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(54) **SECURITY VERIFICATION METHOD AND RELEVANT DEVICE**

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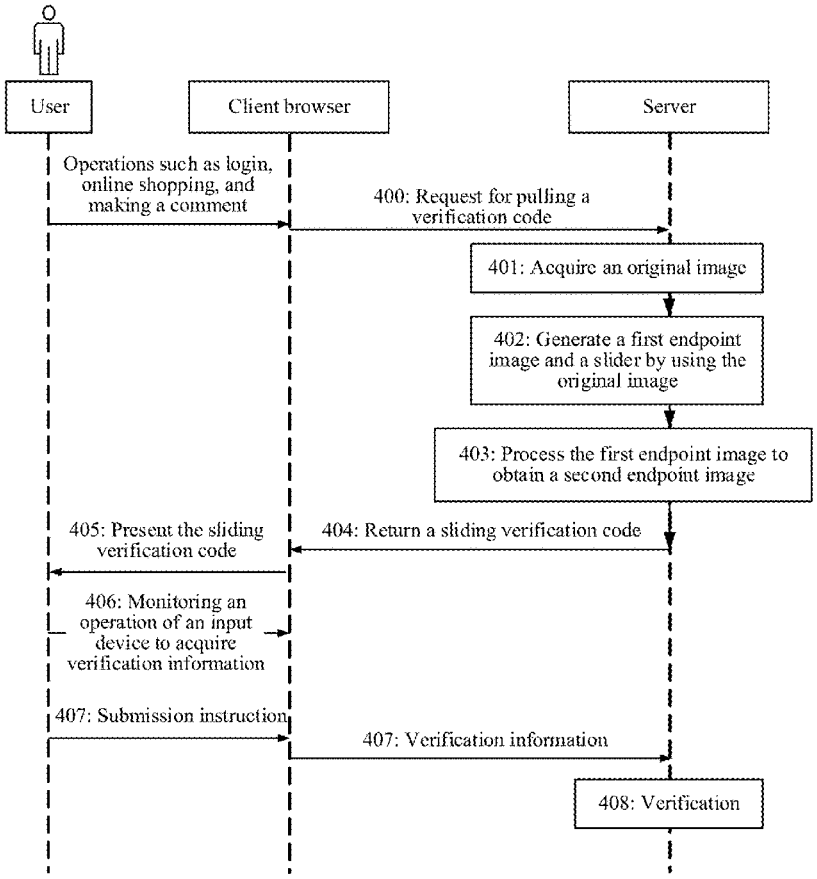
(57) **ABSTRACT**

The present disclosure provides a security verification method and a relevant device, to increase the difficulty of cracking. The method includes: receiving, from a verification requester, a request for pulling a sliding verification code; acquiring the sliding verification code which includes a slider and a second endpoint image obtained by performing filter processing on a first endpoint image; and returning the sliding verification code to the verification requester. The first endpoint image and the slider are generated from the same original image, and the slider and the second endpoint image are returned to the verification requester finally. The second endpoint image is obtained by performing image processing on the first endpoint image, and after the image processing, in an area outside the slider placement area, pixel values of pixels in the second endpoint image are different from pixel values of corresponding pixels in the original image.



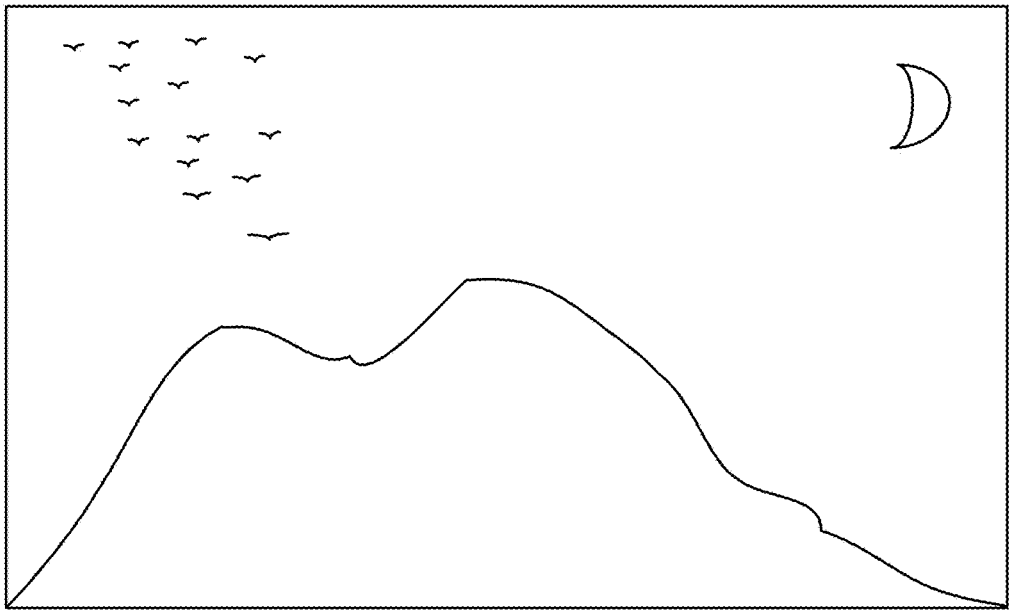


FIG. 1a

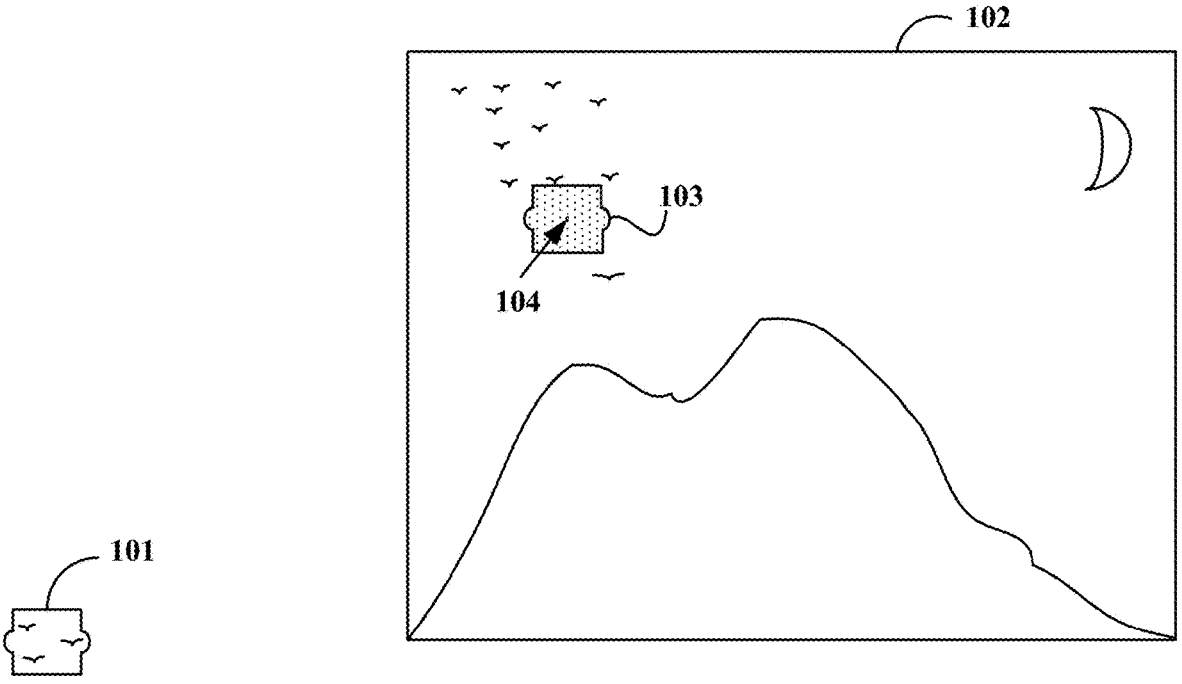


FIG. 1b

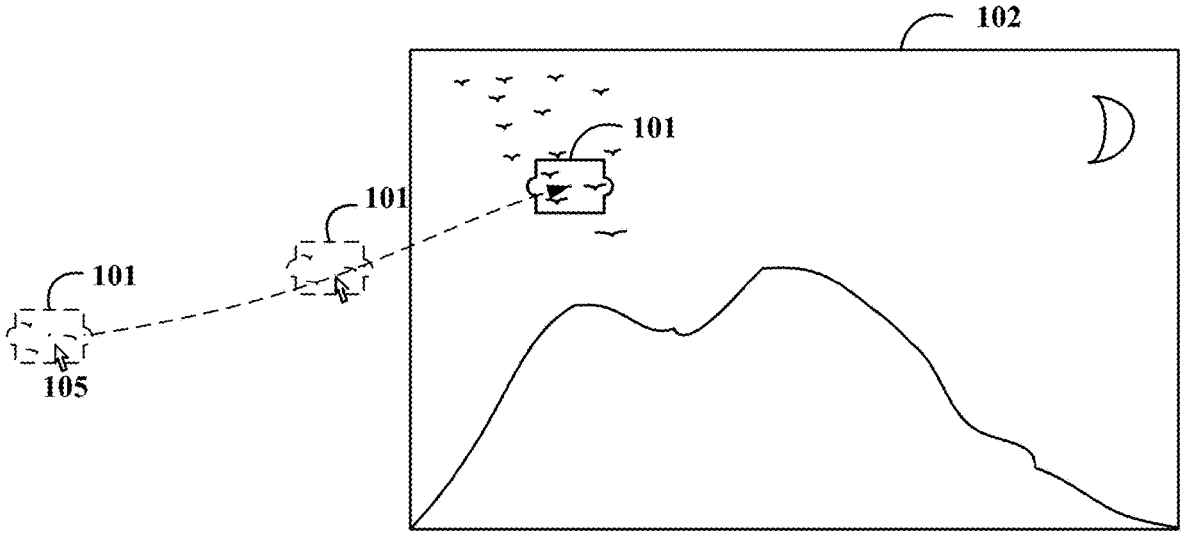


FIG. 1c

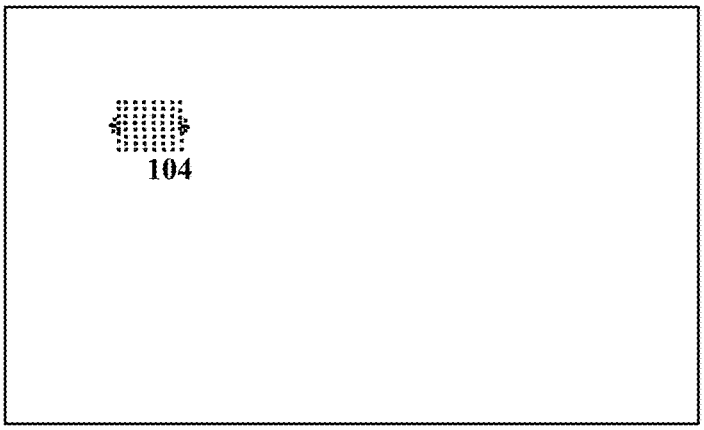


FIG. 1d

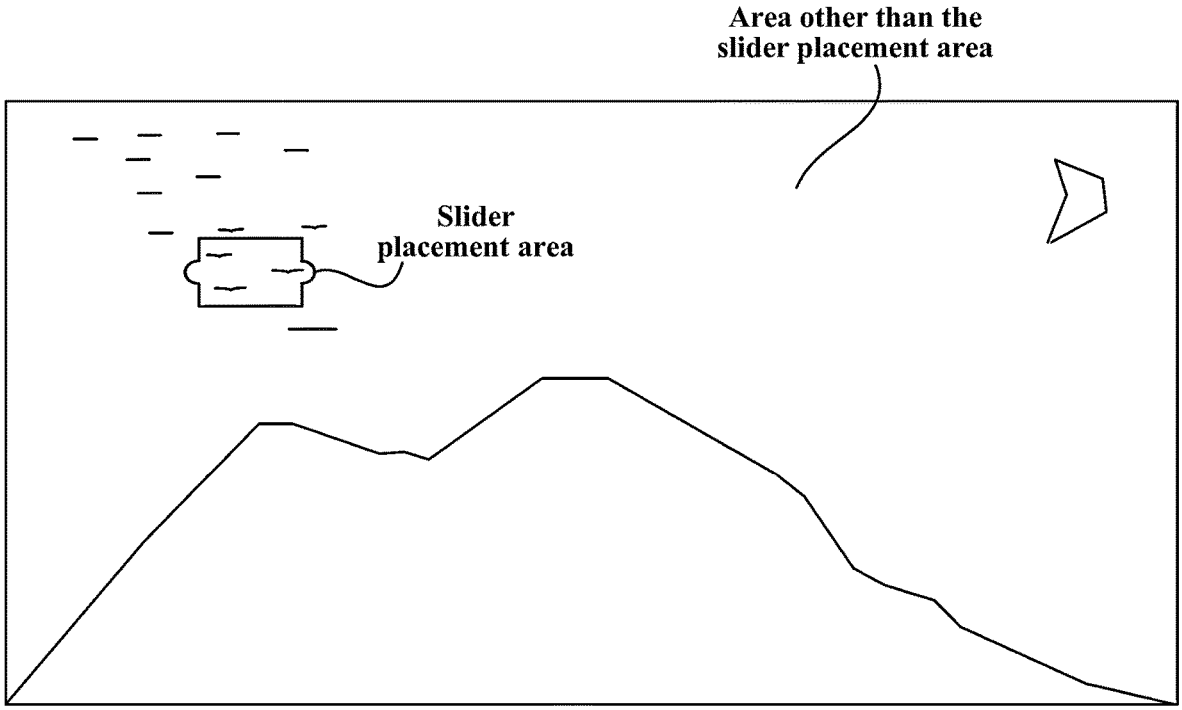

Area other than the slider placement area
Slider placement area

FIG. 2

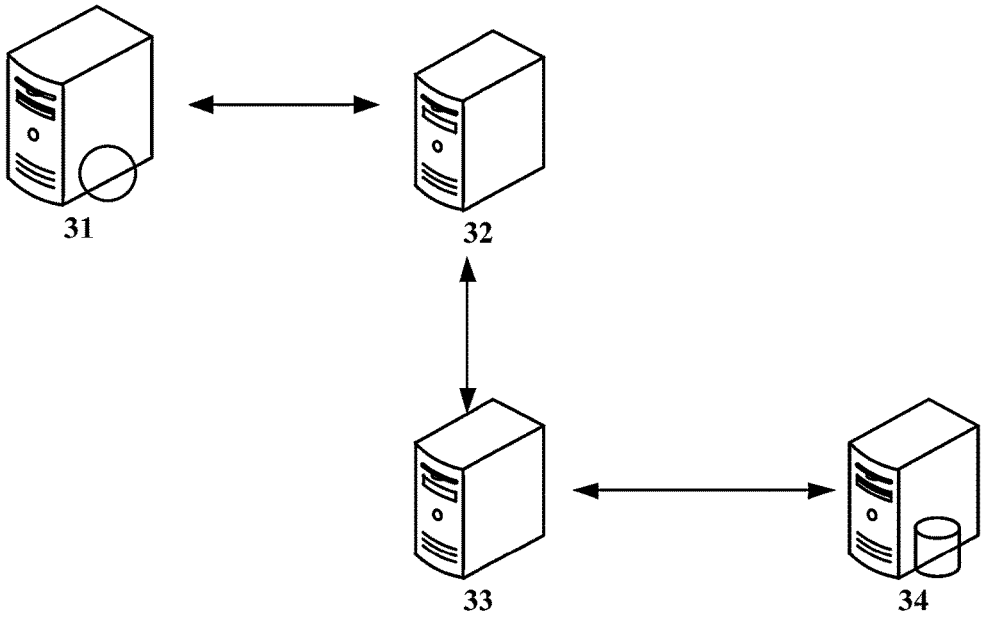

31
32
33
34

FIG. 3a

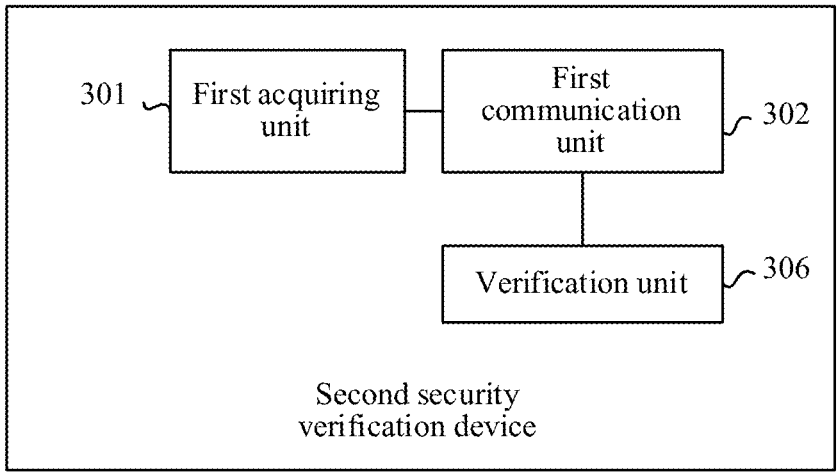

301
First acquiring unit
First communication unit
302
Verification unit
306
Second security verification device

FIG. 3b

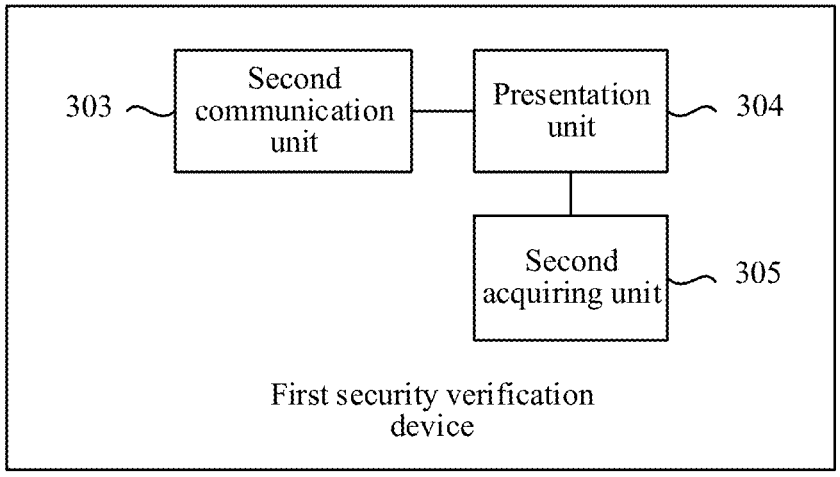

303
Second communication unit
Presentation unit
304
Second acquiring unit
305
First security verification device

FIG. 3c

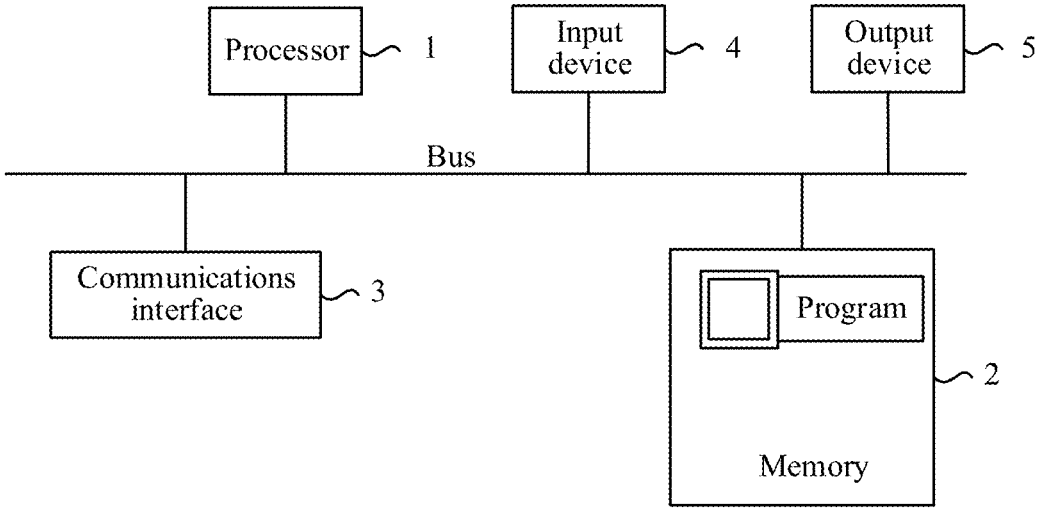

Processor
1
Input device
4
Output device
5
Bus
Communications interface
3
Program
2
Memory

FIG. 3d

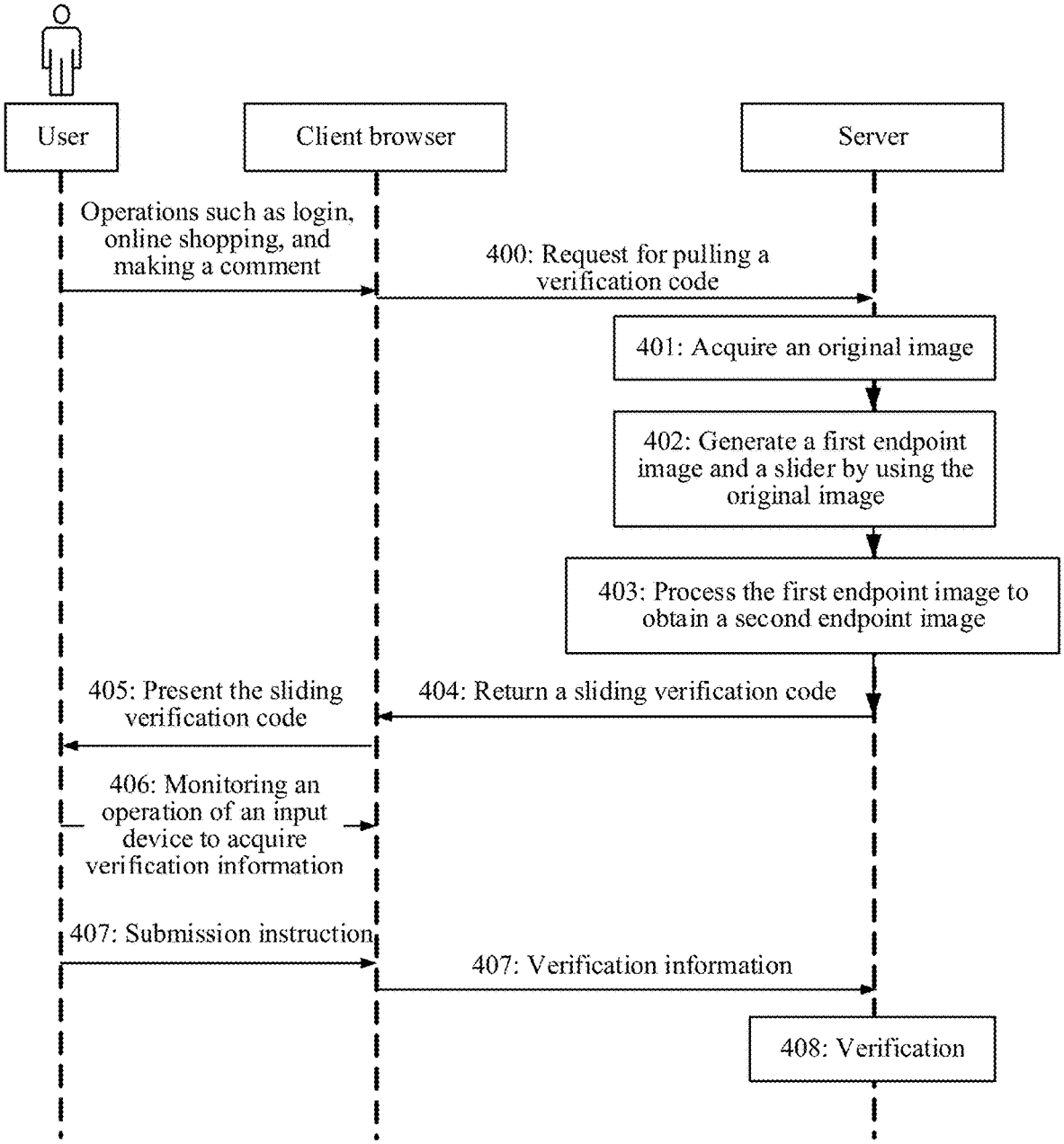

User
Client browser
Server
Operations such as login, online shopping, and making a comment
400: Request for pulling a verification code
401: Acquire an original image
402: Generate a first endpoint image and a slider by using the original image
403: Process the first endpoint image to obtain a second endpoint image
404: Return a sliding verification code
405: Present the sliding verification code
406: Monitoring an operation of an input device to acquire verification information
407: Submission instruction
407: Verification information
408: Verification

FIG. 4

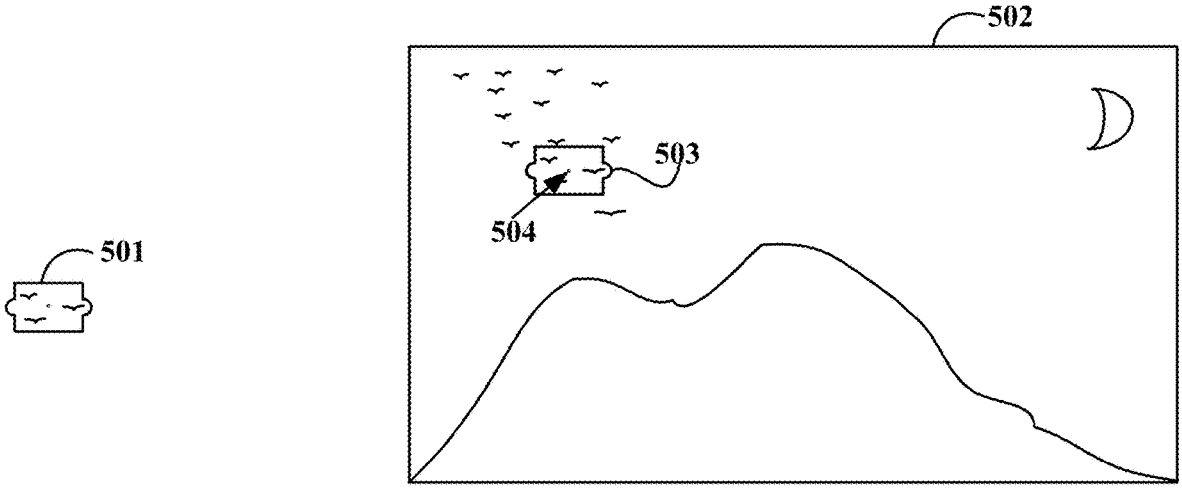


FIG. 5a

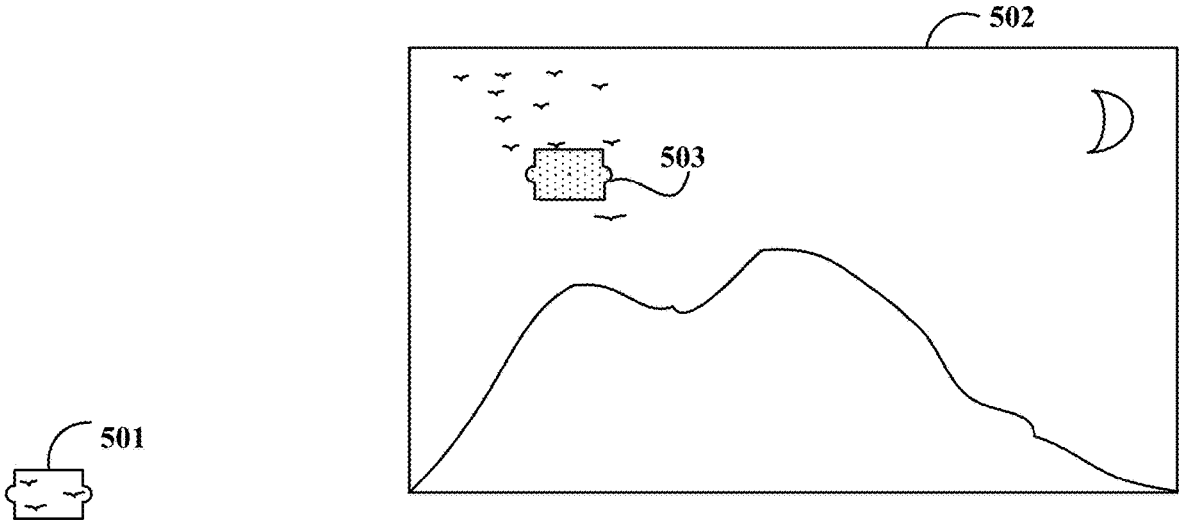


FIG. 5b

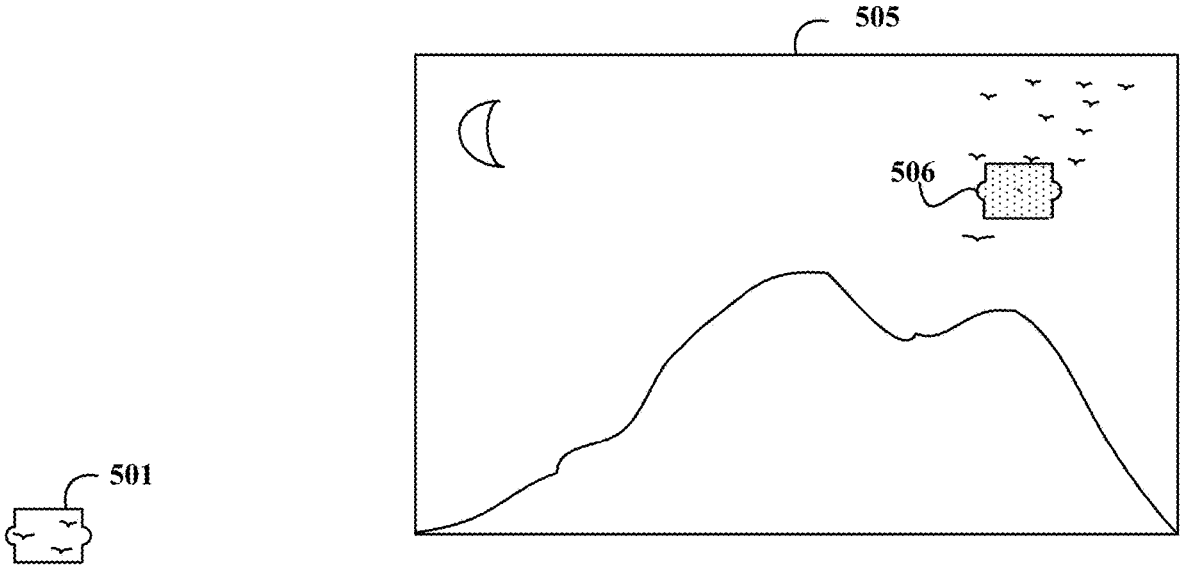


FIG. 5c

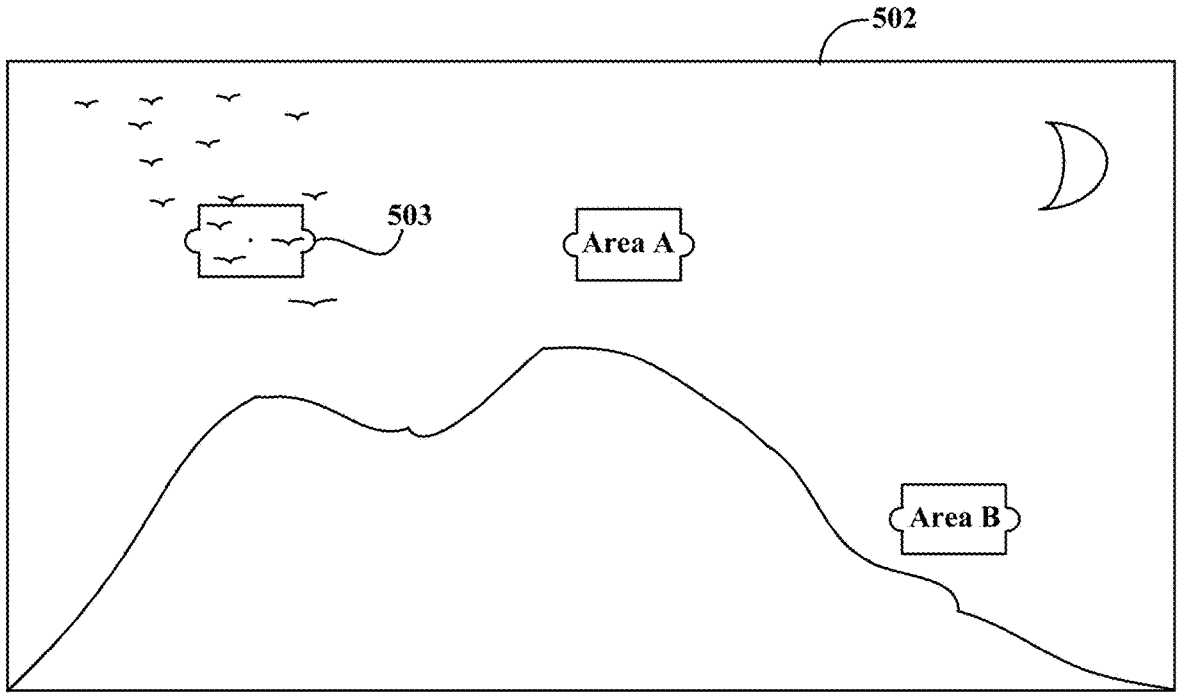


FIG. 5d

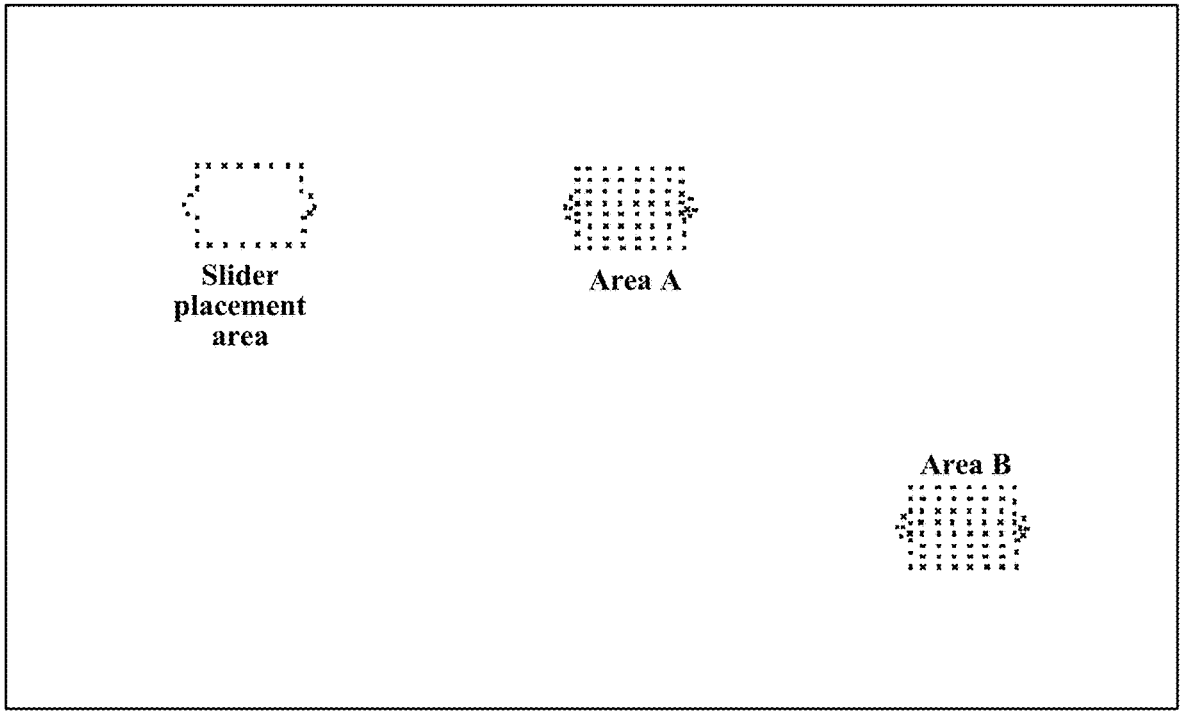


FIG. 5e

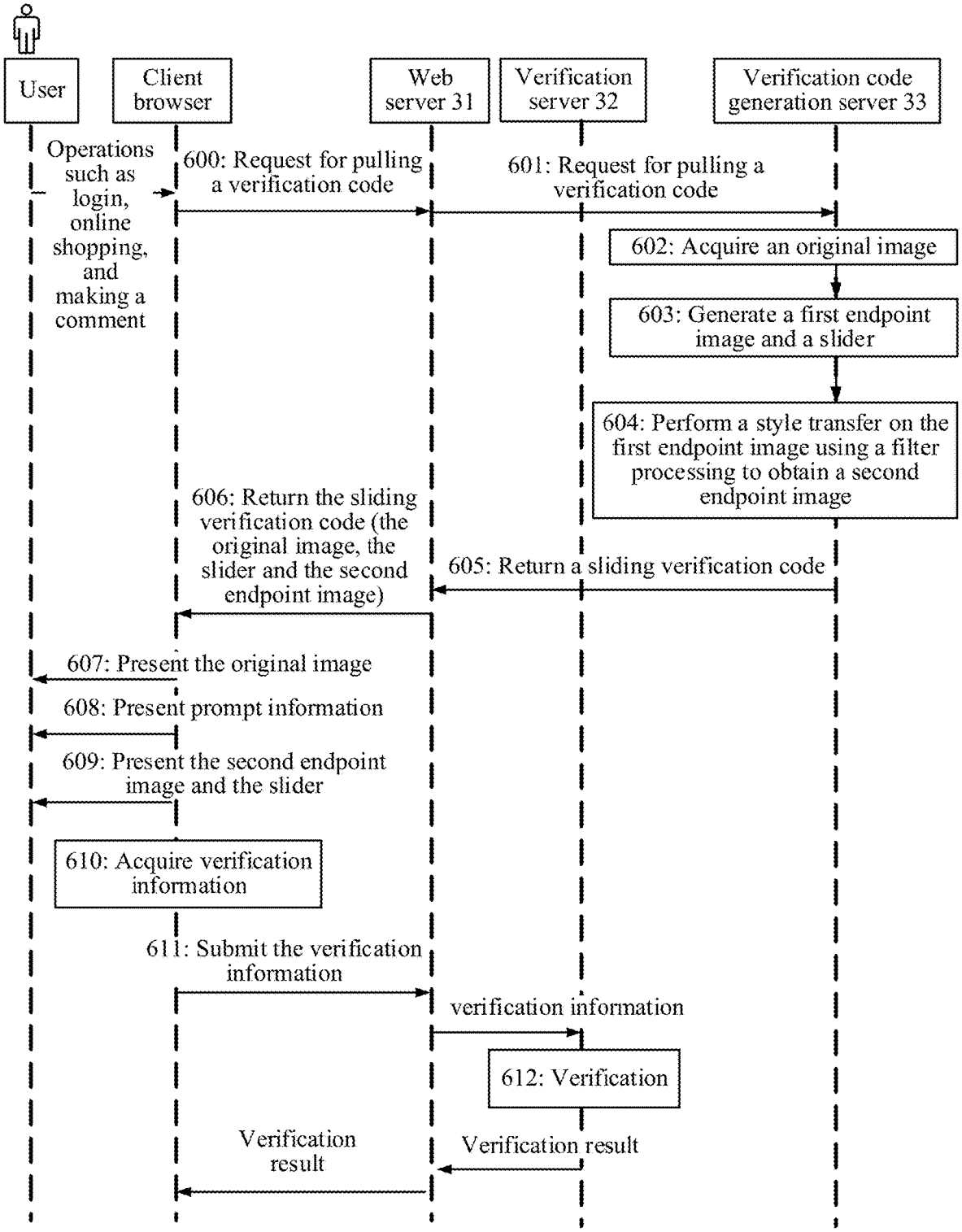

User
Client browser
Web server 31
Verification server 32
Verification code generation server 33
Operations such as login, online shopping, and making a comment
600: Request for pulling a verification code
601: Request for pulling a verification code
602: Acquire an original image
603: Generate a first endpoint image and a slider
604: Perform a style transfer on the first endpoint image using a filter processing to obtain a second endpoint image
605: Return a sliding verification code
606: Return the sliding verification code (the original image, the slider and the second endpoint image)
607: Present the original image
608: Present prompt information
609: Present the second endpoint image and the slider
610: Acquire verification information
611: Submit the verification information
verification information
612: Verification
Verification result
Verification result

FIG. 6

FIG. 7a

FIG. 7b

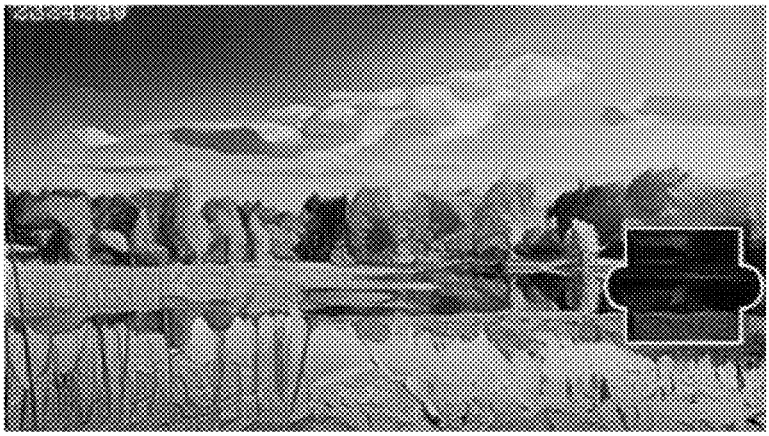


FIG. 7c

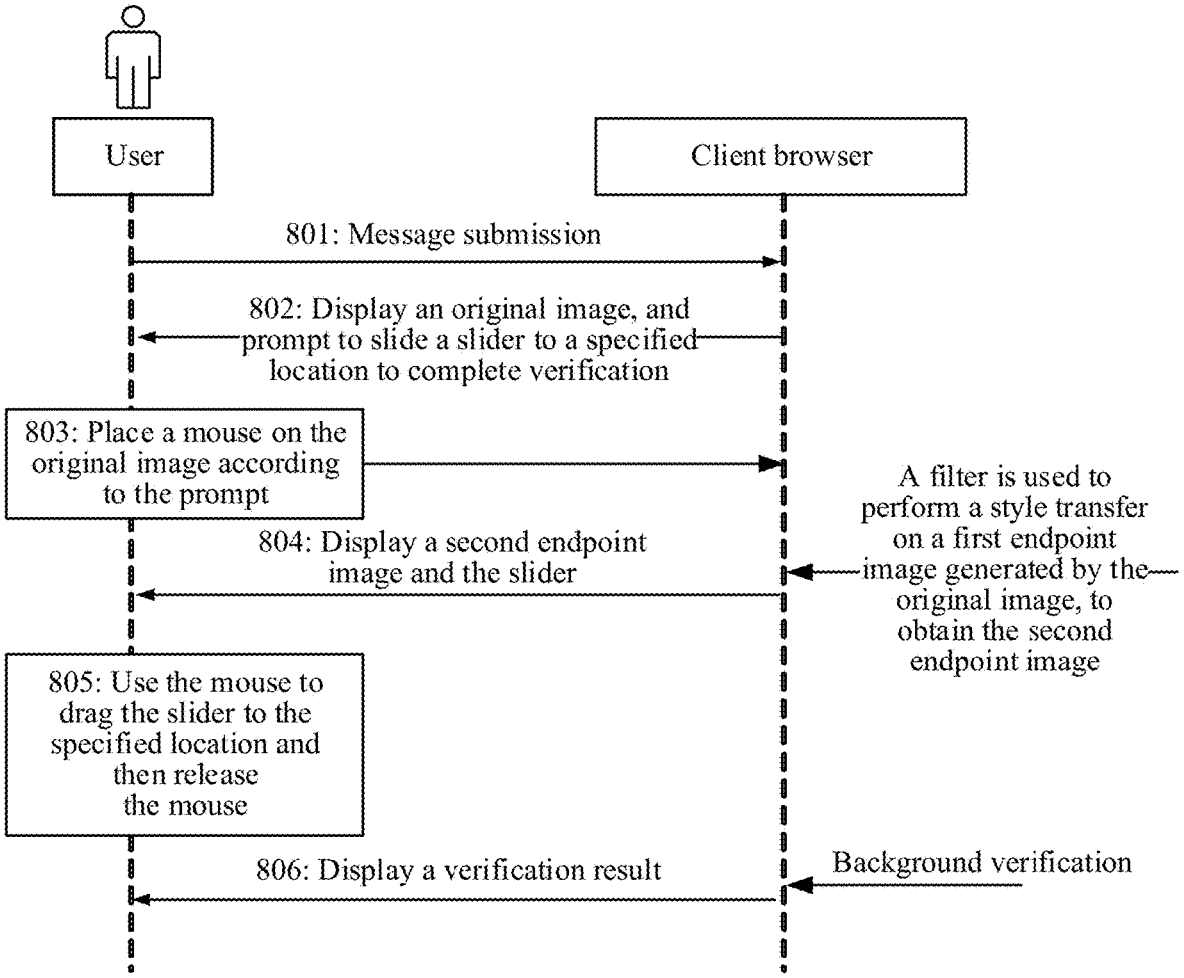

User
Client browser
801: Message submission
802: Display an original image, and prompt to slide a slider to a specified location to complete verification
803: Place a mouse on the original image according to the prompt
A filter is used to perform a style transfer on a first endpoint image generated by the original image, to obtain the second endpoint image
804: Display a second endpoint image and the slider
805: Use the mouse to drag the slider to the specified location and then release the mouse
806: Display a verification result
Background verification

FIG. 8

FIG. 9a

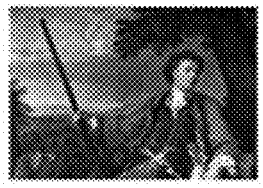


FIG. 9b

FIG. 9c

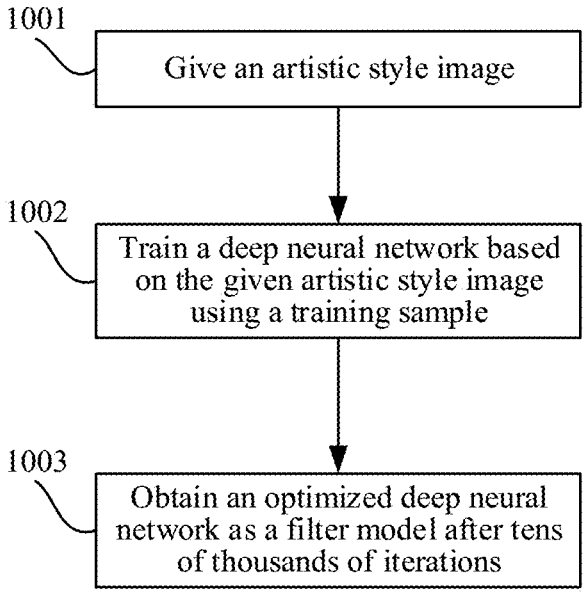


FIG. 10

SECURITY VERIFICATION METHOD AND RELEVANT DEVICE

RELATED APPLICATION

[0001] This application is a continuation application of U.S. application Ser. No. 16/673,455, filed on Nov. 4, 2019, which is a continuation application of PCT Patent Application No. PCT/CN2018/112625, filed on Oct. 30, 2018, which claims priority to Chinese Patent Application No. 201711123509.5, entitled "SECURITY VERIFICATION METHOD AND RELEVANT DEVICE" filed on Nov. 14, 2017, both of which are incorporated herein by reference in their entireties.

FIELD OF THE TECHNOLOGY

[0002] The present disclosure relates to the field of communications technologies, and in particular, to security verification.

BACKGROUND OF THE DISCLOSURE

[0003] Completely Automated Public Turing test to tell Computers and Humans Apart (CAPTCHA), commonly referred to as a verification code, is a public completely automated technology for determining whether the user is a computer or human. CAPTCHA generates and grades a test that humans can pass but computers cannot, to determine whether an operation is performed by a human or computer.

[0004] A sliding verification code is a verification code including an original image, a slider, and an endpoint image. Both the slider and the endpoint image are generated from the original image.

[0005] It is assumed that an original image is shown in FIG. **1***a*, and a slider **101** and an endpoint image **102** generated from the original image are shown in FIG. **1***b*. The endpoint image **102** includes a slider placement area **103**, and the center point of the slider placement area **103** is a slider endpoint **104**. During verification, the slider placement area **103** is dimmed. As shown in FIG. **1***c*, a user needs to drag the slider **101** to the slider placement area **103** (in FIG. **1***c*, a mouse is denoted by an arrow **105**) to cause the center point of the slider **101** to coincide with the slider endpoint **104**, in order to pass the verification.

[0006] The slider endpoint **104** is easily cracked by pixel-by-pixel subtraction between the original image and the endpoint image **102**. This is because that during verification, except for the dimmed slider placement area **103**, pixel values of pixels in other areas in the endpoint image **102** are the same as those of corresponding pixels in the original image. For example, after pixel-by-pixel subtraction is performed on the original image and the endpoint image **102**, a subtraction result shown in FIG. **1***d* is obtained, that is, pixel values in all areas except the slider placement area are zero (in FIG. **1***d*, a cross is used to represent that a pixel value of a pixel is not zero).

[0007] Therefore, how to increase the difficulty of cracking a sliding validation code has become a hot research topic.

SUMMARY

[0008] In view of this, embodiments of the present disclosure provide a security verification method and a relevant device, to increase the difficulty of cracking a sliding verification code.

[0009] To address the above issues, the embodiments of the present disclosure provide the following technical solutions.

[0010] According to a first aspect, the embodiments of the present disclosure provide a security verification method performed by a server. The method may include:

[0011] receiving, from a client, a request for security verification;

[0012] acquiring a slider and a second endpoint image, the second endpoint image being obtained by performing image processing on a first endpoint image, both the first endpoint image and the slider being generated from a same original image; and

[0013] sending the slider and the second endpoint image to the client for the client to display the slider and the second endpoint image for the security verification, wherein neither the original image nor a graphical representation of the original image is displayed on the client for the security verification.

[0014] According to a second aspect, the embodiments of the present disclosure provide a security verification method performed by a client. The method may include:

[0015] sending a request for security verification to a server;

[0016] receiving a slider and a second endpoint image, the second endpoint image being obtained by performing image processing on a first endpoint image, both the first endpoint image and the slider being generated from a same original image; and

[0017] displaying the slider and the second endpoint image for the security verification, wherein neither the original image nor a graphical representation of the original image is displayed for the security verification.

[0018] According to a third aspect, the embodiments of the present disclosure provide a security verification device, including a memory operable to store program code and a processor. The processor is operable to read the program code and perform a plurality of operations including:

[0019] receiving, from a client, a request for security verification;

[0020] acquiring a slider and a second endpoint image, the second endpoint image being obtained by performing image processing on a first endpoint image, both the first endpoint image and the slider being generated from a same original image; and

[0021] sending the slider and the second endpoint image to the client for the client to display the slider and the second endpoint image for the security verification, wherein neither the original image nor a graphical representation of the original image is displayed on the client for the security verification.

[0022] According to a fourth aspect, the embodiments of the present disclosure provide a security verification system, including a front-end server and a verification code generation server, the front-end server being configured to: receive, from a verification requester, a request for pulling a sliding verification code, acquire a sliding verification code generated by the verification code generation server, and return the sliding verification code to the verification requester, the sliding verification code at least including a slider and a second endpoint image obtained by performing image processing on a first endpoint image, both the first endpoint image and the slider being generated from the same original image, an edge of the slider matching with an edge of a

slider placement area in the first endpoint image, and an edge of the slider matching with an edge of a slider placement area in the second endpoint image; and the verification code generation server being configured to generate the sliding verification code.

[0023] In the sliding verification code including a slider and a second endpoint image according to the embodiments of the present disclosure, the first endpoint image and the slider are generated from the same original image, and the slider and the second endpoint image are returned to the verification requester finally. The second endpoint image is obtained by performing image processing on the first endpoint image, and after the image processing, in an area outside the slider placement area, pixel values of pixels in the second endpoint image are different from pixel values of corresponding pixels in the original image. In this way, even if pixel-by-pixel subtraction is performed between the original image and the second endpoint image, not all pixel values of other areas other than the slider placement area are zero, thereby increasing the difficulty of cracking the sliding verification code and improving security.

BRIEF DESCRIPTION OF THE DRAWINGS

[0024] FIG. **1***a* is a schematic diagram of an original image.

[0025] FIG. **1***b* is a schematic diagram of a slider and an endpoint image.

[0026] FIG. **1***c* is a schematic diagram of a dragging process.

[0027] FIG. **1***d* is a schematic diagram of a result of subtraction between an original image and an endpoint image in an existing verification method.

[0028] FIG. **2** is a schematic diagram of a second endpoint image according to an embodiment of the present disclosure.

[0029] FIG. **3***a* is an exemplary structural diagram of a security verification system according to an embodiment of the present disclosure.

[0030] FIG. **3***b* to FIG. **3***d* are exemplary structural diagrams of a security verification device according to an embodiment of the present disclosure.

[0031] FIG. **4** and FIG. **6** are exemplary flowcharts of a security verification method according to an embodiment of the present disclosure.

[0032] FIG. **5***a* and FIG. **5***b* are schematic diagrams of a slider and a first endpoint image according to an embodiment of the present disclosure.

[0033] FIG. **5***c* is a schematic diagram of a second endpoint image according to an embodiment of the present disclosure.

[0034] FIG. **5***d* is a schematic diagram of processing an area other than a slider placement area in a first endpoint image according to an embodiment of the present disclosure.

[0035] FIG. **5***e* is a schematic diagram of a result of subtraction between an original image and a second endpoint image according to an embodiment of the present disclosure.

[0036] FIG. **7***a* is a schematic diagram of a first endpoint image according to an embodiment of the present disclosure.

[0037] FIG. **7***b* and FIG. **7***c* are schematic diagrams of a second endpoint image according to an embodiment of the present disclosure.

[0038] FIG. **8** is an exemplary flowchart of a security verification method from the perspective of a user according to an embodiment of the present disclosure.

[0039] FIG. **9***a* is a schematic diagram of a first endpoint image according to an embodiment of the present disclosure.

[0040] FIG. **9***b* is a schematic diagram of a given artistic style image according to an embodiment of the present disclosure.

[0041] FIG. **9***c* is a schematic diagram of a second endpoint image according to an embodiment of the present disclosure.

[0042] FIG. **10** is a flowchart of training according to an embodiment of the present disclosure.

DESCRIPTION OF EMBODIMENTS

[0043] The embodiments of the present disclosure provide a security verification method and a relevant device (a security verification device and a security verification system).

[0044] The security verification method and the relevant device may be applied to a scenario where a user uses a client to interact with a server to complete verification.

[0045] The core concept of the embodiments of the present disclosure is that: taking a slider **101** and an endpoint image **102** shown in FIG. **1***b* as an example, the slider **101** and the endpoint image **102** are not directly returned to a verification requester (that is, the client); instead, image processing (certainly, in the embodiments of the present disclosure, a slider placement area **103** in the endpoint image **102** may be dimmed or not) is performed on the endpoint image **102** which serves as an intermediate image (also referred to as a first endpoint image), to obtain a second endpoint image (for example, as shown in FIG. **2**).

[0046] A dimming effect may be achieved by subtracting a value from RGB channels of a slider placement area. The brightness is determined by the value, and the value can be adjusted.

[0047] The second endpoint image also includes the slider placement area. After the image processing, in an area other than the slider placement area, pixel values of pixels of the second endpoint image may be different from pixel values of corresponding pixels of an original image. In this way, even if pixel-by-pixel subtraction is performed between the original image and the second endpoint image, not all pixel values of other parts other than the slider placement area are zero after the subtraction, thereby increasing the difficulty of cracking the sliding verification code and improving security.

[0048] After the core concept is introduced, the relevant device according to the embodiments of the present disclosure is described below.

[0049] A security verification device may be deployed on each of a client (a terminal) and a server to complete interaction and verification. For purpose of distinguishing, the security verification device of the client may be referred to as a first security verification device, and the security verification device of the server may be referred to as a second security verification device.

[0050] The first security verification device may be applied to a terminal (a client) such as a desktop computer, a mobile terminal (such as, a smartphone), an iPad, and the like. More specifically, the first security verification device may be a browser installed in the terminal.

[0051] On the side of the server, the second security verification device may be applied to the server in a software or hardware form.

[0052] In an actual scenario, on the side of the server, a plurality of servers having different functions may collaborate to provide a verification service. Therefore, the security verification system described above may include the plurality of servers having different functions. Certainly, the client may also be considered as a constituent of the security verification system.

[0053] FIG. **3***a* shows an exemplary architecture of the security verification system, including a web server **31**, a verification server **32**, a verification code generation server **33**, and an image storage server **34**.

[0054] The web server **31** is a front-end server responsible for communicating with a client browser, and the verification server **32**, the verification code generation server **33** and the image storage server **34** are back-end servers. The verification server **32** may provide a verification service, the verification code generation server **33** may provide a verification code generation service, and the image storage server **34** may be configured to store an image (an original image) for generating a verification code.

[0055] Certainly, functions of a plurality of servers may be implemented by one server. For example, the verification code generation server **33** and the image storage server **34** may be integrated into one server, or the functions of the verification server **32**, the verification code generation server **33**, and the image storage server **34** may be integrated into one server.

[0056] Internal structures of the devices are described below.

[0057] An exemplary structure of the second security verification device is shown in FIG. **3***b*, including a first acquiring unit **301** and a first communication unit **302**. The first acquiring unit **301** may be configured to acquire a sliding verification code (at least including a slider and a second endpoint image), and the first communication unit **302** is configured to return the sliding verification code to a verification requester.

[0058] An exemplary structure of the first security verification device is shown in FIG. **3***c*, including:

[0059] a second communication unit **303**, configured to receive the sliding verification code returned by the first communication unit **302**; and

[0060] a presentation unit **304**, configured to present the sliding verification code.

[0061] The presentation unit **304** may specifically be a display screen, and the first communication unit **302** and the second communication unit **303** may specifically be communications interfaces.

[0062] Still referring to FIG. **3***c*, in another embodiment of the present disclosure, the first security verification device may further include a second acquiring unit **305** configured to acquire verification information after the presentation unit **304** presents the sliding verification code; and the second communication unit **303** returns the verification information to the second security verification device.

[0063] Correspondingly, referring to FIG. **3***b*, the second security verification device may further include a verification unit **306** configured to perform verification based on the verification information returned by the verification requester.

[0064] FIG. **3***d* is another possible schematic structural diagram of the second security verification device according to the embodiment, including:

[0065] a bus, a processor **1**, a memory **2**, a communications interface **3**, an input device **4**, and an output device **5**, the processor **1**, the memory **2**, the communications interface **3**, the input device **4** and the output device **5** being interconnected through the bus.

[0066] The bus may include a path for transmitting information between components of a computer system.

[0067] The processor **1** may be a general-purpose processor such as a general-purpose central processing unit (CPU), a network processor (NP), a microprocessor and the like, or may be an application-specific integrated circuit (ASIC), or one or more integrated circuits configured to control the execution of a program in the solution of the present disclosure, or may be a digital signal processor (DSP), a field programmable gate array (FPGA) or other programmable logic device, discrete gate or transistor logic device, or discrete hardware component.

[0068] The memory **2** stores a program or script for executing a technical solution of the present disclosure, and may further store an operating system and other key services. Specifically, the program may include program code, and the program code includes a computer operation instruction. The script is usually stored in text (such as ASCII), and is parsed or compiled only when called.

[0069] More specifically, the memory **2** may include a read-only memory (ROM), other types of static storage devices capable of storing static information and instructions, a random access memory (RAM), other types of dynamic storage devices capable of storing information and instructions, a magnetic disk storage, a flash, and the like.

[0070] The input device **4** may include a device configured to receive data and information inputted by a user, such as a keyboard, a mouse, a camera, a voice input device, a touchscreen, and the like.

[0071] The output device **5** may include a device configured to output information to the user, such as a display screen, a speaker, and the like.

[0072] The communications interface **3** may include a device using any type of transceiver to communicate with another device or a communication network, such as an Ethernet, a radio access network (RAN), a wireless local area network (WLAN), and the like.

[0073] It may be understood that FIG. **3***d* only shows a simplified design of a server/intelligent terminal. In actual applications, the second security verification device may include any number of transmitters, receivers, processors, controllers, memories, communications interfaces, and the like, and all servers/intelligent terminals that can implement the embodiments of the present disclosure fall within the protection scope of the embodiments of the present disclosure.

[0074] The processor **1** may implement a verification method provided in the following embodiments by executing the program stored in the memory **2** and calling another device.

[0075] In addition, functions of units of the second security verification device may be implemented by the processor **1** executing the program stored in the memory **2** and calling another device.

[0076] For the first security verification device mentioned above, the servers may use a computer architecture similar to the second security verification device.

[0077] The embodiments of the present disclosure are described in further detail below based on common aspects of the foregoing embodiments of the present disclosure.

[0078] FIG. **4** shows an exemplary interaction process of generating a sliding verification code and performing verification, which may at least include the following steps:

[0079] Part **400**: A client/terminal (a browser) sends a request for pulling a verification code to a server.

[0080] The client/terminal (the browser) is a verification requester.

[0081] This embodiment may be applied to any scenario requiring verification of the verification code, such as user login, online shopping (such as ticket purchasing), making a comment, and the like.

[0082] In different scenarios, conditions of triggering the sending of a request for pulling a verification code (briefly referred to as pulling request) may be different. For example, in a login scenario, the pulling request may be sent when the user clicks on a login button of the client. For example, in a ticket purchasing scenario, the pulling request may be sent when the user clicks on a ticket purchasing button.

[0083] Part **401**: The server acquires an original image used for generating a sliding verification code.

[0084] The original image may be acquired at random or according to a preset rule.

[0085] For example, the original image is as shown in FIG. **1***a*.

[0086] Part **402**: The server generates a first endpoint image and a slider by using the original image.

[0087] Referring to FIG. **5***a* and FIG. **5***b*, an edge of a slider **501** matches with an edge of a slider placement area **503** in the first endpoint image **502**, and the slider placement area **503** may be dimmed (as shown in FIG. **5***b*) or not (as shown in FIG. **5***a*).

[0088] Certainly, a slider endpoint is at the location of a center point **504** (referring to FIG. **5***a*) of the slider placement area **503**.

[0089] Part **403**: The server performs image processing on the first endpoint image to obtain a second endpoint image.

[0090] The second endpoint image and the slider will be presented to the user through the client finally, and the first endpoint image will not be presented to the user.

[0091] The second endpoint image also has a slider placement area, and an edge of the slider also matches with an edge of the slider placement area in the second endpoint image.

[0092] After generating the second endpoint image, the server records the location of the center point of the slider placement area in the second endpoint image, that is, the slider endpoint (also referred to as a first endpoint location), for subsequent verification.

[0093] In an example, a coordinate of the center point in a coordinate system of the second endpoint image may be used as the slider endpoint. In this case, no matter where the image is on the screen, a coordinate of an edge vertex on the image does not change.

[0094] An objective of the image processing includes: at least changing the distribution of pixel values of the second endpoint image, especially, the distribution of pixel values outside the slider placement area. In this way, even if pixel-by-pixel subtraction is performed between the original image and the second endpoint image, not all pixel values of other parts are zero after the subtraction, thereby increasing the difficulty of cracking the sliding verification code and improving security.

[0095] Pixel values of a color image refer to corresponding values of channel matrixes of RGB channels in the color image.

[0096] The objective may be achieved by using a plurality of image processing manners, for example, adding random noise or performing filter processing on the first endpoint image. In addition, a horizontal flip may be performed, or resolution may be changed.

[0097] Referring to FIG. **5***c*, a horizontal flip is used as an example. Compared with FIG. **5***b*, a second endpoint image **505** in FIG. **5***c* is obtained by performing a horizontal flip on the first endpoint image **502**. This also makes pixel values of pixels in the second endpoint image **505** different from pixel values of corresponding pixels in the original image.

[0098] The reason of changing the resolution is based on the following considerations:

[0099] Generally speaking, image resolution refers to the number of pixels. For example, resolution of 480*800 refers to 480 horizontal pixels and 800 vertical pixels.

[0100] Assuming that resolution of the first endpoint image is 480*800, resolution of the original image is also 480*800. If resolution of the second endpoint image is changed to be different from 480*800, for example, changed to 800*480, pixel-by-pixel subtraction between the original image and the second endpoint image cannot be performed, thereby increasing the difficulty of cracking.

[0101] In addition, a partial or entire area of the first endpoint image may be processed by using the image processing manner.

[0102] Referring to FIG. **5***d*, a partial area is used as an example. The second endpoint image may be obtained by processing an area A and an area B other than the slider placement area **503** in the first endpoint image in the image processing manner. Refer to FIG. **5***e* for a result of subtraction between the original image and the second endpoint image. As can be seen, in addition to the slider placement area **503**, pixel values of the area A and the area B also are not zero, thereby increasing the difficulty of cracking.

[0103] The image processing may be performed on the slider or not.

[0104] Part **404**: The server returns a sliding verification code to the client/terminal (the browser).

[0105] The sliding verification code may include the slider and the second endpoint image, or may include the original image, the slider and the second endpoint image.

[0106] In a case that the sliding verification code includes the original image, the slider and the second endpoint image, the server may return the three images at a time, or return the three images in two stages: first return the original image and then return the slider and the second endpoint image.

[0107] Part **405**: The client/terminal (the browser) presents the received sliding verification code.

[0108] In the case that the sliding verification code includes the slider and the second endpoint image and does not include the original image, the client/terminal (the browser) may directly present the slider and the second endpoint image.

[0109] In the case that the sliding verification code includes the original image, the slider and the second endpoint image, the client/terminal (the browser) may present the three blocks in two stages: first present the original

image and then present the slider and the second endpoint image. This will be described below in the present disclosure.

[0110] Part **406**: The client/terminal (the browser) monitors an operation of an input device to acquire verification information.

[0111] The input device is usually a mouse or a keyboard.

[0112] The user may drag the slider with the input device such as the mouse and the keyboard on the client. The client/terminal (the browser) may monitor the input device such as the mouse and the keyboard.

[0113] Take the mouse as example, after detecting a mouse release event, the client/terminal (the browser) may acquire a location at which the slider is to be placed, that is, an endpoint location (also referred to as a second endpoint location). The endpoint location may be represented by a coordinate of the center point of the slider on the second endpoint image presented on the client.

[0114] In an example, the verification information at least includes an endpoint location at which the slider is to be placed by the user.

[0115] In addition, in other examples, the verification information may further include a sliding trajectory generated by the user dragging the slider. The server may subsequently compare the sliding trajectory with massive samples to determine whether the user is a machine and human.

[0116] Part **407**: The client/terminal (the browser) receives a submission instruction inputted by the input device and submits the verification information.

[0117] In practice, the user uses the input device such as the mouse and the keyboard to click a submit button to send the submission instruction.

[0118] Certainly, in some scenarios, the client/terminal (the browser) may directly submit the verification information after monitoring a mouse or keyboard release event.

[0119] Part **408**: The server receives the verification information, and performs verification based on the verification information.

[0120] In an example, if the verification information includes only the second endpoint location, the server may compare the second endpoint location with a correct first endpoint location.

[0121] In another example, if the verification information further includes the sliding trajectory, the server may further compare the sliding trajectory with massive samples to determine whether the user is a machine and human.

[0122] Subsequently, if the verification succeeds, the server may send a notification indicating that the security verification is successful to the client/terminal (the browser).

[0123] If the verification fails, the server may send a verification failure notification.

[0124] Alternatively, the server may calculate the number of failures for the same sliding verification code; and if the number of failures reaches a threshold, send the verification failure notification.

[0125] Certainly, in others embodiment, when the current verification fails or the number of failures reaches a threshold, the server may acquire a new sliding verification code and send the new sliding verification code to the client/terminal.

[0126] As can be seen, in the embodiments of the present disclosure, the first endpoint image and the slider are generated from the same original image, and the slider and the second endpoint image included in the sliding verification code are returned to the verification requester finally. The second endpoint image is obtained by performing image processing on the first endpoint image, and after the image processing, pixel values of pixels in the second endpoint image are different from pixel values of corresponding pixels in the original image. In this way, even if pixel-by-pixel subtraction is performed between the original image and the second endpoint image, not all pixel values of other areas other than the slider placement area are zero after the subtraction, thereby increasing the difficulty of cracking the sliding verification code and improving security.

[0127] The filter processing manner is mentioned above. Filter is a special image effect processing technology, and utilizes a particular program algorithm to calculate and transform the color, brightness, saturation ratio, contrast ratio, hue, distribution, arrangement and other attributes of pixels in an image, to generate a special visual effect of the image.

[0128] The following embodiments are described focusing on filter processing.

[0129] Referring to FIG. **6**, FIG. **6** uses the servers in the security verification system shown in FIG. **3***a* as an example to describe in detail an interaction process between the servers end and the client during verification.

[0130] Part **600**: The client/terminal (the browser) sends a request for pulling a verification code to the web server **31**.

[0131] Part **600** is similar to Part **400**, and the details are not described herein again.

[0132] Part **601**: After receiving the pulling request, the web server **31** forwards the pulling request to the verification code generation server **33**.

[0133] In an example, the web server **31** may forward the pulling request to the verification code generation server **33** through the verification server **32**, or may directly forward the pulling request to the verification code generation server **33**.

[0134] Specifically, the first communication unit **302** of the second security verification device may be deployed on the web server **31** to receive the pulling request and forward the pulling request to the verification code generation server **33**.

[0135] The first acquiring unit **301** of the second security verification device may be deployed on the web server **31**, or may be deployed on the verification code generation server **33**.

[0136] When the first acquiring unit **301** is deployed on the web server **31**, the "acquiring a sliding verification code" may refer to receiving a sliding verification code returned by the verification code generation server **33**.

[0137] When the first acquiring unit **301** is deployed on the verification code generation server **33**, the "acquiring a sliding verification code" may include an operation of generating a sliding verification code.

[0138] Part **602**: The verification code generation server **33** acquires an original image used for generating a sliding verification code.

[0139] Part **602** is similar to Part **401**, and the details are not described herein again.

[0140] Part **603**: The verification code generation server **33** generates a first endpoint image and a slider by using the original image.

[0141] Part **603** is similar to Part **402**, and the details are not described herein again.

[0142] The verification code generation server **33** may further include a sliding verification code unit and a transfer unit.

[0143] Parts **602** to **603** may be specifically completed by the sliding verification code unit, and the transfer unit may be configured to implement the following Part **604**.

[0144] In an example, the sliding verification code unit and the transfer unit may also serve as constituents of the second security verification device.

[0145] Part **604**: The verification code generation server **33** performs a style transfer on the first endpoint image in a filter processing manner to obtain a second endpoint image.

[0146] Different filters may be used to achieve different style transfers, to achieve visual effects such as relief sculpture, blur, dynamic blur, radial blur, and the like.

[0147] In addition, the filter may also be used to change the artistic style of an image. For example, the image may have visual effects such as oil painting, watercolor painting, pencil painting, chalk painting, gouache painting, and the like.

[0148] Certainly, the filter may also be used to transfer the style of an image into a painting style of an artist (such as Van Gogh, Monet, and Picasso).

[0149] For example, referring to FIG. **7***a*, assuming that the first endpoint image is as shown in FIG. **7***a*, the filter may be used to transfer the style of the first endpoint image into a style shown in FIG. **7***b* or FIG. **7***c*.

[0150] As can be seen, if the filter processing is used properly, not only the anti-cracking rate of the verification code can be increased, but also the aesthetics can be ensured.

[0151] Refer to Part **403** of the foregoing embodiment for other relevant descriptions, and the details are not described herein again.

[0152] In an example, a filter model may be used to perform the filter processing on the first endpoint image to obtain the second endpoint image.

[0153] The filter model may be obtained through training by the transfer unit, and the specific method for training the filter model will be introduced later.

[0154] Part **605**: The verification code generation server **33** returns the sliding verification code to the web server **31**.

[0155] Specifically, the sliding verification code may be returned to the web server **31** by the transfer unit.

[0156] In this embodiment, the sliding verification code includes the original image, the slider and the second endpoint image.

[0157] In an example, the verification code generation server **33** may return the sliding verification code to the web server **31** through the verification server **32**. The verification server **32** records the location of the center point, that is, a slider endpoint (also referred to as a first endpoint location) of the slider placement area in the second endpoint image at the same time, for subsequent verification.

[0158] In another example, the verification code generation server **33** may return the sliding verification code directly to the web server **31**, and meanwhile, the verification code generation server **32** may notify the verification server **32** of the first endpoint location.

[0159] Part **606**: After receiving the sliding verification code, the web server **31** returns the sliding verification code to the client/terminal (the browser).

[0160] Specifically, the sliding verification code may be returned by the first communication unit **302**, and may be received by the second communication unit **303** of the client.

[0161] Part **606** is similar to Part **404**, and the details are not described herein again.

[0162] Part **607**: The client/terminal (the browser) presents the original image in sliding verification code.

[0163] In this case, a verification image begins to appear from the perspective of the user.

[0164] Part **608**: The client/terminal (the browser) presents prompt information for instructing the user to slide the slider to a specified location to complete the verification. In this process, the client/terminal (the browser) continuously monitors an operation of the input device.

[0165] More specifically, Part **607** and Part **608** may be completed by the presentation unit **304** of the first security verification device, and the second acquiring unit **305** monitors the input device.

[0166] Part **609**: When detecting that the focus is on the original image, the client/terminal (the browser) presents the second endpoint image and the slider in the sliding verification code.

[0167] Take the mouse as example, after the user places the mouse on the original image, the background detects the operation and presents the second endpoint image and the slider to the user, and then, the user operates the mouse to drag the slider to complete the verification.

[0168] More specifically, the presentation unit **304** may be used to present the second endpoint image and the slider.

[0169] Part **610**: The client/terminal (the browser) acquires verification information.

[0170] Take the mouse as example, after monitoring a mouse release event, the client/terminal (the browser) may acquire a location at which the slider is to be placed, that is, an endpoint location (also referred to as a second endpoint location). The endpoint location may be represented by a coordinate of the center point of the slider on the second endpoint image presented on the client.

[0171] In an example, the verification information at least includes an endpoint location at which the slider is to be placed by the user.

[0172] In addition, in other examples, the verification information may further include a sliding trajectory generated by the user dragging the slider. The server may subsequently compare the sliding trajectory with massive samples to determine whether the user is a machine and human.

[0173] Specifically, Part **610** may be executed by the second acquiring unit **305**.

[0174] Part **611**: The client/terminal (the browser) submits the verification information.

[0175] In an example, the client/terminal (the browser) may submit the verification information as triggered by a submission instruction. The user the input device such as the mouse and the keyboard to click a submit button to send the submission instruction.

[0176] Certainly, in some scenarios, the client/terminal (the browser) may directly submit the verification information after monitoring the mouse or keyboard release event.

[0177] More specifically, Part **611** may be completed by the second communication unit **303**.

[0178] Part **612**: The web server **31** transmits the received verification information to the verification server **32** for verification.

[0179] In an example, the verification information may be received by the first communication unit **302** and transmitted by the first communication unit **302** to the verification server **32**.

[0180] In an example, if the verification information includes only the second endpoint location, the verification server **32** may determine whether the second endpoint location is consistent with a correct first endpoint location (where a certain error is allowed).

[0181] In another example, if the verification information further includes the sliding trajectory, the verification server **32** may further compare the sliding trajectory with massive samples to determine whether the user is a machine and human.

[0182] Subsequently, if the verification succeeds, the verification server **32** may send a notification indicating that security verification is successful to the client/terminal (the browser) through the web server **31**.

[0183] If the verification fails, the verification server **32** may send a verification failure notification through the web server **31**.

[0184] Alternatively, the verification server **32** may calculate the number of failures for the same sliding verification code; and if the number of failures reaches a threshold, send the verification failure notification through the web server **31**.

[0185] Certainly, in other embodiments, when the current verification fails or the number of failures reaches a threshold, the verification server **32** may instruct the web server **31** to acquire a new sliding verification code and send the new sliding verification code to the client/terminal.

[0186] Assuming that a user wants to make a comment on news of a portal website, the portal website requires the user to pass the verification of the sliding verification code before making a comment, in order to prevent malicious spamming and other purposes.

[0187] Referring to FIG. **8**, from the perspective of a user, the procedure and operations involved are as follows:

[0188] Step **801**: The user clicks a "Submit Message" button.

[0189] Step **802**: A browser displays an original image, and provides a prompt for instructing the user to slide a slider to a specified location to complete verification.

[0190] Step **803**: The user places a mouse on the original image according to the prompt.

[0191] Step **804**: The browser displays a second endpoint image and the slider.

[0192] Certainly, in the background which is invisible to the user, a filter is used to perform a style transfer on a first endpoint image generated from the original image, to obtain the second endpoint image.

[0193] Step **805**: The user uses the mouse to drag the slider to the specified location and then releases the mouse.

[0194] Step **806**: The browser displays a verification result.

[0195] If the verification succeeds, the submission of the message of the user will succeed correspondingly.

[0196] As can be seen, in the embodiments of the present disclosure, the filter is used to perform a style transfer on the first endpoint image to obtain the second endpoint image, thereby obtaining a sliding verification code including the second endpoint image and the slider. After the style transfer, pixel values of pixels in the second endpoint image are different from pixel values of corresponding pixels in the original image. In this way, even if pixel-by-pixel subtraction is performed between the original image and the second endpoint image, not all pixel values of other areas other than the slider placement area are zero after the subtraction. In addition, after the style transfer, the contour of the slider placement area becomes more difficult to recognize and crack, thereby increasing the difficulty of cracking the sliding verification code and improving security. Also, the aesthetics is ensured and user experience is improved.

[0197] Finally, how to train the filter model is described below.

[0198] In an example, the filter model may be trained based on given reference images.

[0199] Specifically, a deep neural network may be trained based on the given reference images, and the trained deep neural network may be used as the filter model.

[0200] Due to the strong aesthetics of artistic styles, an artistic style image may be given, and the deep neural network is trained to perform a style transfer on an input image, so as to generate an image having an artistic style of the artistic style image.

[0201] For example, assuming that the first endpoint image is as shown in FIG. **9***a* and the given artistic style image is as shown in FIG. **9***b*, the generated second endpoint image may be as shown in FIG. **9***c*. The content of the second endpoint image is as similar as possible to the first endpoint image (or the original image), and the artistic style of the second endpoint image is similar to the given artistic style image.

[0202] Referring to FIG. **10**, specific implementation steps of the training process are described below.

[0203] Part **1001**: An artistic style image (for example, the artistic style image shown in FIG. **9***b*) is given.

[0204] In a specific implementation, the artistic style image may be manually specified (or inputted) or automatically selected from an art gallery.

[0205] Part **1002**: A deep neural network is trained by using training samples based on the given artistic style image.

[0206] In an example, more than 100,000 images provided in a COCO database (Common Objects in Context, a deep learning dataset provided by Microsoft) may be used as training samples and inputted to the deep neural network. The deep neural network is trained according to a loss function of the deep neural network to obtain an optimized deep neural network.

[0207] An architecture of the deep neural network is usually formed by stacking a plurality of layers of simple modules, and the multilayer architecture may be trained using a stochastic gradient descent method.

[0208] Two loss functions of the deep neural network, that is, a style loss function and a content loss function, may be optimized constantly through the training using the stochastic gradient descent method.

[0209] A smaller value of the style loss function indicates that the artistic style of the image after the transfer is more similar to the artistic style of the given artistic style image. A smaller value of the content loss function indicates that content of the image after the transfer is more similar to the inputted training sample.

[0210] The value of the style loss function may be obtained by calculating a two-norm between the image after the transfer and a deep feature map of the artistic style image.

[0211] The value of the content loss function may be obtained by calculating a two-norm between the image after the transfer and the original image.

[0212] The deep feature map is in a matrix form.

[0213] The two-norm is two norms of matrix A, that is, a square root value of a maximum characteristic root of a product of a transpose matrix of A and the matrix A, which is a linear distance between two vector matrices in space. This is similar to calculating a linear distance between two points on a chessboard.

[0214] Part **1003**: An optimized deep neural network may be obtained as a filter model after tens of thousands of iterations.

[0215] For example, if the first endpoint image is input to the trained deep neural network, an image having the artistic style shown in FIG. **9***b* may be obtained.

[0216] Certainly, a plurality of different artistic style images may be given, and the deep neural network is trained according to the foregoing steps respectively to obtain a plurality of filter models, so that diversified second endpoint images having different styles may be obtained.

[0217] Certainly, other constraints may further be defined for the artistic style transfer. For example, the image after the style transfer should not affect the user visual experience, and the slider placement area is recognizable by human eyes (that is, may be recognized by humans or artificial intelligence). In addition, the image after the style transfer needs to effectively resist cracking attacks which adopt subtraction between two images.

[0218] Therefore, in other embodiments of the present disclosure, the plurality of trained filter models (each filter model corresponds to one filter processing manner) may further be screened to select an artistic style processing manner that is the most difficult to crack.

[0219] For example, there are a total of 100 filter processing manners obtained through training, from which N filter processing manners (where N is a positive integer) that are the most difficult to crack may be selected and used to process the first endpoint image. That is, the filter processing manners (also referred to as optimal filter processing manners) for the filter processing of the first endpoint image are the N filter processing manners that are the most difficult to crack and that are selected from a plurality of filter processing manners.

[0220] More specifically, the N filter processing manners that are the most difficult to crack may be selected by using the following method:

[0221] calculating a cracking rate of each filter processing manner; and

[0222] selecting N filter processing manners having the lowest cracking rates as the optimal filter processing manners.

[0223] A method of calculating the cracking rate is described as follows:

[0224] For any one of the filter processing manners, process the first endpoint images amount to m by using a filter model corresponding to the filter processing manner to obtain m second endpoint images;

[0225] Attempt to crack the m second endpoint images by using a cracking method of "pixel-by-pixel subtraction between two images";

[0226] Count the quantity n of cracked second endpoint images; and

[0227] Use n/m as a cracking rate of the filter processing manner.

[0228] In addition, in other embodiments of the present disclosure, the filter processing manner may be selected from the plurality of filter processing manners based on a user preference. For example, if the user likes Van Gogh, and if a filter processing manner with the Van Gogh style is the most difficult to crack among the filter processing manners, the filter processing manner with this style may be selected as the optimal filter processing manner.

[0229] In addition, the embodiments of the present disclosure further provide a storage medium configured to store program code, the program code being configured to perform the security verification method according to the foregoing embodiments.

[0230] The embodiments of the present disclosure further provide a computer program product including an instruction, the computer program product, when run on a server or a terminal, causing the server or the terminal to perform the security verification method according to the foregoing embodiments.

[0231] The embodiments of the specification are described in a progressive manner. Each embodiment focuses on a difference from other embodiments. For same or similar parts in the embodiments, refer to these embodiments. The device disclosed in the embodiments corresponds to the method disclosed in the embodiments and therefore is briefly described. For related parts, refer to the description of the method.

[0232] A person skilled in the art may further realize that units and algorithm steps of each example described in combination with the embodiments herein can be implemented through electronic hardware, computer software, or a combination thereof. In order to clearly describe the interchangeability between hardware and software, the compositions and steps of the examples have been generally described according to functions in the foregoing descriptions. Whether to implement the functions through hardware or software depends on particular applications and design constraints of the technical solutions. A person skilled in the art may use a different method to implement the described functions for each particular application, but such an implementation shall not be considered as going beyond the scope of this application.

[0233] In combination with the embodiments disclosed in this specification, method or algorithm steps may be implemented directly through hardware, a software unit executed by a processor, or a combination thereof. The software unit may reside in a random access memory (RAM), a memory, a read-only memory (ROM), an electrically programmable ROM, an electrically erasable programmable ROM, a register, a hard disk, a removable disk, a CD-ROM, or any other form of storage medium known in the art.

[0234] The foregoing descriptions of the disclosed embodiments enable a person skilled in the art to implement or use this application. Various modifications to the embodiments are apparent to a person skilled in the art, and the generic principles defined herein may be implemented in other embodiments without departing from the spirit or scope of this application. Therefore, this application is not intended to be limited to the embodiments described herein but is to be accorded the broadest scope consistent with the principles and novel features disclosed herein.

What is claimed is:

1. A security verification method performed by a server, the method comprising:

receiving, from a client, a request for security verification;

acquiring a slider and a second endpoint image, the second endpoint image being obtained by performing

image processing on a first endpoint image, both the first endpoint image and the slider being generated from a same original image; and

sending the slider and the second endpoint image to the client for the client to display the slider and the second endpoint image for the security verification, wherein neither the original image nor a graphical representation of the original image is displayed on the client for the security verification.

2. The method according to claim **1**, wherein the performing the image processing on the first endpoint image comprises changing a distribution of pixel values of the first endpoint image to obtain the second endpoint image.

3. The method according to claim **2**, wherein the image processing comprises an addition of random noise, a filter processing, a horizontal flip, or a change of resolution.

4. The method according to claim **2**, wherein the distribution of pixel values outside a slider placement area in the first endpoint image is changed.

5. The method according to claim **1**, wherein after the sending the slider and the second endpoint image, the method further comprises:

receiving a verification information returned by the client; and

performing verification based on the verification information.

6. The method according to claim **1**, wherein the acquiring the slider and the second endpoint image comprises:

acquiring an original image;

generating the first endpoint image and the slider using the original image; and

performing a filter processing on the first endpoint image to obtain the second endpoint image.

7. The method according to claim **6**, wherein the filter processing is used to perform a style transfer on the first endpoint image.

8. The method according to claim **7**, wherein the second endpoint image is obtained by performing the filter processing on the first endpoint image using a filter model; and the filter model is obtained through a training based on given reference images.

9. The method according to claim **6**, wherein

the filter processing comprises: first N filter processing manners with a lowest cracking rates selected from a plurality of filter processing manners, N being a positive integer; or

a filter processing manner determined based on a user preference.

10. The method according to claim **6**, wherein the performing the filter processing on the first endpoint image comprises:

performing filter processing on a partial or entire area of the first endpoint image.

11. A security verification method performed by a client, the method comprising:

sending a request for security verification to a server;

receiving a slider and a second endpoint image, the second endpoint image being obtained by performing image processing on a first endpoint image, both the first endpoint image and the slider being generated from a same original image; and

displaying the slider and the second endpoint image for the security verification, wherein neither the original image nor a graphical representation of the original image is displayed for the security verification.

12. The method according to claim **11**, wherein the image processing comprises an addition of random noise, a filter processing, a horizontal flip, or a change of resolution.

13. The method according to claim **11**, wherein the first endpoint image is not displayed for the security verification.

14. The method according to claim **11**, wherein the client is a browser.

15. The method according to claim **11**, wherein after the displaying the slider and the second endpoint image, the method further comprises:

acquiring verification information; and

returning the verification information for a verifier to perform verification based on the verification information.

16. The method according to claim **15**, wherein the verification information comprises an endpoint location at which the slider is placed by an user and a sliding trajectory generated by the user dragging the slider.

17. A security verification device, comprising:

a memory operable to store program code; and

a processor operable to read the program code and perform a plurality of operations including:

receiving, from a client, a request for security verification;

acquiring a slider and a second endpoint image, the second endpoint image being obtained by performing image processing on a first endpoint image, both the first endpoint image and the slider being generated from a same original image; and

sending the slider and the second endpoint image to the client for the client to display the slider and the second endpoint image for the security verification, wherein neither the original image nor a graphical representation of the original image is displayed on the client for the security verification.

18. The device according to claim **17**, wherein the processor is operable to perform the plurality of operations including:

changing a distribution of pixel values of the first endpoint image to obtain the second endpoint image.

19. The device according to claim **17**, wherein the processor is further operable to perform a plurality of operations including:

receiving a verification information returned by the client; and

performing verification based on the verification information.

20. The device according to claim **17**, wherein the processor is operable to perform the plurality of operations including:

acquiring an original image;

generating the first endpoint image and the slider using the original image; and

performing a filter processing on the first endpoint image to obtain the second endpoint image.

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