

IMAGE ACQUISITION METHOD, APPARATUS, SYSTEM, DEVICE AND MEDIUM

Cross-Reference to Related Application

[0001] This international application is based upon and claims priority to Chinese
5 Application No. 201810777979.1, filed on July 16, 2018, which is incorporated herein by reference
in its entirety.

Technical Field

[0002] This specification relates to the field of computer technologies, and in particular, to
10 an image acquisition method, apparatus and system and an electronic device.

Technical Background

[0003] With the continuous development of pattern recognition, artificial intelligence and
other technologies, biometric feature recognition technologies are also attracting increasingly more
15 attention. At present, biometric feature recognition mainly includes fingerprint recognition, face
recognition, speech recognition, palmprint recognition, eye print recognition, iris recognition,
facial expression recognition, and so on.

[0004] In order to improve the accuracy of biometric recognition technologies, related
technical personnel and research institutions are considering combining face recognition with eye
20 recognition (such as eye print recognition and iris recognition) to solve the problem of inaccurate
recognition caused by similar faces (such as identical twins) in face recognition.

[0005] However, for face recognition, only ordinary RGB cameras can often meet
acquisition requirements of the face recognition. Due to a limited resolution, a limited Depth of
Field (DoF), a limited Field of View (FoV) and other problems, the ordinary RGB cameras cannot
25 achieve accurate acquisition of eye regions. Therefore, a more optimized solution is still needed to
improve the accuracy of face recognition results.

Summary of the Invention

[0006] An image acquisition method, apparatus and system and an electronic device are provided in embodiments of this application to solve the problem that existing face image acquisition methods are not optimized enough.

[0007] In order to solve the foregoing technical problem, the embodiments of this specification are implemented as follows.

[0008] In a first aspect, an image acquisition method is proposed, comprising:

[0009] acquiring an initial face image of a user by a first image acquisition apparatus;

10 [0010] controlling a second image acquisition apparatus to acquire an eye print image of the user according to a target acquisition parameter, the target acquisition parameter being determined based on the initial face image; and

[0011] synthesizing the initial face image and the eye print image into a target face image of the user.

15 [0012] In a second aspect, an image acquisition apparatus is proposed, comprising:

[0013] a first acquisition unit configured to acquire an initial face image of a user by a first image acquisition apparatus;

[0014] a second acquisition unit configured to control a second image acquisition apparatus to acquire an eye print image of the user according to a target acquisition parameter, the target acquisition parameter being determined based on the initial face image; and

20 [0015] a synthesis unit configured to synthesize the initial face image and the eye print image into a target face image of the user.

[0016] In a third aspect, an image acquisition system is proposed, comprising a first image acquisition apparatus, a second image acquisition apparatus, a control apparatus, and a synthesis apparatus, wherein

25 [0017] the first image acquisition apparatus is configured to acquire an initial face image

of a user;

[0018] the second image acquisition apparatus is configured to acquire an eye print image of the user;

[0019] the control apparatus is configured to control the second image acquisition apparatus to acquire the eye print image of the user according to a target acquisition parameter;
5 and

[0020] the synthesis apparatus is configured to synthesize the initial face image and the eye print image into a target face image of the user.

[0021] In a fourth aspect, an electronic device is proposed, comprising:

10 [0022] a processor; and

[0023] a memory configured to store a computer executable instruction, wherein when executed, the executable instruction causes the processor to perform the following operations:

[0024] acquiring an initial face image of a user by a first image acquisition apparatus;

[0025] controlling a second image acquisition apparatus to acquire an eye print image of the user according to a target acquisition parameter, the target acquisition parameter being
15 determined based on the initial face image; and

[0026] synthesizing the initial face image and the eye print image into a target face image of the user.

[0027] In a fifth aspect, a computer readable storage medium is proposed, wherein one or
20 more programs are stored in the computer readable storage medium, and when executed by an electronic device that includes a plurality of applications, the one or more programs cause the electronic device to perform the following operations:

[0028] acquiring an initial face image of a user by a first image acquisition apparatus;

[0029] controlling a second image acquisition apparatus to acquire an eye print image of the user according to a target acquisition parameter, the target acquisition parameter being
25 determined based on the initial face image; and

[0030] synthesizing the initial face image and the eye print image into a target face image of the user.

[0031] It can be seen from the technical solutions provided in the embodiments of this application that the solutions in the embodiments of this application have at least one of the following technical effects:

[0032] When a face image of a user is acquired, an initial face image of the user can be acquired by a first image acquisition apparatus, a target acquisition parameter can be determined based on the initial face image, then a second image acquisition apparatus is controlled to acquire an eye print image of the user according to a target acquisition parameter, and finally the initial face image and the eye print image are synthesized into a target face image of the user. As such, the acquired face image includes the face image of the user as well as an eye region image of the user, and the eye region image is the eye print image of the user. On one hand, the accuracy of face recognition is improved, and on the other hand, the second image acquisition apparatus can also be controlled to acquire the eye print image of the user based on the initial face image of the user, thus avoiding that the user further needs to adjust his/her own acquisition angle and improving user experience.

Brief Description of the Drawings

[0033] The accompanying drawings described here are used to provide further understanding of this application and form a part of this application. Schematic embodiments of this application and their descriptions are used to interpret this application and do not constitute an undue limitation to this application. In the drawings:

[0034] FIG. 1 is a schematic diagram of an implementation process of an image acquisition method according to an embodiment of this specification;

[0035] FIG. 2 is a schematic diagram of an image acquisition method applied to an actual scenario according to an embodiment of this specification;

[0036] FIG. 3 is a schematic structural diagram of an image acquisition apparatus according to an embodiment of this specification;

[0037] FIG. 4 is a schematic structural diagram of an image acquisition system according to an embodiment of this specification; and

5 [0038] FIG. 5 is a schematic structural diagram of an electronic device according to an embodiment of this specification.

Detailed Description

[0039] In order to make the objectives, technical solutions and advantages of this application much clearer, the technical solutions of this application will be clearly and completely
10 described in the following in combination with specific embodiments of this application and the corresponding accompanying drawings. It is apparent that the embodiments described are merely some of rather than all of the embodiments of this application. All other embodiments obtained by those of ordinary skill in the art based on the embodiments in this application without creative
15 efforts should all be encompassed in the protection scope of this application.

[0040] The technical solutions provided in the embodiments of this application are described in detail in the following with reference to the accompanying drawings.

[0041] In order to solve the problem that existing face image acquisition methods are not optimized enough, an image acquisition method is provided in the embodiments of this
20 specification. The image acquisition method provided in the embodiments of this specification may be executed by, but not limited to, at least one of user terminals that can be configured to perform the method provided in the embodiments of this specification such as mobile phones, tablet computers, and wearable devices. Or, the method may also be executed by a client terminal that can perform the method.

25 [0042] For ease of description, an implementation manner of the method is introduced in the following by taking that the method is performed by a mobile terminal capable of performing

the method as an example. It should be appreciated that the method being performed by a mobile terminal is only an exemplary description, which should not be construed as a limitation to the method.

[0043] Specifically, a schematic diagram of an implementation process of an image acquisition method according to one or more embodiments of this specification is shown in FIG. 1, including the following steps.

[0044] In step 110, an initial face image of a user is acquired by a first image acquisition apparatus.

[0045] As stated in the Technical Background, existing ordinary RGB cameras for face image acquisition often can only meet acquisition requirements of face recognition. For acquisition of eye prints in an eye region, the ordinary RGB cameras have the following problems. 1) The ordinary RGB cameras have a limited resolution, which cannot guarantee a high resolution for the acquired eye prints in the eye region. 2) The ordinary RGB cameras have a limited DoF, which cannot guarantee accurate focusing of the cameras in the eye region. 3) The ordinary RGB cameras have a limited FoV, so it is impossible to maintain a wide FoV while capturing the eye prints in the eye region, and it is impossible to acquire eye prints of users of different heights.

[0046] However, in the solutions for iris imaging in the prior art, it needs to complete iris acquisition by a single camera, and imaging DoF and FoV of the single camera used are both limited; therefore, a user usually can complete image acquisition of an eye region only when he/she is in a specified position, which affects user experience. In addition, the iris acquisition also requires adding an infrared light supplementation component and a camera infrared filter to an imaging system, which increases the complexity of the imaging system.

[0047] In order to solve this problem, the image acquisition method provided in one or more embodiments of this specification includes a first image acquisition apparatus configured to acquire an initial face image of a user and a second image acquisition apparatus configured to acquire an eye print image of the user, which can achieve acquisition of a face image and an eye

image at the same time. The first image acquisition apparatus acquires an initial face image of a user, and it should be understood that the initial face image described here may be acquired based on a face video stream of the user acquired by the first image acquisition apparatus in real time.

[0048] In step 120, a second image acquisition apparatus is controlled to acquire an eye
5 print image of the user according to a target acquisition parameter, the target acquisition parameter being determined based on the initial face image.

[0049] In order to solve the problem in the prior art that user experience is affected as the user can complete image acquisition of an eye region only when he/she is in a specified position, a preferred solution is provided in one or more embodiments of the present invention, in which a
10 second image acquisition apparatus is controlled to acquire an eye print image of the user according to a target acquisition parameter. Specifically, first of all, a target acquisition parameter of the second image acquisition apparatus can be determined based on the initial face image; and then the second image acquisition apparatus is controlled to acquire the eye print image of the user based on the target acquisition parameter. The target acquisition parameter can include parameter
15 information such as an acquisition angle and an acquisition height of the second image acquisition apparatus. This avoids that the user further needs to adjust his/her own height and angle multiple times to cooperate with the second image acquisition apparatus for acquiring an eye print image, thereby providing the user with better user experience.

[0050] It should be appreciated that different users usually have different heights and
20 pupillary distances of two eyes. In order to ensure that the second image acquisition apparatus can acquire a clear eye print image, specifically, the determining a target acquisition parameter of the second image acquisition apparatus based on the initial face image can include first determining eye space location information of the user based on the initial face image of the user, that is, locating key points based on the initial face image of the user to determine the eye space location
25 information of the user; and then determining the target acquisition parameter of the second image acquisition apparatus based on the eye space location information of the user, that is, determining

a target acquisition parameter such as an optimal acquisition angle or acquisition height of the second image acquisition apparatus. The eye space location information of the user includes pupil center location information of two eyes of the user.

[0051] Optionally, in order to ensure that the second image acquisition apparatus can
5 acquire a sufficiently clear eye print image, specifically, the controlling a second image acquisition apparatus to acquire an eye print image of the user according to a target acquisition parameter may include first controlling the second image acquisition apparatus to acquire an eye region image of the user according to the target acquisition parameter; and then segmenting the eye region image of the user by a full convolutional depth neural network to acquire an eye print image of which the
10 sharpness meets a preset condition. As the eye region image of the user is segmented by the full convolutional depth neural network, the quality of the acquired eye print image can be quickly judged to enable the second image acquisition apparatus to complete the focusing, thus obtaining a sufficiently clear eye print image.

[0052] In the image acquisition method in one or more embodiments of this specification,
15 the first image acquisition apparatus is configured to acquire a face image of the user, the second image acquisition apparatus is configured to acquire an eye print image of the user, and it is evident that they have different FoV requirements. In order to meet their acquisition requirements at the same time, an ordinary camera with a large FoV may be selected for the first image acquisition apparatus, and an ordinary camera with a small FoV may be selected for the second image
20 acquisition apparatus. That is, the FoV of the first image acquisition apparatus is greater than that of the second image acquisition apparatus. The FoV of the first image acquisition apparatus is greater than or equal to $45^{\circ} \times 100^{\circ}$; and the FoV of the second image acquisition apparatus is greater than or equal to 50 mm*140 mm.

[0053] In addition, other parameters of the first image acquisition apparatus and the second
25 image acquisition apparatus are as follows: a spatial resolution of the first image acquisition apparatus is greater than or equal to 2 mm, an imaging distance range is 500 mm to 1000 mm, and

an image frame rate is greater than or equal to 15 fps; and a spatial resolution of the second image acquisition apparatus is no less than 3-5 line pairs/mm.

[0054] In an actual application, as a steering gimbal has relatively high accuracy and is easy to control, the second image acquisition apparatus can be controlled by the steering gimbal to adjust an acquisition parameter such as an image acquisition angle, and then the controlling a second image acquisition apparatus to acquire an eye print image of the user according to a target acquisition parameter may specifically include controlling the second image acquisition apparatus by using a steering gimbal to acquire the eye print image of the user according to the target acquisition parameter.

10 [0055] Optionally, a lens of the second image acquisition apparatus may be an optical zoom lens or a prime lens. If the lens of the second image acquisition apparatus is an optical zoom lens, the optical zoom lens can ensure a consistent acquisition resolution for acquisition of the eye print image at different distances. If the lens of the second image acquisition apparatus is a prime lens, digital zoom can be used to facilitate adjustment of a lens focal length to obtain a clear eye print image. The digital zoom adopted in the prime lens makes the cost of the whole image acquisition system cheaper, but the sharpness of the eye print image acquired by it will be reduced compared with that of the eye print image acquired by the optical zoom lens. In addition, in order to ensure that the second image acquisition apparatus can acquire an eye print image of which the sharpness meets a preset condition, no matter which lens is adopted by the second image acquisition apparatus, 15 the DoF thereof should be greater than or equal to 2 cm.

[0056] As shown in FIG. 2, it is a schematic diagram of an image acquisition method applied to an actual scenario according to one or more embodiments of this specification, which includes two parts, i.e., a software algorithm and an imaging system. The imaging system includes a face acquisition camera with a large FoV (i.e., a camera A, which is also the first image acquisition apparatus in this specification), an eye print acquisition camera with a small FoV (i.e., a camera B, which is also the second image acquisition apparatus using an optical zoom lens in 25

this specification), and a steering gimbal configured to control an acquisition parameter of the camera B. The software algorithm mainly includes face detection, eye detection, and control algorithms, which can be recorded in a control chip or stored in an upper computer.

[0057] The process of acquiring an initial face image and an eye print image of a user in
5 FIG. 2 includes: first acquiring a face video stream of the user by the camera A; then acquiring the face video stream by the control chip or upper computer, acquiring the initial face image by face detection, acquiring pupil center location information of two eyes of the user by key point locating and eye detection, determining a target acquisition parameter of the camera B based on the location information, and sending the target acquisition parameter to the steering gimbal; and finally,
10 controlling the camera B, by the steering gimbal after the target acquisition parameter is received, to acquire the eye print image of the user according to the target acquisition parameter.

[0058] In step 130, the initial face image and the eye print image are synthesized into a target face image of the user.

[0059] After the initial face image of the user is acquired by the first image acquisition
15 apparatus and the eye print image of the user is acquired by the second image acquisition apparatus respectively, the initial face image and the eye print image can be synthesized into a target face image of the user. When the identity of the user is verified, identity verification can be carried out in combination with the face image and the eye print image at the same time. Eye print image recognition is to distinguish people's identity according to arrangements of blood vessels in the
20 white area of the human eye, everyone has a unique eye print, even twins with a high facial similarity have different arrangements of blood vessels in their eye prints, and thus the identity verification carried out in combination with the face image and the eye print image at the same time is more accurate.

[0060] When a face image of a user is acquired, an initial face image of the user can be
25 acquired by a first image acquisition apparatus, a target acquisition parameter can be determined based on the initial face image, then a second image acquisition apparatus is controlled to acquire

an eye print image of the user according to a target acquisition parameter, and finally the initial face image and the eye print image are synthesized into a target face image of the user. As such, the acquired face image includes the face image of the user as well as an eye region image of the user, and the eye region image is the eye print image of the user. On one hand, the accuracy of face
5 recognition is improved, and on the other hand, the second image acquisition apparatus can also be controlled to acquire the eye print image of the user based on the initial face image of the user, thus avoiding that the user further needs to adjust his/her own acquisition angle and improving user experience.

[0061] FIG. 3 is a schematic structural diagram of an image acquisition apparatus 200
10 according to this specification. Referring to FIG. 3, in a software implementation manner, the image acquisition apparatus 200 can include a first acquisition unit 201, a second acquisition unit 202, and a synthesis unit 203.

[0062] The first acquisition unit 201 is configured to acquire an initial face image of a user by a first image acquisition apparatus.

15 **[0063]** The second acquisition unit 202 is configured to control a second image acquisition apparatus to acquire an eye print image of the user according to a target acquisition parameter, the target acquisition parameter being determined based on the initial face image.

[0064] The synthesis unit 203 is configured to synthesize the initial face image and the eye print image into a target face image of the user.

20 **[0065]** When a face image of a user is acquired, the first acquisition unit 201 can acquire an initial face image of the user by a first image acquisition apparatus and can determine a target acquisition parameter based on the initial face image, then the second acquisition unit 202 controls a second image acquisition apparatus to acquire an eye print image of the user according to a target acquisition parameter, and finally the initial face image and the eye print image are synthesized
25 into a target face image of the user by the synthesis unit 203. As such, the acquired face image includes the face image of the user as well as an eye region image of the user, and the eye region

image is the eye print image of the user. On one hand, the accuracy of face recognition is improved, and on the other hand, the second image acquisition apparatus can also be controlled to acquire the eye print image of the user based on the initial face image of the user, thus avoiding that the user further needs to adjust his/her own acquisition angle and improving user experience.

5 **[0066]** In an implementation manner, the second acquisition unit 202 is configured to:

[0067] determine a target acquisition parameter of the second image acquisition apparatus based on the initial face image; and

[0068] control the second image acquisition apparatus to acquire the eye print image of the user based on the target acquisition parameter.

10 **[0069]** In an implementation manner, the second acquisition unit 202 is configured to:

[0070] determine eye space location information of the user based on the initial face image of the user; and

[0071] determine the target acquisition parameter of the second image acquisition apparatus based on the eye space location information of the user.

15 **[0072]** In an implementation manner, the second acquisition unit 202 is configured to:

[0073] control the second image acquisition apparatus to acquire an eye region image of the user according to the target acquisition parameter; and

[0074] segment the eye region image of the user by a full convolutional depth neural network to acquire an eye print image of which the sharpness meets a preset condition.

20 **[0075]** In an implementation manner, an FoV of the first image acquisition apparatus is greater than that of the second image acquisition apparatus.

[0076] In an implementation manner, the FoV of the first image acquisition apparatus is greater than or equal to $45^{\circ} \times 100^{\circ}$; and

[0077] the FoV of the second image acquisition apparatus is greater than or equal to 50 mm*140 mm.

[0078] In an implementation manner, the second acquisition unit 202 is configured to:

[0079] control the second image acquisition apparatus by using a steering gimbal to acquire the eye print image of the user according to the target acquisition parameter.

[0080] In an implementation manner, a lens of the second image acquisition apparatus is an optical zoom lens or a prime lens.

5 [0081] In an implementation manner, the DoF of the second image acquisition apparatus is greater than or equal to 2 cm.

[0082] In an implementation manner, the eye space location information of the user includes pupil center location information of two eyes of the user.

[0083] The image acquisition apparatus 200 can implement the method of the method
10 embodiments in FIG. 1 and FIG. 2. Reference can be made to the image acquisition method in the embodiments shown in FIG. 1 and FIG. 2 for details, and no elaboration will be provided here.

[0084] FIG. 4 is a schematic structural diagram of an image acquisition system 300 according to this specification. Referring to FIG. 4, in a software implementation manner, the image acquisition system 300 can include a first image acquisition apparatus 301, a second image
15 acquisition apparatus 302, a control apparatus 303, and a synthesis apparatus 304.

[0085] The first image acquisition apparatus 301 is configured to acquire an initial face image of a user.

[0086] The second image acquisition apparatus 302 is configured to acquire an eye print image of the user.

20 [0087] The control apparatus 303 is configured to control the second image acquisition apparatus 302 to acquire the eye print image of the user according to a target acquisition parameter.

[0088] The synthesis apparatus 304 is configured to synthesize the initial face image and the eye print image into a target face image of the user.

[0089] In an implementation manner, the control apparatus 303 is configured to:

25 [0090] determine a target acquisition parameter of the second image acquisition apparatus based on the initial face image; and

[0091] control the second image acquisition apparatus to acquire the eye print image of the user based on the target acquisition parameter.

[0092] In an implementation manner, the control apparatus 303 is configured to:

[0093] determine eye space location information of the user based on the initial face image
5 of the user; and

[0094] determine the target acquisition parameter of the second image acquisition apparatus based on the eye space location information of the user.

[0095] In an implementation manner, the control apparatus 303 is configured to:

[0096] control the second image acquisition apparatus to acquire an eye region image of
10 the user according to the target acquisition parameter; and

[0097] segment the eye region image of the user by a full convolutional depth neural network to acquire an eye print image of which the sharpness meets a preset condition.

[0098] In an implementation manner, a FoV of the first image acquisition apparatus 301 is greater than that of the second image acquisition apparatus 302.

15 [0099] In an implementation manner, the FoV of the first image acquisition apparatus 301 is greater than or equal to $45^{\circ} \times 100^{\circ}$; and

[0100] the FoV of the second image acquisition apparatus 302 is greater than or equal to 50 mm*140 mm.

[0101] In an implementation manner, the control apparatus 303 is configured to:

20 [0102] control the second image acquisition apparatus by using a steering gimbal to acquire the eye print image of the user according to the target acquisition parameter.

[0103] In an implementation manner, a lens of the second image acquisition apparatus 302 is an optical zoom lens or a prime lens.

[0104] In an implementation manner, the DoF of the second image acquisition apparatus
25 302 is greater than or equal to 2 cm.

[0105] In an implementation manner, the eye space location information of the user

includes pupil center location information of two eyes of the user.

[0106] The image acquisition system 300 can implement the method of the method embodiments in FIG. 1 and FIG. 2. Reference can be made to the image acquisition method in the embodiments shown in FIG. 1 and FIG. 2 for details, and no elaboration will be provided here.

5 [0107] FIG. 5 is a schematic structural diagram of an electronic device according to an embodiment of this specification. Referring to FIG. 5, at the hardware level, the electronic device includes a processor, and optionally further includes an internal bus, a network interface, and a memory. The memory may include a memory such as a high-speed Random-Access Memory (RAM), or may further include a non-volatile memory such as at least one magnetic disk memory.
10 Definitely, the electronic device may further include hardware required by other services.

[0108] The processor, the network interface, and the memory may be interconnected through the internal bus, and the internal bus may be an Industry Standard Architecture (ISA) bus, a Peripheral Component Interconnect (PCI) bus, an Extended Industry Standard Architecture (EISA) bus, or the like. The bus may be classified into an address bus, a data bus, a control bus,
15 and the like. For ease of representation, only one double-sided arrow is shown in FIG. 5, but it does not mean that there is only one bus or one type of bus.

[0109] The memory is configured to store a program. Specifically, the program may include program codes including a computer operation instruction. The memory may include the memory and the non-volatile memory, and provides an instruction and data to the processor.

20 [0110] The processor reads, from the non-volatile memory, the corresponding computer program into the memory and runs the computer program, thus forming resource value-added objects and a resource object associated apparatus at the logic level. The processor executes the program stored in the memory, and is specifically configured to perform the following operations:

[0111] acquiring an initial face image of a user by a first image acquisition apparatus;

25 [0112] controlling a second image acquisition apparatus to acquire an eye print image of the user according to a target acquisition parameter, the target acquisition parameter being

determined based on the initial face image; and

[0113] synthesizing the initial face image and the eye print image into a target face image of the user.

[0114] The image acquisition method disclosed in the embodiment shown in FIG. 1 of this specification can be applied to the processor or implemented by the processor. The processor may be an integrated circuit chip having a signal processing capability. In the process of implementation, various steps of the above method may be completed by an integrated logic circuit of hardware in the processor or an instruction in the form of software. The processor may be a general-purpose processor, including a Central Processing Unit (CPU), a Network Processor (NP), etc.; or may be a Digital Signal Processor (DSP), an Application Specific Integrated Circuit (ASIC), a Field-Programmable Gate Array (FPGA) or another programmable logic device, discrete gate or transistor logic device, or discrete hardware component. The methods, steps, and logical block diagrams disclosed in the embodiments of this specification can be implemented or performed. The general-purpose processor may be a microprocessor, or the processor may be any conventional processor or the like. The steps of the method disclosed in one or more embodiments of this application may be directly performed by a hardware decoding processor, or may be performed by a combination of hardware and software modules in the decoding processor. The software module can be located in a storage medium mature in the field, such as a random-access memory, a flash memory, a read-only memory, a programmable read-only memory or an electrically erasable programmable memory, a register, and the like. The storage medium is located in the memory, and the processor reads the information in the memory and implements the steps of the above method in combination with its hardware.

[0115] The electronic device can also perform the image acquisition method of FIG. 1, which will not be elaborated here in this specification.

[0116] Definitely, in addition to the software implementation manner, the electronic device in this specification does not exclude other implementation manners, such as logic devices or a

combination of software and hardware, etc. In other words, the following processing procedure may not be performed only by various logic units, but also can be performed by hardware or logic devices.

[0117] In brief, the above description is merely preferred embodiments of this specification, and is not intended to limit the protection scope of this specification. Any modification, equivalent replacement, improvement and the like made within the spirit and principle of this specification should be included in the protection scope of one or more embodiments of this specification.

[0118] The system, apparatus, module or unit illustrated in the above embodiments may be implemented by a computer chip or an entity, or by a product having a certain function. A typical implementation device is a computer. For example, the computer may be a personal computer, a laptop computer, a cellular phone, a camera phone, a smart phone, a personal digital assistant, a media player, a navigation device, an email device, a game console, a tablet computer, a wearable device, or a combination of any of these devices.

[0119] The computer readable medium includes non-volatile and volatile media as well as movable and non-movable media, and may implement information storage by means of any method or technology. The information may be a computer readable instruction, a data structure, and a module of a program or other data. An example of the storage medium of a computer includes, but is not limited to, a phase change memory (PRAM), a static random access memory (SRAM), a dynamic random access memory (DRAM), other types of RAMs, a ROM, an electrically erasable programmable read-only memory (EEPROM), a flash memory or other memory technologies, a compact disk read-only memory (CD-ROM), a digital versatile disc (DVD) or other optical storages, a cassette tape, a magnetic tape/magnetic disk storage or other magnetic storage devices, or any other non-transmission medium, and can be used to store information accessible to the computing device. According to the definition in this text, the computer readable medium does not include transitory media, such as a modulated data signal and a carrier.

[0120] It should be further noted that the terms "include," "comprise" or any other

variations thereof are intended to cover non-exclusive inclusion, so that a process, method, article or device including a series of elements not only includes the elements, but also includes other elements not expressly listed, or further includes elements inherent to the process, method, article or device. In the absence of more limitations, an element defined by "including a/an..." does not
5 exclude that the process, method, article or device including the element further has other identical elements.

[0121] Various embodiments in this specification are described progressively. The same or similar parts between the embodiments may be referenced to one another. In each embodiment, the part that is different from other embodiments is mainly described. Particularly,
10 the system embodiment is described in a relatively simple manner because it is similar to the method embodiment, and for related parts, reference can be made to the parts described in the method embodiment.