform mapping calculation on random numbers in the random number string based on a predetermined mapping algorithm, to generate all sets of mapping coordinates respectively corresponding to the random numbers, where each set of mapping coordinates is used as an offset corresponding to each password character and is used to offset an operation focus in the virtual reality scenario by an offset corresponding to a password character after the user enters the password character in the virtual reality scenario, and splice all sets of coordinates generated after the operation focus is offset, to obtain the coordinate sequence.

[0120] In this implementation, calculation module 601 is further configured to: determine a set of coordinates of an initial location of the operation focus in a password input interface in the virtual reality scenario, and use a set of mapping coordinates corresponding to the password character as an offset to offset the set of coordinates of the initial location once.

[0121] In this implementation, the mapping algorithm is represented by using the following equations:

$$x=(\text{int}(\text{challenge}[i*2])-4)/10; \text{ and}$$

$$y=(\text{int}(\text{challenge}[i*2+1])-4)/10, \text{ where}$$

x represents an x-axis coordinate value of a set of mapping coordinates; y represents a y-axis coordinate value of the set of mapping coordinates; challenge represents the random number string; challenge[N] represents the Nth number in the random number string; a value range of i is [0, M-1]; and a value of M is one half of a value of the length of

the random number string.

[0122] Corresponding to the previous method implementations, the present specification further provides an implementation of another virtual reality scenario-based authentication apparatus.

[0123] The implementation of the VR scenario-based authentication apparatus in the present specification can be applied to a VR server. The apparatus implementation can be implemented by using software, hardware, or a combination of hardware and software. Software implementation is used as an example. As a logical apparatus, the software is formed by reading a corresponding computer program instruction from a nonvolatile storage to a memory for running by a processor in a VR server that the software belongs to. In terms of hardware, FIG. 7 is a structural hardware diagram illustrating a VR terminal that a VR scenario-based authentication apparatus belongs to, according to an implementation of the present specification. In addition to a processor, a memory, a network interface, and a nonvolatile storage shown in FIG. 7, the VR terminal that the apparatus belongs to in this implementation can usually further include other hardware based on an actual function of the VR terminal. Details are omitted.

[0124] FIG. 8 is a block diagram illustrating a VR scenario-based authentication apparatus, according to an example implementation of the present specification.

[0125] Referring to FIG. 8, virtual reality scenario-based authentication apparatus 80 can be applied to the VR terminal shown in FIG. 7, and includes second acquisition module 801, verification module 802, and determining module 803.

[0126] Second acquisition module 801 is configured to obtain interactive environment authentication information and password information entered by a user in a virtual reality scenario that are sent by a virtual reality terminal, where the interactive environment authentication information is generated through calculation based on random information delivered to the virtual reality terminal.

[0127] Verification module 802 is configured to verify the password information, and if the password information is verified, obtain random information through reverse calculation based on the interactive environment authentication information, and verify whether the random information obtained through reverse calculation matches the random information delivered by the virtual reality server.

[0128] Determining module 803 is configured to determine that security authentication

on an interactive environment of the virtual reality scenario succeeds if the random information obtained through reverse calculation matches the random information delivered to the virtual reality terminal.

[0129] In this implementation, the random information is a random number string of a predetermined length, and the interactive environment authentication information is a coordinate sequence generated through mapping calculation based on the random number string.

[0130] In this implementation, the interactive environment authentication information is a coordinate sequence obtained by using a set of mapping coordinates corresponding to a password character as an offset after the user enters the password character in the virtual reality scenario to offset an operation focus in the virtual reality scenario and splicing all sets of coordinates generated after the operation focus is offset, and all sets of mapping coordinates are generated by separately performing mapping calculation on random numbers in the random number string based on a predetermined mapping algorithm and respectively correspond to the random numbers.

[0131] In this implementation, verification module 802 is configured to: separately calculate offsets corresponding to the sets of coordinates in the coordinate sequence, to obtain sets of mapping coordinates corresponding to password characters in the password information, and separately perform reverse calculation on the original sets of mapping coordinates corresponding to the password characters based on the predetermined mapping algorithm, to generate random numbers respectively corresponding to the sets of mapping coordinates.

[0132] In this implementation, verification module 802 is further configured to: determine a set of coordinates of an initial location of the operation focus existing before the operation focus is offset in a password input interface in the virtual reality scenario, and calculate the corresponding offsets based on the set of coordinates of the initial location and the sets of coordinates in the coordinate sequence.

[0133] In this implementation, the mapping algorithm is represented by using the following equations:

$$x = (\text{int}(\text{challenge}[i*2]) - 4) / 10; \text{ and}$$

$$y = (\text{int}(\text{challenge}[i*2+1]) - 4) / 10, \text{ where}$$

x represents an x-axis coordinate value of a set of mapping coordinates; y

represents a y-axis coordinate value of the set of mapping coordinates; challenge represents the random number string; challenge[N] represents the Nth number in the random number string; a value range of i is [0, M-1]; and a value of M is one half of a value of the length of the random number string.

[0134] For a detailed implementation process of a function of each module in the apparatus, references can be made to an implementation process of a corresponding step in the previous method. Details are omitted here.

[0135] Because an apparatus implementation basically corresponds to a method implementation, for a related part, references can be made to some descriptions in the method implementation. The previously described apparatus implementations are merely examples. The units described as separate parts may or may not be physically separate, and parts displayed as units may or may not be physical units, that is, may be located in one location, or may be distributed on a plurality of network units. Some or all of the modules can be selected based on an actual demand to achieve the objectives of the solutions of the present specification. A person of ordinary skill in the art can understand and implement the implementations of the present specification without creative efforts.

[0136] The system, apparatus, module, or unit illustrated in the previous implementations can be specifically implemented by using a computer chip or an entity, or by using a product having a certain function. A typical implementation device is a computer, and the computer can be specifically a server, a personal computer, a laptop computer, a cellular phone, a camera phone, a smartphone, a personal digital assistant, a media player, a navigation device, an email receiving and sending device, a game console, a tablet computer, a wearable device, or any combination of these devices.

[0137] Corresponding to the previous method implementations, the present specification further provides an implementation of a VR terminal device. The VR terminal device includes a processor and a storage configured to store a machine-executable instruction. The processor and the storage are usually connected to each other by using an internal bus. In another possible implementation, the device may further include an external interface, so that the device can communicate with another device or component.

[0138] In this implementation, a machine-executable instruction that is stored in the storage and that corresponds to control logic of virtual reality scenario-based authentication is read and executed to prompt the processor to: calculate interactive environment

authentication information based on random information delivered by a virtual reality server, obtain password information entered by a user in a virtual reality scenario, and send the password information and the interactive environment authentication information to the virtual reality server, so that the virtual reality server obtains random information through reverse calculation based on the interactive environment authentication information after the password information is verified, and matches the random information obtained through reverse calculation against the random information delivered to a virtual reality client, to perform security authentication on an interactive environment of the virtual reality scenario.

[0139] In this implementation, the random information is a random number string of a predetermined length, and the interactive environment authentication information is a coordinate sequence generated through mapping calculation based on the random number string.

[0140] In this implementation, the machine-executable instruction that is stored in the storage and that corresponds to the control logic of virtual reality scenario-based authentication is read and executed, to further prompt the processor to: separately perform mapping calculation on random numbers in the random number string based on a predetermined mapping algorithm, to generate all sets of mapping coordinates respectively corresponding to the random numbers, where each set of mapping coordinates is used as an offset corresponding to each password character and is used to offset an operation focus in the virtual reality scenario by an offset corresponding to a password character after the user enters the password character in the virtual reality scenario, and splice all sets of coordinates generated after the operation focus is offset, to obtain the coordinate sequence.

[0141] In this implementation, the machine-executable instruction that is stored in the storage and that corresponds to the control logic of virtual reality scenario-based authentication is read and executed, to further prompt the processor to: determine a set of coordinates of an initial location of the operation focus in a password input interface in the virtual reality scenario, and use a set of mapping coordinates corresponding to the password character as an offset to offset the set of coordinates of the initial location once.

[0142] In this implementation, the mapping algorithm is represented by using the following equations:

$$x=(\text{int}(\text{challenge}[i*2])-4)/10; \text{ and} \\ y=(\text{int}(\text{challenge}[i*2+1])-4)/10, \text{ where}$$

x represents an x-axis coordinate value of a set of mapping coordinates; y represents a y-axis coordinate value of the set of mapping coordinates; challenge represents the random number string; challenge[N] represents the Nth number in the random number string; a value range of i is [0, M-1]; and a value of M is one half of a value of the length of the random number string.

[0143] Corresponding to the previous method implementations, the present specification further provides an implementation of a VR server. The VR server includes a processor and a storage configured to store a machine-executable instruction. The processor and the storage are usually connected to each other by using an internal bus. In another possible implementation, the device may further include an external interface, so that the device can communicate with another device or component.

[0144] In this implementation, a machine-executable instruction that is stored in the storage and that corresponds to control logic of virtual reality scenario-based authentication is read and executed, to prompt the processor to: obtain interactive environment authentication information and password information entered by a user in a virtual reality scenario that are sent by a virtual reality terminal, where the interactive environment authentication information is generated through calculation based on random information delivered to the virtual reality terminal, verify the password information, and if the password information is verified, obtain random information through reverse calculation based on the interactive environment authentication information, and verify whether the random information obtained through reverse calculation matches the random information delivered by the virtual reality server, and determine that security authentication on an interactive environment of the virtual reality scenario succeeds if the random information obtained through reverse calculation matches the random information delivered to the virtual reality terminal.

[0145] In this implementation, the random information is a random number string of a predetermined length, and the interactive environment authentication information is a coordinate sequence generated through mapping calculation based on the random number string.

[0146] In this implementation, the machine-executable instruction that is stored in the storage and that corresponds to the control logic of virtual reality scenario-based authentication is read and executed, to further prompt the processor to: separately calculate

offsets corresponding to the sets of coordinates in the coordinate sequence, to obtain sets of mapping coordinates corresponding to password characters in the password information, separately perform reverse calculation on the sets of mapping coordinates corresponding to the password characters based on the predetermined mapping algorithm, to generate random numbers respectively corresponding to the sets of mapping coordinates, and splice the generated random numbers to obtain the random number string.

[0147] In this implementation, the machine-executable instruction that is stored in the storage and that corresponds to the control logic of virtual reality scenario-based authentication is read and executed, to further prompt the processor to: determine a set of coordinates of an initial location of the operation focus existing before the operation focus is offset in a password input interface in the virtual reality scenario, and calculate the corresponding offsets based on the set of coordinates of the initial location and the sets of coordinates in the coordinate sequence.

[0148] In this implementation, the mapping algorithm is represented by using the following equations:

$$x=(\text{int}(\text{challenge}[i*2])-4)/10; \text{ and}$$

$$y=(\text{int}(\text{challenge}[i*2+1])-4)/10, \text{ where}$$

x represents an x-axis coordinate value of a set of mapping coordinates; y represents a y-axis coordinate value of the set of mapping coordinates; challenge represents the random number string; challenge[N] represents the Nth number in the random number string; a value range of i is [0, M-1]; and a value of M is one half of a value of the length of the random number string.

[0149] A person skilled in the art can easily figure out other implementations of the present specification after considering the specification and practicing the present specification here. The present specification is intended to cover any variations, uses, or adaptations of the present specification, and these variations, uses, or adaptations follow the general principles of the present specification and include common knowledge or conventional techniques that are not disclosed in the technical field of the present specification. The specification and the implementations are merely considered as examples, and the actual scope and the spirit of the present specification are specified by the following claims.

[0150] It should be understood that the present specification is not limited to the

previously described precise structures shown in the drawings, and various modifications and changes can be made without departing from the scope of the present specification. The scope of the present specification is limited by the appended claims only.

[0151] Specific implementations of the present specification are described above. Other implementations fall within the scope of the appended claims. In some cases, the actions or steps recorded in the claims can be performed in an order different from the order in the implementations and the desired results can still be achieved. In addition, the process depicted in the accompanying drawings does not necessarily require a particular execution order to achieve the desired results. In some implementations, multi-tasking and parallel processing may be advantageous.

[0152] The previous descriptions are some implementations of the present specification, but are not intended to limit the present specification. Any modification, equivalent replacement, improvement, etc. made without departing from the spirit and principle of the present specification shall fall within the protection scope of the present specification.

CLAIMS

1. A -method for authentication in a virtual reality scenario, the method comprising:

calculating interactive environment authentication information based on random information delivered by a virtual reality server, wherein the random information comprises a random number string of a predetermined length, and the interactive environment authentication information comprises a coordinate sequence generated through mapping calculation based on the random number string;

obtaining password information entered by a user in the virtual reality scenario; and

sending the password information and the interactive environment authentication information to the virtual reality server, wherein the virtual reality server obtains random information through reverse calculation based on the interactive environment authentication information after the password information is verified, and matches the random information obtained through reverse calculation against the random information delivered to a virtual reality client, to perform security authentication on an interactive environment of the virtual reality scenario.

2. The method according to claim 1, wherein the method further comprises:

detecting that the user triggers a target service in the virtual reality scenario;

sending a service request to the virtual reality server;

obtaining encrypted random information delivered by the virtual reality server in response to the virtual reality server receiving the service request; and

decrypting the encrypted random information.

3. The method according to claim 1, wherein the coordinate sequence comprises a set of a series of coordinates generated in response to determining a displacement of an operation focus during interaction between the user and the virtual reality scenario.

4. The method according to claim 1, wherein calculating the interactive environment authentication information based on random information delivered by the virtual reality server comprises:

separately performing mapping calculation on random numbers in the random number string based on a predetermined mapping algorithm, to generate all sets of mapping coordinates respectively corresponding to the random numbers, wherein each set of mapping coordinates is used as an offset corresponding to each password character and is offsetting an

operation focus in the virtual reality scenario by an offset corresponding to a password character after the user enters the password character in the virtual reality scenario; and

splicing all sets of coordinates generated after the operation focus is offset, to obtain the coordinate sequence.

5. The method according to claim 4, wherein offsetting the operation focus in the virtual reality scenario comprises:

determining a set of coordinates of an initial location of the operation focus in a password input interface in the virtual reality scenario; and

using a set of mapping coordinates corresponding to the password character as an offset to offset the set of coordinates of the initial location once.

6. The method according to claim 2, wherein the target service is a virtual reality scenario-based fast payment service.

7. A method for authentication in a virtual reality scenario, the method comprising:

obtaining, by a virtual reality server, interactive environment authentication information and password information entered by a user in a virtual reality scenario that are sent by a virtual reality terminal, wherein the interactive environment authentication information is generated through calculation based on random information delivered to the virtual reality terminal, wherein the random information comprises a random number string of a predetermined length, and the interactive environment authentication information comprises a coordinate sequence generated through mapping calculation based on the random number string;

verifying, by the virtual reality server, the password information; and if the password information is verified, obtaining random information through reverse calculation based on the interactive environment authentication information, and verifying whether the random information obtained through reverse calculation matches the random information delivered by the virtual reality server; and

determining, by the virtual reality server, that security authentication on an interactive environment of the virtual reality scenario succeeds if the random information obtained through reverse calculation matches the random information delivered to the virtual reality terminal.

8. The method according to claim 7, wherein the method further comprises:
receiving a service request sent by a virtual reality terminal in response to the virtual reality terminal detecting that the user triggers a target service in the virtual reality scenario;
generating the random information in response to the received service request; and
encrypting the random information and delivering encrypted random information to the virtual reality terminal.

9. The method according to claim 7, wherein the coordinate sequence comprises a set of a series of coordinates generated in response to determining a displacement of an operation focus during interaction between the user and the virtual reality scenario.

10. The method according to claim 7, wherein the interactive environment authentication information comprises a coordinate sequence obtained by using a set of mapping coordinates corresponding to a password character as an offset after the user enters the password character in the virtual reality scenario to offset an operation focus in the virtual reality scenario and splicing all sets of coordinates generated after the operation focus is offset, and all sets of mapping coordinates are generated by separately performing mapping calculation on random numbers in the random number string based on a predetermined mapping algorithm and respectively correspond to the random numbers; and

obtaining the random information through reverse calculation based on the interactive environment authentication information comprises:

separately calculating offsets corresponding to the sets of coordinates in the coordinate sequence, to obtain sets of mapping coordinates corresponding to password characters in the password information;

separately performing reverse calculation on the sets of mapping coordinates corresponding to the password characters based on the predetermined mapping algorithm, to generate random numbers respectively corresponding to the sets of mapping coordinates; and
splicing the random numbers to obtain the random number string.

11. The method according to claim 10, wherein the separately calculating offsets corresponding to the sets of coordinates in the coordinate sequence comprises:

determining a set of coordinates of an initial location of the operation focus existing before the operation focus is offset in a password input interface in the virtual reality scenario; and

calculating the corresponding offsets based on the set of coordinates of the initial

location and the sets of coordinates in the coordinate sequence.

12. The method according to claim 8, wherein the target service is a virtual reality scenario-based fast payment service.

13. An apparatus for authentication in a virtual reality scenario, the apparatus comprising:

a calculation module, configured to calculate interactive environment authentication information based on random information delivered by a virtual reality server, wherein the random information comprises a random number string of a predetermined length, and the interactive environment authentication information comprises a coordinate sequence generated through mapping calculation based on the random number string;

a first acquisition module, configured to obtain password information entered by a user in a virtual reality scenario; and

a sending module, configured to send the password information and the interactive environment authentication information to the virtual reality server, so that the virtual reality server obtains random information through reverse calculation based on the interactive environment authentication information after the password information is verified, and matches the random information obtained through reverse calculation against the random information delivered to a virtual reality client, to perform security authentication on an interactive environment of the virtual reality scenario.

14. The apparatus according to claim 13, wherein the coordinate sequence comprises a set of a series of coordinates generated in response to determining a displacement of an operation focus during interaction between the user and the virtual reality scenario.

15. The apparatus according to claim 13, wherein the calculation module is configured to:

separately perform mapping calculation on random numbers in the random number string based on a predetermined mapping algorithm, to generate all sets of mapping coordinates respectively corresponding to the random numbers, wherein each set of mapping coordinates is used as an offset corresponding to each password character and is used to offset an operation focus in the virtual reality scenario by an offset corresponding to a password character after the user enters the password character in the virtual reality scenario; and

splice all sets of coordinates generated after the operation focus is offset, to obtain the coordinate sequence.

16. The apparatus according to claim 15, wherein the calculation module is further configured to:

determine a set of coordinates of an initial location of the operation focus in a password input interface in the virtual reality scenario; and

use a set of mapping coordinates corresponding to the password character as an offset to offset the set of coordinates of the initial location once.

17. An apparatus for authentication in a virtual reality scenario, the apparatus comprising:

a second acquisition module, configured to obtain interactive environment authentication information and password information entered by a user in a virtual reality scenario that are sent by a virtual reality terminal, wherein the interactive environment authentication information is generated through calculation based on random information delivered to the virtual reality terminal, wherein the random information comprises a random number string of a predetermined length, and the interactive environment authentication information comprises a coordinate sequence generated through mapping calculation based on the random number string;

a verification module, configured to verify the password information; and if the password information is verified, obtain random information through reverse calculation based on the interactive environment authentication information, and verify whether the random information obtained through reverse calculation matches the random information delivered by the virtual reality server; and

a determining module, configured to determine that security authentication on an interactive environment of the virtual reality scenario succeeds if the random information obtained through reverse calculation matches the random information delivered to the virtual reality terminal.

18. The apparatus according to claim 17, wherein the coordinate sequence comprises a set of a series of coordinates generated in response to determining a displacement of an operation focus during interaction between the user and the virtual reality scenario.

19. The apparatus according to claim 18, wherein the interactive environment authentication information comprises a coordinate sequence obtained by using a set of mapping coordinates corresponding to a password character as an offset after the user enters the password character in the virtual reality scenario to offset an operation focus in the virtual reality scenario and splicing all sets of coordinates generated after the operation focus is offset, and all sets of mapping coordinates are generated by separately performing mapping calculation on random numbers in the random number string based on a predetermined mapping algorithm and respectively correspond to the random numbers; and

the verification module is configured to:

separately calculate offsets corresponding to the sets of coordinates in the coordinate sequence, to obtain sets of mapping coordinates corresponding to password characters in the password information;

separately perform reverse calculation on the sets of mapping coordinates corresponding to the password characters based on the predetermined mapping algorithm, to generate random numbers respectively corresponding to the sets of mapping coordinates; and

splice the generated random numbers to obtain the random number string.

20. The apparatus according to claim 19, wherein the verification module is further configured to:

determine a set of coordinates of an initial location of the operation focus existing before the operation focus is offset in a password input interface in the virtual reality scenario; and

calculate the corresponding offsets based on the set of coordinates of the initial location and the sets of coordinates in the coordinate sequence.

21. A virtual reality terminal device for authentication in a virtual reality scenario, the virtual reality terminal device comprising:

a processor; and

a storage, configured to store a machine-executable instruction, wherein

a machine-executable instruction that is stored in the storage and that corresponds to control logic of virtual reality scenario-based authentication is read and executed, to prompt the processor to:

calculate interactive environment authentication information based on random information delivered by a virtual reality server, wherein the random information comprises a

random number string of a predetermined length, and the interactive environment authentication information comprises a coordinate sequence generated through mapping calculation based on the random number string;

obtain password information entered by a user in a virtual reality scenario; and

send the password information and the interactive environment authentication information to the virtual reality server, so that the virtual reality server obtains random information through reverse calculation based on the interactive environment authentication information after the password information is verified, and matches the random information obtained through reverse calculation against the random information delivered to a virtual reality client, to perform security authentication on an interactive environment of the virtual reality scenario.

22. A virtual reality server device for authentication in a virtual reality scenario, the virtual reality server device comprising:

a processor; and

a storage, configured to store a machine-executable instruction, wherein

a machine-executable instruction that is stored in the storage and that corresponds to control logic of virtual reality scenario-based authentication is read and executed, to prompt the processor to:

obtain interactive environment authentication information and password information entered by a user in a virtual reality scenario that are sent by a virtual reality terminal, wherein the interactive environment authentication information is generated through calculation based on random information delivered to the virtual reality terminal, wherein the random information comprises a random number string of a predetermined length, and the interactive environment authentication information comprises a coordinate sequence generated through mapping calculation based on the random number string;

verify the password information; and if the password information is verified, obtain random information through reverse calculation based on the interactive environment authentication information, and verify whether the random information obtained through reverse calculation matches the random information delivered by the virtual reality server; and

determine that security authentication on an interactive environment of the virtual reality scenario succeeds if the random information obtained through reverse calculation matches the random information delivered to the virtual reality terminal.