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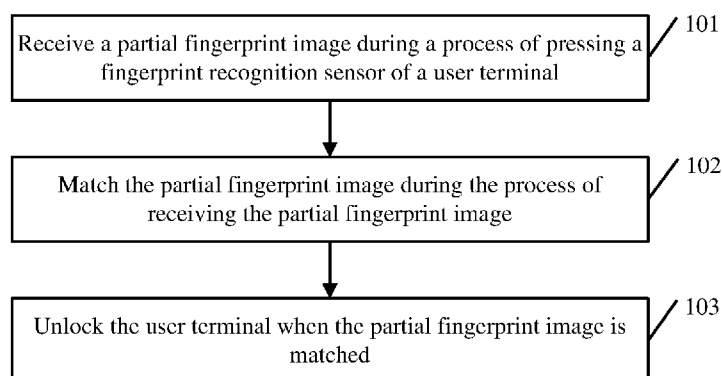


FIG. 1

(57) Abstract: A method for fingerprint unlocking includes the follows. A partial fingerprint image is received during a process of pressing a fingerprint recognition sensor of a user terminal. The partial fingerprint image corresponds to part of fingerprints of a finger. Matching the partial fingerprint image is performed during the process of receiving the partial fingerprint image, and a user terminal is unlocked when the partial fingerprint image is matched. A related device for fingerprint unlocking and a related user terminal are also provided..



METHOD AND DEVICE FOR FINGERPRINT UNLOCKING AND USER TERMINAL

FIELD

5 The present disclosure relates to the field of electronic technology, and particularly to a method and a device for fingerprint unlocking, and a user terminal.

BACKGROUND

10 With the rapid development of electronic technology and the rapid popularization of user terminals, functions of the user terminals are becoming more and more perfect, and more and more user terminals are related to fingerprint recognition technology. The fingerprint recognition technology has become one of standard configurations for flagship models of mainstream user terminal manufacturers, and can be applied to wake up the user terminal, unlock the user terminal, mobile payment, and so on.

15 The fingerprint recognition unlocking may include a screen-on unlocking that a screen of the user terminal is unlocked when the screen is on, and a screen-off unlocking that the screen is unlocked when the screen is off. The screen-off unlocking may further include the screen-off press unlocking, that is, unlocking the screen of the user terminal is triggered by pressing. The process of the screen-off
20 press unlocking may include acquiring a press instruction, initiating a request of pressing the user terminal, receiving a response instruction corresponding to the request of pressing the user terminal, acquiring fingerprint data, matching the fingerprint data, opening a locked screen, opening a locked interface, turning on the screen, and other operations, which results in multiple steps and complex operation.
25 The time required by the screen-off press unlocking may be a sum of the time of acquiring the press instruction, the time of initiating the request of pressing the user terminal, the time of waiting for the response instruction corresponding to the request of pressing the user terminal, the time of acquiring the fingerprint data, the time of matching the fingerprint data, the time of opening the locked interface, and the time of
30 turning on the screen. Due to the order of processing is single, more waiting time is needed, and the time for unlocking is accordingly long.

SUMMARY

Embodiments of the present disclosure provide a method and a device for fingerprint unlocking, and a user terminal, which can reduce the time of unlocking.

5 In a first aspect, the present disclosure provides a method for fingerprint unlocking. The method may include: receiving a partial fingerprint image during a process of pressing a fingerprint recognition sensor of a user terminal; matching the partial fingerprint image during the process of receiving the partial fingerprint image; and unlocking the user terminal when the partial fingerprint image is matched.

10 In combination with the implementation manner of the first aspect, in a first possible implementation manner of the first aspect, receiving the partial fingerprint image may include: receiving N fingerprint region images by scanning from N directions, N being an integer larger than 1; calculating the clarity of each of the N fingerprint region images; and selecting one of the N fingerprint region images as the partial fingerprint image, wherein the clarity of the one of the N fingerprint region images is larger than a preset clarity.

15 In combination with the implementation manner of the first aspect or the first possible implementation manner of the first aspect, matching the partial fingerprint image may include: performing a feature point extraction processing on the partial fingerprint image to acquire multiple feature points; selecting target feature points from the multiple feature points; and matching the target feature points with a preset fingerprint template.

20 In combination with a second possible implementation manner of the first aspect, in a third possible implementation manner of the first aspect, selecting the target feature points from the multiple feature points may include at least one of the follows: determining feature points with grey values falling within a preset range to be the target feature points; and removing a portion of the multiple feature points according to a preset processing, and determining the remaining feature points among the multiple feature points as the target feature points.

25 In combination with the implementation manner of the first aspect or the first possible implementation manner of the first aspect, in a fourth implementation manner of the first aspect, matching the partial fingerprint image may include: performing an image enhancement processing on the partial fingerprint image, and matching the partial fingerprint image subjected to the image enhancement processing with the preset fingerprint template.

30 In combination with the implementation manner of the first aspect or the first possible implementation manner of the first aspect, in a fifth possible implementation manner of the first aspect, the method may further include the follows before

receiving the partial fingerprint image: determining whether a press force of pressing the fingerprint recognition sensor is larger than a preset press force; and proceeding to the process of receiving the partial fingerprint image when the press force of pressing the fingerprint recognition sensor is larger than the preset press force.

5 In a second aspect, the present disclosure provides a device for fingerprint unlocking. The device may include a receiving unit, a matching unit, and an unlocking unit. The receiving unit is configured to receive a partial fingerprint image during a process of pressing a fingerprint recognition sensor of a user terminal, and the partial fingerprint image corresponds to part of fingerprints of a finger. The
10 matching unit is configured to match the partial fingerprint image during the process of receiving the partial fingerprint image. The unlocking unit is configured to unlock the user terminal when the partial fingerprint image is matched.

In combination with the device of the second aspect, in a first possible device of the second aspect, the receiving unit may include a scanning sub-unit, a calculating
15 sub-unit, and a selecting sub-unit. The scanning sub-unit is configured to receive N fingerprint region images by scanning from N directions, and N is an integer larger than 1. The calculating sub-unit is configured to calculate the clarity of each of the N fingerprint region images. The selecting sub-unit is configured to select one of the N fingerprint region images as the partial fingerprint image, wherein the clarity of the
20 one of the N fingerprint region images is larger than a preset clarity.

In combination with the device of the second aspect or the first possible device of the second aspect, in a second possible device of the first aspect, the matching unit may include an extracting sub-unit, a determining sub-unit, and a first matching
25 sub-unit. The extracting sub-unit is configured to perform a feature point extraction processing on the partial fingerprint image to acquire multiple feature points. The determining sub-unit is configured to select target feature points from the multiple feature points. The first matching sub-unit is configured to match the target feature points with a preset fingerprint template.

In combination with the second possible device of the second aspect, in a third
30 possible device of the second aspect, the determining sub-unit that is configured to select the target feature points from the multiple feature points may be further configured to execute at least one of the follows: determining feature points with grey values falling within a preset range to be the target feature points; and removing a portion of the multiple feature points according to a preset processing, and
35 determining the remaining feature points among the multiple feature points as the target feature points.

In combination with the device of the second aspect or the first possible device of the second aspect, in a fourth possible device of the second aspect, the matching unit may include a processing sub-unit and a second matching sub-unit. The processing sub-unit is configured to perform an image enhancement processing on the partial fingerprint image, and the second matching sub-unit is configured to match the partial fingerprint image subjected to the image enhancement processing with the preset fingerprint template.

In combination with the device of the second aspect or the first possible device of the second aspect, in a fifth possible device of the second possible, the device may further include a judging unit configured to judge whether a press force applied to the fingerprint recognition sensor is larger than a preset press force before the receiving unit receives the partial fingerprint image. The receiving unit is configured to receive the partial fingerprint image when the press force applied to the fingerprint recognition sensor is larger than the preset press force.

In a third aspect, the present disclosure provides a user terminal. The user terminal may include a memory configured to store computer-readable program codes, and a processor configured to invoke the computer-readable program codes to execute: receiving a partial fingerprint image during a process of pressing a fingerprint recognition sensor of the user terminal, the partial fingerprint image corresponding to part of fingerprints of a finger; matching the partial fingerprint image during the process of receiving the partial fingerprint image; and unlocking the user terminal when the partial fingerprint image is matched.

In combination with the user terminal of the third aspect, in a first possible user terminal of the third aspect, the processor that is configured to invoke the computer-readable program codes to execute receiving the partial fingerprint image may be further configured to execute: receiving N fingerprint region images by scanning from N directions, N being an integer larger than 1; calculating the clarity of each of the N fingerprint region images; and selecting one of the N fingerprint region images as the partial fingerprint image, wherein the clarity of the one of the N fingerprint region images is larger than a preset clarity.

In combination with the user terminal of the third aspect or the first possible user terminal of the third aspect, in a second possible user terminal of the third aspect, the processor that is configured to invoke the computer-readable program codes to execute matching the partial fingerprint image is further configured to execute: performing a feature point extraction processing on the partial fingerprint image to acquire multiple feature points; selecting target feature points from the multiple

feature points; and matching the target feature points with a preset fingerprint template.

In combination with the second possible user terminal of the third aspect, in a third possible user terminal of the third aspect, the processor that is configured to
5 invoke the computer-readable program codes to execute selecting the target feature points from the multiple feature points is further configured to execute at least one of the follows: determining feature points with grey values falling within a preset range to be the feature points; and removing a portion of the multiple feature points according to a preset processing, and determining the remaining feature points among
10 the multiple feature points as the target feature points.

In combination with the user terminal of the third aspect or the first possible user terminal of the third aspect, in a fourth possible user terminal of the third aspect, the processor that is configured to invoke the computer-readable program codes to execute matching the partial fingerprint image may be further configured to execute:
15 performing an image enhancement processing on the partial fingerprint image; and matching the partial fingerprint image subjected to the image enhancement processing with the preset fingerprint template.

In combination with the user terminal of the third aspect or the first possible user terminal of the third aspect, in a fifth possible user terminal of the third aspect, the processor is further configured to invoke the computer-readable program codes to execute the follows before receiving the partial fingerprint image: judging whether a press force applied to the fingerprint recognition sensor is larger than a preset press force; and proceeding to the process of receiving the partial fingerprint image when the press force applied to the fingerprint recognition sensor is larger than the preset
25 press force.

By means of the embodiment of the present disclosure, the partial fingerprint image is received during the process of pressing the fingerprint recognition sensor. Matching the partial fingerprint image is performed during the process of receiving the partial fingerprint image. The user terminal is unlocked when the partial
30 fingerprint image is matched. Thus, by means of the present embodiment, the efficiency of unlocking a screen of the user terminal is improved.

BRIEF DESCRIPTION OF THE DRAWINGS

In order to illustrate technical solutions of embodiments of the present disclosure
35 more clearly, the drawings used in the description of the embodiments will be briefly described, it will be apparent that the drawings described in the following are

embodiments of the present disclosure, and it will be apparent to those skilled in the art that other drawings can be obtained from the drawings without any creative work.

FIG. 1 is a flow chart of a method for fingerprint unlocking in accordance with an embodiment of the present disclosure.

5 FIG. 2 is a flow chart of another method for fingerprint unlocking in accordance with an embodiment of the present disclosure.

FIG. 3 is a flow chart of yet another method for fingerprint unlocking in accordance with an embodiment of the present disclosure.

10 FIG. 4 is a structure diagram of a device for fingerprint unlocking in accordance with an embodiment of the present disclosure.

FIG. 5 is a structure diagram of another device for fingerprint unlocking in accordance with an embodiment of the present disclosure.

FIG. 6 is a structure diagram of a user terminal in accordance with an embodiment of the present disclosure.

15 FIG. 7 is a schematic diagram illustrating an example of a fingerprint template.

DETAILED DESCRIPTION

20 The technical solutions in the embodiments of the present disclosure will be described below clearly and completely in conjunction with the accompanying drawings in the embodiments of the present disclosure. Obviously, the described embodiments are some embodiments of the present disclosure, not all of the embodiments. On the basis of the embodiments of the present disclosure, all other embodiments obtained by persons skilled in the art without creative efforts shall fall within the protection scope of the present disclosure.

25 In the present disclosure, the term “fingerprint template” means that, when a fingerprint function of a terminal such as a mobile phone is enabled for the first time, the user may be asked to undergo a fingerprint registration process. During the fingerprint registration, the user puts his or her finger on a fingerprint sensor for fingerprint image reception, and fingerprint feature information of the received
30 fingerprint images will be extracted to form a fingerprint template, usually, one finger corresponds to one fingerprint template. Generally, the fingerprint sensor may receive 10-20 times for each finger in order to receive the whole fingerprint face and generate a comprehensive fingerprint template. FIG. 7 illustrates an exemplary fingerprint template, and each number marked in the fingerprint of FIG. 7 refers to
35 fingerprint feature information.

In the following, when we refer to “receive” or “receiving” fingerprint image or

fingerprint data, it means that a user terminal or a fingerprint recognition sensor of the user terminal or other related components of the user terminal can acquire, collect, obtain or in other manners to get the fingerprint image or fingerprint data. The present disclosure is not limited thereto.

5 The present disclosure relates to a method for fingerprint unlocking. The method includes the follows. A partial fingerprint image is received during a process of pressing a fingerprint recognition sensor of a user terminal. The partial fingerprint image corresponds to part of fingerprints of a finger. Matching the partial fingerprint image is performed during the process of receiving the partial
10 fingerprint image, and a user terminal is unlocked when the partial fingerprint image is matched.

The present disclosure further relates to a user terminal to execute the above method. The user terminal described in embodiments of the present disclosure may be a smart phone (for example, Android phone, iOS phone, Windows Phone, and so
15 on), a tablet computer, a handheld computer, a mobile internet device (MID), a wearable device, or other. The terminal in the present disclosure can also include an automated teller machine (ATM), a ticket machine, an entrance guard machine, medical equipment, and other terminal equipped with fingerprint recognition function. The above terminal are just examples, and the present disclosure is not limited thereto.

20 FIG. 1 is a flow chart of a method for fingerprint unlocking in accordance with an embodiment of the present disclosure. The method for fingerprint unlocking may include the follows.

At block 101, a partial fingerprint image is received during a process of pressing a fingerprint recognition sensor of a user terminal, and the partial fingerprint image
25 corresponds to part of fingerprints of a finger.

In at least one implementation manner, during the process of pressing the fingerprint recognition sensor, fingerprints can be collected by the fingerprint recognition sensor, and part of fingerprints are used to form the partial fingerprint image.

30 In at least one alternative embodiment, the user terminal can receive signals from multiple touch points of the fingerprint recognition sensor to acquire multiple pixel points. When the number of the acquired pixel points is greater than a threshold, the acquired pixel points can be used to form the partial fingerprint image.

In at least one alternative embodiment, the user terminal can receive fingerprint
35 images from different directions, and extract feature points of each of the fingerprint images. The fingerprint image having the largest number of feature points is

determined as the partial fingerprint image.

In at least one alternative embodiment, during the process of pressing the fingerprint recognition sensor, the user terminal can divide the received fingerprint image into multiple regions, and the region with the greatest clarity is determined as the partial fingerprint image.

At block 102, during the process of receiving the partial fingerprint image, the partial fingerprint image is matched.

In at least one implementation manner, the partial fingerprint image can be received by a thread or a process, and matching the partial fingerprint image, for example, matching the partial fingerprint image with a preset fingerprint template is performed by another thread or another processor. That is, the process of receiving the partial fingerprint image and the process of matching the partial fingerprint are executed in parallel. The two processes are executed simultaneously, thus the efficiency of unlocking is improved.

In at least one alternative embodiment, the user terminal can extract feature points of the partial fingerprint image and extract feature points of the preset fingerprint template. When the number of matched feature points of the partial fingerprint image and the preset fingerprint template is greater than a preset threshold, it is determined that the partial fingerprint image matches with the preset fingerprint template. Or, the user terminal can perform profile extraction on the partial fingerprint image and the preset fingerprint template. When the number of matched profiles of the partial fingerprint image and the preset fingerprint template is greater than a preset threshold, it is determined that the partial fingerprint image matches with the preset fingerprint template. Or, the user terminal can determine matching degrees between the feature points of the partial fingerprint image and the feature points of the preset fingerprint template, select the matched feature points whose matching degrees are larger than a preset threshold, and determine a possible matching region of the preset fingerprint template whose area is the same as that of the partial fingerprint image according to the matched feature points. The partial fingerprint image is matched with the possible matching region. When the partial fingerprint image matches with the possible matching region, the user terminal is unlocked.

In at least one alternative embodiment, the process that the user terminal matches the partial fingerprint image with the preset fingerprint template can be executed in the following manner. The user terminal can extract multiple feature points of the partial fingerprint image. The feature points of the partial fingerprint image can be

extracted according to scale invariant feature transform (SIFT) extraction or Harris angle point extraction. Each feature point has its size and direction. The user terminal can select target feature points from the multiple feature points. The user terminal can determine feature points with gray values falling within a preset range to be the target feature points. Generally, when a feature point is too bright or too black, the matching efficiency may be affected. Therefore, a selection needs to be performed on the multiple feature points. The preset range can be determined according to experience. The preset range may be a range from 50 to 180, or a range from 35 to 200, or other. The user terminal can also remove a portion of the multiple feature points according to a preset processing, for example, RANSAC algorithm. To improve the stability of feature points, the RANSAM algorithm can be performed for several times. The remaining feature points are used as the target feature points. The user terminal then matches the target feature points with the preset fingerprint template. Thus, the number of the target feature points is less than that of the multiple feature points, and the target feature points are more stable, accordingly, the matching speed can be improved, and the matching efficiency can be improved.

At block 103, when the partial fingerprint image is matched, the user terminal is unlocked.

In at least one implementation manner, when the partial fingerprint image is matched, receiving a subsequent fingerprint image can be stopped, and the user terminal is unlocked. When the matching of the partial fingerprint image, for example the matching between the partial fingerprint image and the preset fingerprint template is not completed, the matching between the partial fingerprint image and the preset fingerprint template can be stopped.

In FIG. 1, the partial fingerprint image is received during the process of pressing the fingerprint recognition sensor. Matching the partial fingerprint image is performed during the process of receiving the partial fingerprint image. The user terminal is unlocked when the partial fingerprint image is matched. Thus, by means of the present embodiment, the efficiency of unlocking a screen of the user terminal is improved.

FIG. 2 is a flow chart of another method for fingerprint unlocking in accordance with an embodiment of the present disclosure. As illustrated in FIG. 2, the method for fingerprint unlocking may include the follows.

At block 201, during a process of pressing a fingerprint recognition sensor of a user terminal, N fingerprint region images are received via scanning from N directions, where N is an integer larger than 1.

In at least one implementation manner, during the process of pressing the fingerprint recognition sensor, at least one direction can be scanned. Thus, fingerprint images from different directions can be received. It is assumed that there are N directions, N fingerprint region images can be received, where N is an integer larger than 1.

Furthermore, the N directions can be scanned simultaneously, or the N directions can be scanned in a time sequence. For example, at the first time point, the first direction is scanned, at the second time point, the second direction is scanned, and so on.

At block 202, the clarity of each of the N fingerprint region images is calculated.

In at least one implementation manner, the user terminal can calculate the clarity of each of the N fingerprint region images.

At block 203, one of the fingerprint region image is selected as the partial fingerprint image, where the clarity of the one of the fingerprint region image is larger than a preset clarity.

In at least one implementation manner, after the clarity of each of the N fingerprint region images is acquired, the clarity of each of the N fingerprint region images can be compared with the preset clarity. When the clarity of one of the N fingerprint region images is greater than the preset clarity, the one of the N fingerprint region image can be determined as the partial fingerprint image. The preset clarity can be a fixed threshold, and can also be a specified threshold. The fixed threshold may be 0.8, 1, 1.2, or other. The specified threshold can be determined according to the clarity of each of the N fingerprint region images. For example, the specified threshold can be the second largest clarity of the N clarities, or an average value of the N clarities, or an average value of the first largest clarity and the smallest clarity.

At block 204, during the process of receiving the partial fingerprint image, the partial fingerprint image is matched. The operation at block 204 can correspond to the operation at block 102.

At block 205, when the partial fingerprint image is matched, the user terminal is unlocked. The operation at block 205 can correspond to the operation at block 103.

In FIG. 2, the N directions are scanned to receive the N fingerprint region images, and N is an integer larger than 1. The clarities of the N fingerprint region images are calculated. The fingerprint region image whose clarity is larger than the preset clarity is determined as the partial fingerprint image. The fingerprint region image with a larger clarity is determined as the partial fingerprint image, thus the time of matching the partial fingerprint image can be reduced. Furthermore, during the

process of receiving the partial fingerprint image, receiving the partial fingerprint image and matching the partial fingerprint image are executed in parallel. When the partial fingerprint image is matched, the user terminal is unlocked. Thus, by means of the present embodiment, the efficiency of unlocking a screen of the user terminal is improved.

FIG. 3 is a flow chart of another method for fingerprint unlocking in accordance with an embodiment of the present disclosure. The method for fingerprint unlocking may include the follows.

At block 301, during a process of pressing a fingerprint recognition sensor of a user terminal, N directions are scanned to acquire N fingerprint region images, where N is an integer larger than 1.

In at least one implementation manner, during the process of pressing the fingerprint recognition sensor, whether a press force applied to the fingerprint recognition sensor is larger than a preset press force is judged. The preset press force can be set according to user requirements, or the user terminal can set the preset press force according to history setting records, or the preset press force is a default threshold of the user terminal. The embodiment of the present disclosure is not limited thereto. By means of the embodiment of the present disclosure, whether to unlock the user terminal can be determined by judging whether the press force applied to the fingerprint recognition sensor is larger than the preset press force. That is, the operation can be recognized as a triggering signal, thus to a certain degree operation of the user terminal is facilitated.

At block 302, the clarity of each of the N fingerprint region images is calculated. The operation at block 302 can correspond to the operation at block 202.

At block 303, one of the fingerprint region images is selected as the partial fingerprint image, where the clarity of the one of the fingerprint region images is larger than a preset clarity. The operation at block 303 can correspond to the operation at block 203.

At block 304, during the process of receiving the partial fingerprint image, an image enhancement processing is performed on the partial fingerprint image, and the partial fingerprint image subjected to the image enhancement processing is matched.

In at least one implementation manner, the partial fingerprint image can be received via a thread or a process, and the image enhancement processing can be performed on the partial fingerprint image via another thread or another process. The partial fingerprint image subjected to the image enhancement processing is matched, for example matched with a preset fingerprint template. The user terminal

can perform the image enhancement processing on the partial fingerprint image, and then the partial fingerprint image subjected to the image enhancement processing is matched with the preset fingerprint template.

5 In at least one alternative embodiment, the user terminal can divide the partial fingerprint image into multiple regions, and calculate a contrast ratio of each of the multiple regions. The image enhancement processing is performed on the region whose contrast ratio is less than a certain threshold. Thus, there is no need to perform the image enhancement processing on each of the multiple regions, and the image enhancement processing is performed on only the region with bad image
10 quality, thus the region with the high clarity is unchanged, and the region with the low clarity becomes clear after performing the image enhancement processing.

Furthermore, after performing the image enhancement processing on the partial fingerprint image, the partial fingerprint image becomes much clearer. Thus, during the process of matching the partial fingerprint image, more feature points can be
15 acquired. Thus, the efficiency of matching the partial fingerprint image with the preset fingerprint image can be improved.

In at least one alternative embodiment, during the process that the user terminal receives the partial fingerprint image, performing the image enhancement processing on the partial fingerprint image and matching the partial fingerprint image subjected
20 to the image enhancement processing can be executed in parallel in the following manner. For example, during the process that the user terminal receives the partial fingerprint image, determining whether the clarity of the partial fingerprint image is greater than a certain threshold is executed. When the clarity of the partial fingerprint image is larger than the certain threshold, the partial fingerprint image is
25 matched with the preset fingerprint template. When the clarity of the partial fingerprint image is not larger than the certain threshold, the image enhancement processing is performed on the partial fingerprint image, and the partial fingerprint image subjected to the image enhancement processing is matched with the preset fingerprint template. That is, when the quality of the partial fingerprint image is
30 better, there is no need to perform the image enhancement processing on the partial fingerprint image, and when the quality of the partial fingerprint image is poor, it needs to perform the image enhancement processing on the partial fingerprint image.

In at least one alternative embodiment, matching the partial fingerprint image with the preset fingerprint template can be that multiple feature points are extracted
35 from the partial fingerprint image, target feature points are selected from the multiple feature points, and the target feature points are matched with the preset fingerprint

template.

Furthermore, selecting the target feature points from the multiple feature points may include that the feature points with gray values falling within a preset range are determined as the target feature points, or a portion of the multiple feature points are removed according to a preset processing, and the remaining feature points among the multiple feature points are determined as the target feature points.

In at least one implementation manner, the user terminal can adopt any of extraction manners (for example, SIFT extraction manner) to extract feature points of the partial fingerprint image.

In at least one implementation manner, the preset range can be set according to user requirements, and can be a default range of the user terminal, and can be further set according to history setting records, and the embodiment of the present disclosure is not limited thereto.

In at least one implementation manner, the preset processing can be set according to user requirements, and can be a default preset algorithm of the user terminal, and can further be set according to history setting records, and the embodiment of the present disclosure is not limited thereto.

At block 305, when the partial fingerprint image is matched, the user terminal is unlocked. The operation at block 305 can correspond to the operation at block 205 or block 103.

In FIG. 3, multiple feature points are extracted from the partial fingerprint image, target feature points are selected from the multiple feature points, and the target feature points are matched. The image enhancement processing can also be performed on the partial fingerprint image, and then the partial fingerprint image subjected to the image enhancement processing is matched with the preset fingerprint template. By means of the two above matching manners, the time of matching the partial fingerprint image can be reduced, and the efficiency of unlocking a screen of the user terminal is improved.

FIG. 4 is a structure diagram of a device for fingerprint unlocking in accordance with an embodiment of the present disclosure. The device illustrated in FIG. 4 can be applied in smart phones (for example, Android phones, iOS phones, Windows phones, and so on), tablet computers, handheld computers, laptop computers, MIDs, wearable devices, and so on. As illustrated in FIG. 4, the device for fingerprint unlocking may include a receiving unit 401, a matching unit 402, and an unlocking unit 403.

The receiving unit 401 is configured to receive a partial fingerprint image during

a process of pressing a fingerprint recognition sensor of a user terminal, and the partial fingerprint image corresponds to part of fingerprints of a finger.

In at least one implementation manner, during the process of pressing the fingerprint recognition sensor, fingerprints can be collected by the fingerprint recognition sensor, and a part of fingerprints are used to form the partial fingerprint image.

In at least one alternative embodiment, the receiving unit 401 can receive signals from multiple touch points of the fingerprint recognition sensor to acquire multiple pixel points. When the number of the acquired pixel points is greater than a threshold, the acquired pixel points can be used to form the partial fingerprint image.

In at least one alternative embodiment, the receiving unit 401 can receive fingerprint images from different directions, and extract feature points of each of the fingerprint images. The fingerprint image having the largest number of feature points is determined as the partial fingerprint image.

In at least one alternative embodiment, during the process of pressing the fingerprint recognition sensor, the receiving unit 401 can divide the received fingerprint image into multiple regions, and the region with the greatest clarity is determined as the partial fingerprint image.

The matching unit 402 is configured to match the partial fingerprint image during the process of receiving the partial fingerprint image.

In at least one implementation manner, the partial fingerprint image can be received by a thread or a process, and matching the partial fingerprint image, for example, matching the partial fingerprint image with a preset fingerprint template can be performed by another thread or another processor. That is, the process that the receiving unit 401 receives the partial fingerprint image and the process that the matching unit 402 matches the partial fingerprint are executed in parallel. The two processes are executed simultaneously, thus the efficiency of unlocking is improved.

In at least one alternative embodiment, the matching unit 402 can extract feature points of the partial fingerprint image and extract feature points of the preset fingerprint template. When the number of matched feature points of the partial fingerprint image and the preset fingerprint template is greater than a preset threshold, it is determined that the partial fingerprint image matches with the preset fingerprint template. Or, the matching unit 402 can perform profile extraction on the partial fingerprint image and the preset fingerprint template. When the number of matched profiles of the partial fingerprint image and the preset fingerprint template is greater than a preset threshold, it is determined that the partial fingerprint image matches with

the preset fingerprint template. Or, the matching unit 402 can determine matching degrees between the feature points of the partial fingerprint image and the feature points of the preset fingerprint template, select the matched feature points whose matching degrees are larger than a preset threshold, and determine a possible matching region of the preset fingerprint template whose area is the same as that of the partial fingerprint image according to the matched feature points. The partial fingerprint image is matched with the possible matching region. When the partial fingerprint image matches with the possible matching region, the user terminal is unlocked.

In at least one alternative embodiment, the process that the matching unit 402 matches the partial fingerprint image with the preset fingerprint template can be executed in the following manner. The matching unit 402 can extract multiple feature points of the partial fingerprint image. The feature points of the partial fingerprint image can be extracted according to scale invariant feature transform (SIFT) extraction or Harris angle point extraction. Each feature point has its size and direction. The matching unit 402 can select target feature points from the multiple feature points. The matching unit 402 can determine feature points with gray values falling within a preset range to be the target feature points. Generally, when a feature point is too bright or too black, the matching efficiency may be affected. Therefore, a selection needs to be performed on the multiple feature points. The preset range can be determined according to experience. The preset range may be a range from 50 to 180, or a range from 35 to 200, or other. The matching unit 402 can also remove a portion of the multiple feature points according to a preset processing, for example, RANSAC algorithm. To improve the stability of feature points, the RANSAM algorithm can be performed for several times. The remaining feature points are used as the target feature points. The user terminal then matches the target feature points with the preset fingerprint template. Thus, the number of the target feature points is less than that of the multiple feature points, and the target feature points are more stable, accordingly, the matching speed can be improved, and the matching efficiency can be improved.

The unlocking unit 403 is configured to unlock the user terminal when the partial fingerprint image is matched.

In at least one implementation manner, when the partial fingerprint image is matched, receiving a subsequent fingerprint image can be stopped, and the user terminal is unlocked. When the matching of the partial fingerprint image, for example the matching between the partial fingerprint image and the preset fingerprint

template is not completed, the matching between the partial fingerprint image and the preset fingerprint template can be stopped.

In FIG. 4, the receiving unit 401 receives the partial fingerprint image during the process of pressing the fingerprint recognition sensor. The matching unit 402 matches the partial fingerprint image during the process of receiving the partial fingerprint image. The unlocking unit 403 unlocks the user terminal when the partial fingerprint image is matched. Thus, by means of the present embodiment, the efficiency of unlocking a screen of the user terminal is improved.

FIG. 5 is another device for fingerprint unlocking in accordance with an embodiment of the present disclosure. Besides the receiving unit 401, the matching unit 402, and the unlocking unit 403, the device illustrated by FIG. 5 further includes a judging unit 404 configured to judge whether a press force applied to a fingerprint recognition sensor of a user terminal is larger than a preset press force before the receiving unit 401 receives a partial fingerprint image. The partial fingerprint image corresponds to part of fingerprints of a finger.

The receiving unit 401 is configured to receive the partial fingerprint image when the judging unit 404 judges that the press force applied to the fingerprint recognition sensor is larger than the preset press force.

In at least one alternative embodiment, the receiving unit 401 includes a scanning sub-unit 4010, a calculating sub-unit 4011, and a selecting sub-unit 4012.

The scanning sub-unit 4010 is configured to acquire N fingerprint region images by scanning from N directions, where N is an integer larger than 1.

The calculating sub-unit 4011 is configured to calculate the clarity of each of the N fingerprint region images.

The selecting sub-unit 4012 is configured to select one of the fingerprint region images as the partial fingerprint image, where the clarity of the one of the fingerprint region images is larger than a preset clarity.

In at least one alternative embodiment, the matching unit 402 includes an extracting sub-unit 4020, a determining sub-unit 4021, and a first matching sub-unit 4022.

The extracting sub-unit 4020 is configured to perform feature point extraction processing on the partial fingerprint image to acquire multiple feature points.

The determining sub-unit 4021 is configured to select target feature points from the multiple feature points.

The first matching sub-unit 4022 is configured to match the target feature points.

In at least one implementation manner, the operation that the determining

sub-unit 4021 selects the target feature points from the multiple feature points may include that the determining sub-unit 4021 selects feature points with gray values falling within a preset range as the target feature points, or the determining sub-unit 4021 removes a portion of feature points from the multiple feature points according to a preset processing, and determines the remaining feature points among the multiple feature points as the target feature points.

In at least one alternative embodiment, the matching unit 402 may further include a processing sub-unit 4023 and a second matching unit 4024.

The processing sub-unit 4023 is configured to perform an image enhancement processing on the partial fingerprint image.

The second matching sub-unit 4024 is configured to match the partial fingerprint image subjected to the image enhancement processing.

By means of the embodiments illustrated by FIG. 5, the efficiency of unlocking a screen of the user terminal is improved.

In the above embodiments, the device for fingerprint unlocking is presented in the form of units. “Units” used herein may refer to any one of an application-specific integrated circuit (ASIC), processors for performing one or more software or hardware programs, a memory, a integrated logic circuit, or other components with the above functions.

FIG. 6 is a structure diagram of a user terminal in accordance with an embodiment of the present disclosure, and the user terminal is configured to execute the method for fingerprint unlocking. As illustrated in FIG. 6, the user terminal 600 may include at least one processor 601, at least one input device 602, at least one output device 603, a memory 604, and other components. These components are coupled and communicate with each other via one or more buses 605. A person skilled in the art shall understand that the structure of the user terminal illustrated in FIG. 6 is not limit the embodiment of the present disclosure. The structure can be a bus structure, can also be a star structure, and can include more or less components, or some components can be combined, or components can be arranged in a different way.

The processor 601 is a control center of the user terminal, and is coupled to various components of the user terminal via various interfaces and lines. The processor 601 runs or executes program codes and/or modules of the memory 604 and invokes data of the memory 604 to execute various functions and data processing of the user terminal. The processor 601 can be formed by an integrated circuit (IC), for example, can be formed by a single packaged IC, and can be formed by coupling multiple ICs having the same function or different functions. For example, the

processor 601 can only include a central processing unit (CPU), and can be a combination of the CPU, a digital signal processor (DSP), a graphic processing unit (GPU), and various control chips. In the embodiment of the present disclosure, the CPU can be a single computing core, and can also include a multiple computing core.

5 The input device 602 may include a touch screen, a keyboard, and so on, and can also include a wired interface, a wireless interface, and so on.

 The output device 603 can include a display screen, a loudspeaker, and so on, and can also include a wired interface, a wireless interface, and so on.

 The memory 604 can store soft programs and modules. The processor 601
10 invokes the soft programs and modules stored in the memory 604 to execute various functions and data processing of the user terminal. The memory 604 may include a program storing region and a data storing region. The program storing region can store an operating system, computer-readable program codes for at least one function, and so on. The data storing region can store data created according to use of the
15 user terminal. In the embodiment of the present disclosure, the operating system can be an Android system, an iOS system, a Windows system, or other.

 The processor 601 invokes the computer-readable program codes stored in the memory 604 to execute the follows.

 A partial fingerprint image is received during a process of pressing a fingerprint
20 recognition sensor of the user terminal. The partial fingerprint image corresponds to part of fingerprints of a finger. Matching the partial fingerprint image is performed during the process of receiving the partial fingerprint image, and the user terminal is unlocked when the partial fingerprint image is matched.

 In at least one embodiment, the processor that is configured to invoke the
25 computer-readable program codes to perform receiving the partial fingerprint image is further configured to perform receiving N fingerprint region images by scanning from N directions, N being an integer larger than 1; calculating the clarity of each of the N fingerprint region images; and selecting one of the N fingerprint region images as the partial fingerprint image, wherein the clarity of each of the one of the N fingerprint
30 region images is larger than a preset clarity.

 In at least one embodiment, the processor that is configured to invoke the computer-readable program codes to execute matching the partial fingerprint image is further configured to execute performing a feature point extraction processing on the partial fingerprint image to acquire multiple feature points, selecting target feature
35 points from the multiple feature points, and matching the target feature points with a preset fingerprint template.

In at least one embodiment, the processor that is configured to invoke the computer-readable program codes to execute selecting the target feature points from the multiple feature points is further configured to execute at least one of the follows: determining feature points with grey values falling within a preset range to be the target feature points; and removing a portion of the multiple feature points according to a preset processing, and determining the remaining feature points among the multiple feature points as the target feature points.

In at least one embodiment, the processor that is configured to invoke the computer-readable program codes to execute matching the partial fingerprint image is further configured to execute performing an image enhancement processing on the partial fingerprint image, and matching the partial fingerprint image subjected to the image enhancement processing with a preset fingerprint template.

In at least one embodiment, the processor is further configured to execute the follows before receiving the partial fingerprint image: determining whether a press force applied to the fingerprint recognition sensor is larger than a preset press force; and proceeding to the process of receiving the partial fingerprint image when the press force applied to the fingerprint recognition sensor is larger than the preset press force.

The user terminal illustrated in the embodiments can implement a part of or all of procedures of the method for fingerprint unlocking illustrated by FIG. 1, FIG. 2, or FIG. 3.

The units or sub-units of the embodiments of the present disclosure can be realized by a general integrated circuit, for example, a CPU, an application specific integrated circuit (ASIC).

According to actual needs, the order of the operations of the methods in the embodiments of the present disclosure can be adjusted, some operations can be merged into one operation, and some operation can be deleted.

According to actual needs, some units of the terminals in the embodiments of the present disclosure can be merged into one unit, some unit can be divided into several units, and some unit can be deleted.

Those skilled in the art can understand that all or a part of procedures can be accomplished by using a computer program to instruct related hardware. The program can be stored in a computer-readable storage medium. When the program is executed, the procedures of the embodiments of the above-mentioned methods can be included. Wherein, the storage medium can be a magnetic disk, an optical disk, a ROM (Read-Only Memory, ROM), a RAM (Random Access Memory, RAM), or the like.

The embodiments described above are merely preferred ones of the present disclosure but are not limitations to the protection scope of the present disclosure, thus equivalent variations made according to the appended claims of the present disclosure still fall within the scope of the present disclosure.

CLAIMS

1. A method for fingerprint unlocking, comprising:
 - receiving a partial fingerprint image during a process of pressing a fingerprint recognition sensor of a user terminal, the partial fingerprint image corresponding to
 - 5 part of fingerprints of a finger;
 - matching the partial fingerprint image during the process of receiving the partial fingerprint image; and
 - unlocking the user terminal when the partial fingerprint image is matched.
- 10 2. The method of claim 1, wherein receiving the partial fingerprint image comprises:
 - receiving N fingerprint region images by scanning from N directions, N being an integer larger than 1;
 - calculating the clarity of each of the N fingerprint region images; and
 - selecting one of the N fingerprint region images as the partial fingerprint image,
 - 15 wherein the clarity of the one of the N fingerprint region images is larger than a preset clarity.
3. The method of claim 1 or claim 2, wherein matching the partial fingerprint image comprises:
 - 20 performing a feature point extraction processing on the partial fingerprint image to acquire multiple feature points;
 - selecting target feature points from the multiple feature points; and
 - matching the target feature points with a preset fingerprint template.
- 25 4. The method of claim 3, wherein selecting the target feature points from the multiple feature points comprises at least one of the follows:
 - determining feature points with grey values falling within a preset range to be the target feature points; and
 - removing a portion of the multiple feature points according to a preset processing,
 - 30 and determining the remaining feature points among the multiple feature points as the target feature points.
5. The method of claim 1 or claim 2, wherein matching the partial fingerprint image comprises:
 - 35 performing an image enhancement processing on the partial fingerprint image;

and

matching the partial fingerprint image subjected to the image enhancement processing with a preset fingerprint template.

- 5 6. The method of claim 1 or claim 2, wherein the method further comprises the follows before receiving the partial fingerprint image:

judging whether a press force applied to the fingerprint recognition sensor is larger than a preset press force; and

- 10 proceeding to the process of receiving the partial fingerprint image when the press force applied to the fingerprint recognition sensor is larger than the preset press force.

7. A device for fingerprint unlocking, comprising:

- 15 a receiving unit, configured to receive a partial fingerprint image during a process of pressing a fingerprint recognition sensor of a user terminal, the partial fingerprint image corresponding to part of fingerprints of a finger;

a matching unit, configured to match the partial fingerprint image during the process of receiving the partial fingerprint image; and

- 20 an unlocking unit, configured to unlock the user terminal when the partial fingerprint image is matched.

8. The device of claim 7, wherein the receiving unit comprises:

a scanning sub-unit, configured to receive N fingerprint region images by scanning from N directions, N being an integer larger than 1;

- 25 a calculating sub-unit, configured to calculate the clarity of each of the N fingerprint region images; and

a selecting sub-unit, configured to select one of the N fingerprint region images as the partial fingerprint image, wherein the clarity of the one of the N fingerprint region images is larger than a preset clarity.

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9. The device of claim 7 or claim 8, wherein the matching unit comprises:

an extracting sub-unit, configured to perform a feature point extraction processing on the partial fingerprint image to acquire multiple feature points;

- 35 a determining sub-unit, configured to select target feature points from the multiple feature points; and

a first matching sub-unit, configured to match the target feature points with a

preset fingerprint template.

10. The device of claim 9, wherein the determining sub-unit that is configured to select the target feature points from the multiple feature points is further configured to execute at least one of the follows:

determining feature points with grey values falling within a preset range to be the target feature points; and

removing a portion of the multiple feature points according to a preset processing, and determining the remaining feature points among the multiple feature points as the target feature points.

11. The device of claim 7 or claim 8, wherein the matching unit comprises:

a processing sub-unit, configured to perform an image enhancement processing on the partial fingerprint image; and

a second matching sub-unit, configured to match the partial fingerprint image subjected to the image enhancement processing with a preset fingerprint template.

12. The device of claim 7 or claim 8, wherein the device further comprises:

a judging sub-unit, configured to judge whether a press force applied to the fingerprint recognition sensor is larger than a preset press force before the receiving unit receives the partial fingerprint image; and

the receiving unit is configured to receive the partial fingerprint image when the press force applied to the fingerprint recognition sensor is larger than the preset press force.

13. A user terminal comprising:

a memory configured to store computer-readable program codes; and

a processor configured to invoke the computer-readable program codes to execute:

receiving a partial fingerprint image during a process of pressing a fingerprint recognition sensor of the user terminal, the partial fingerprint image corresponding to part of fingerprints of a finger;

matching the partial fingerprint image during the process of receiving the partial fingerprint image; and

unlocking the user terminal when the partial fingerprint image is matched.

14. The user terminal of claim 13, wherein the processor that is configured to invoke the computer-readable program codes to execute receiving the partial fingerprint image is further configured to execute:

receiving N fingerprint region images by scanning from N directions, N being an integer larger than 1;

calculating the clarity of each of the N fingerprint region images; and

selecting one of the N fingerprint region images as the partial fingerprint image, wherein the clarity of the one of the N fingerprint region images is larger than a preset clarity.

15. The user terminal of claim 13 or claim 14, wherein the processor that is configured to invoke the computer-readable program codes to execute matching the partial fingerprint image is further configured to execute:

performing a feature point extraction processing on the partial fingerprint image to acquire multiple feature points;

selecting target feature points from the multiple feature points; and

matching the target feature points with a preset fingerprint template;

the processor that is configured to invoke the computer-readable program codes to execute selecting the target feature points from the multiple feature points is further configured to execute at least one of the follows:

determining feature points with grey values falling within a preset range to be the target feature points; and

removing a portion of the multiple feature points according to a preset processing, and determining the remaining feature points among the multiple feature points as the target feature points.

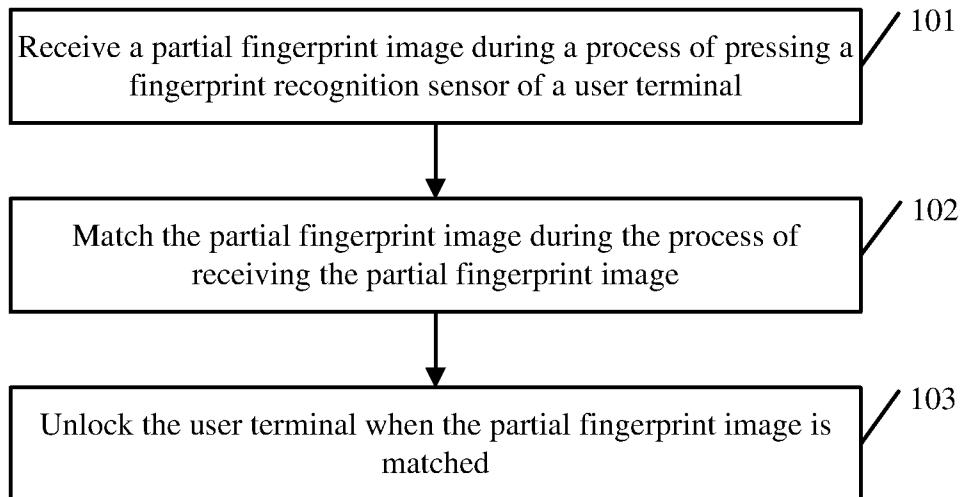


FIG. 1

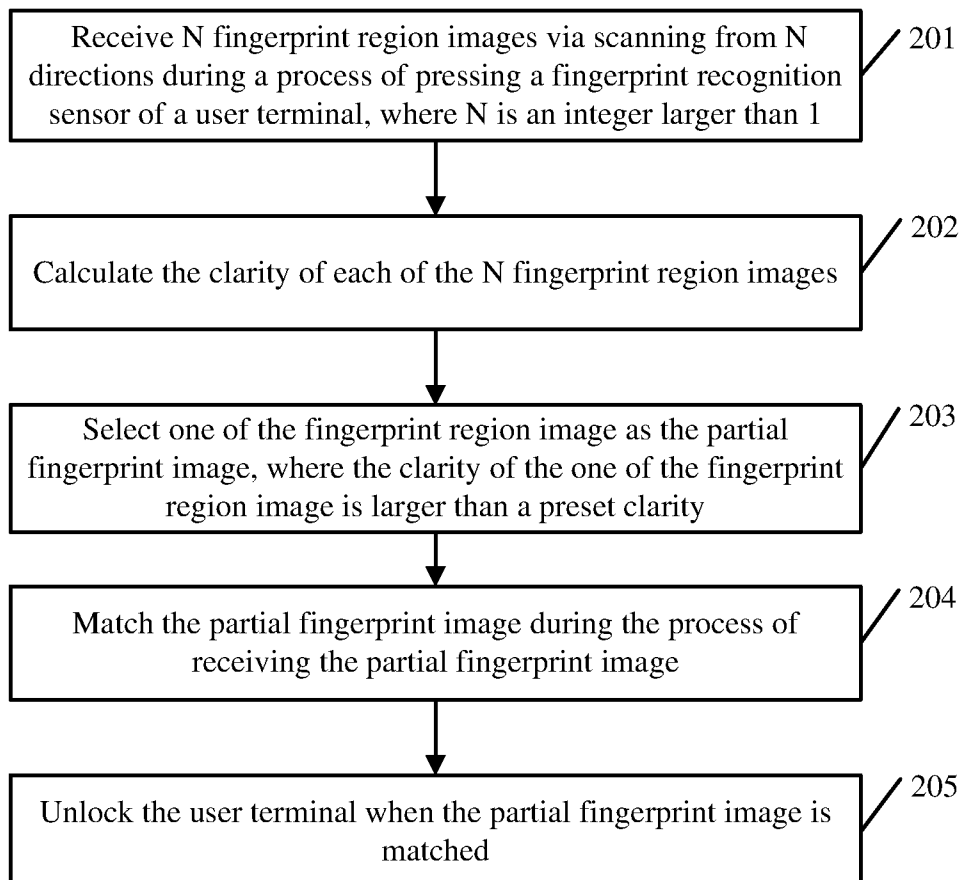


FIG. 2

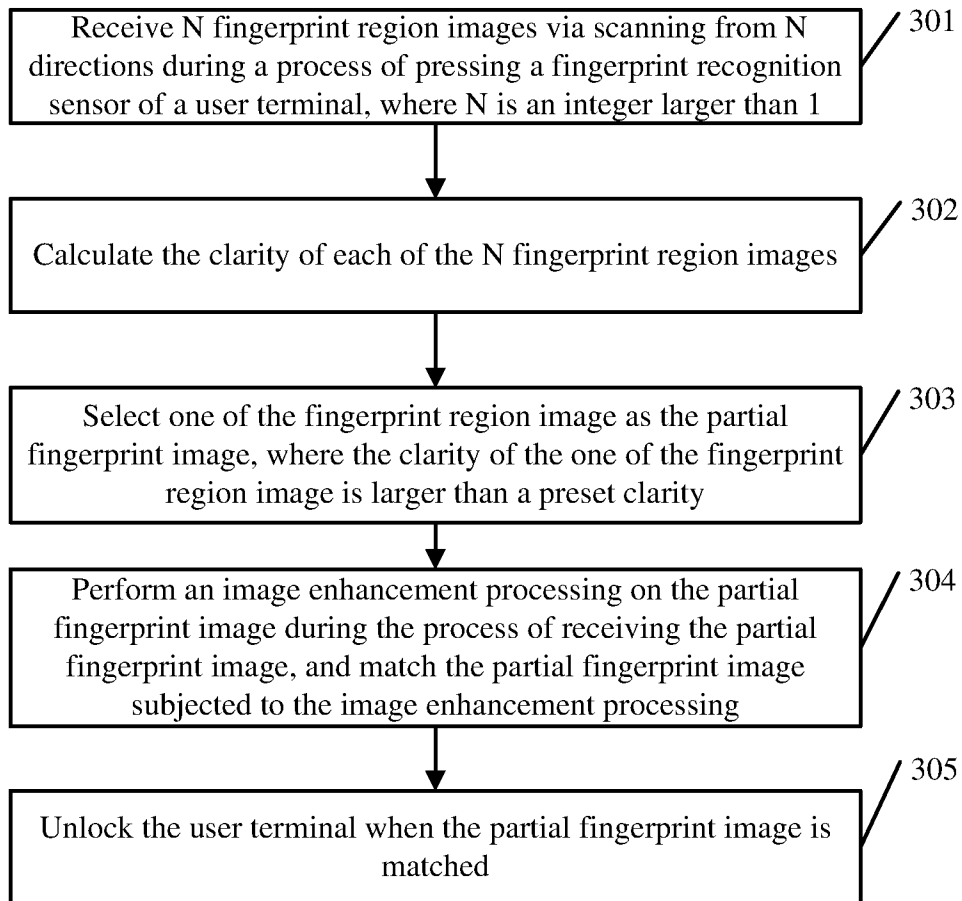


FIG. 3

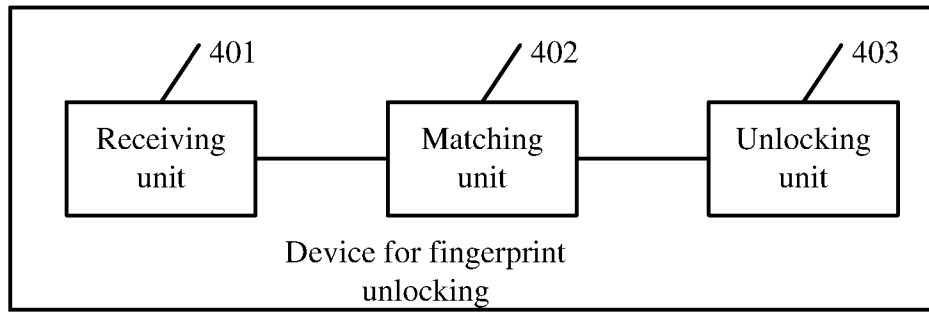


FIG. 4

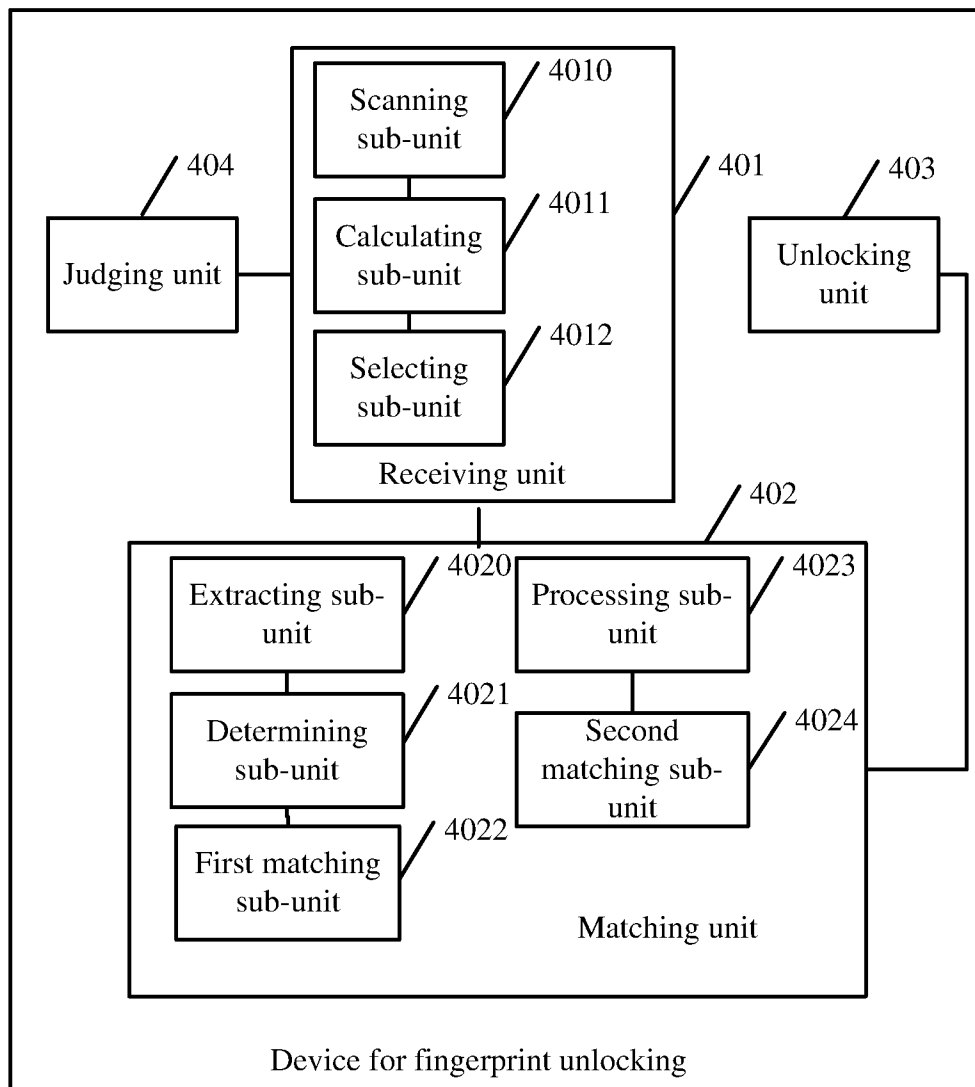


FIG. 5

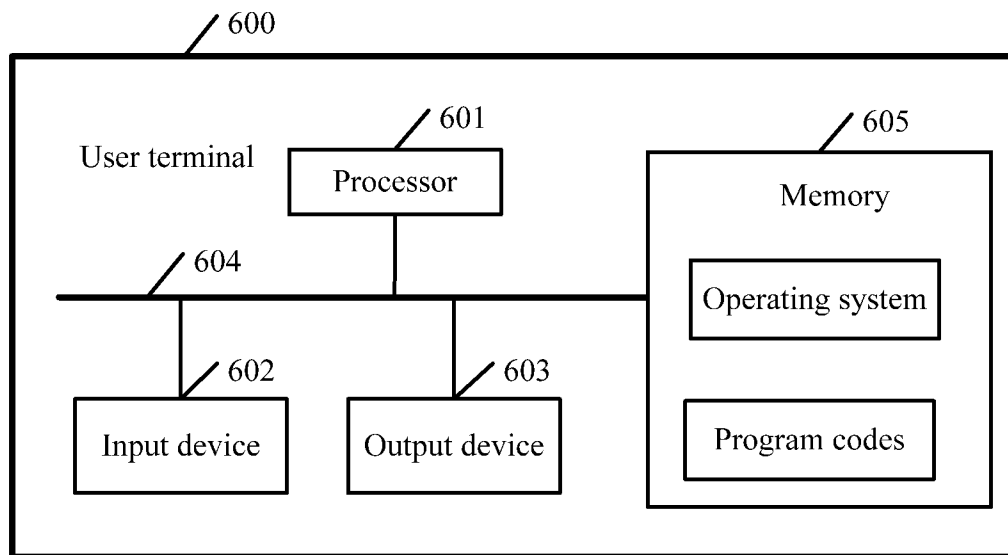


FIG. 6

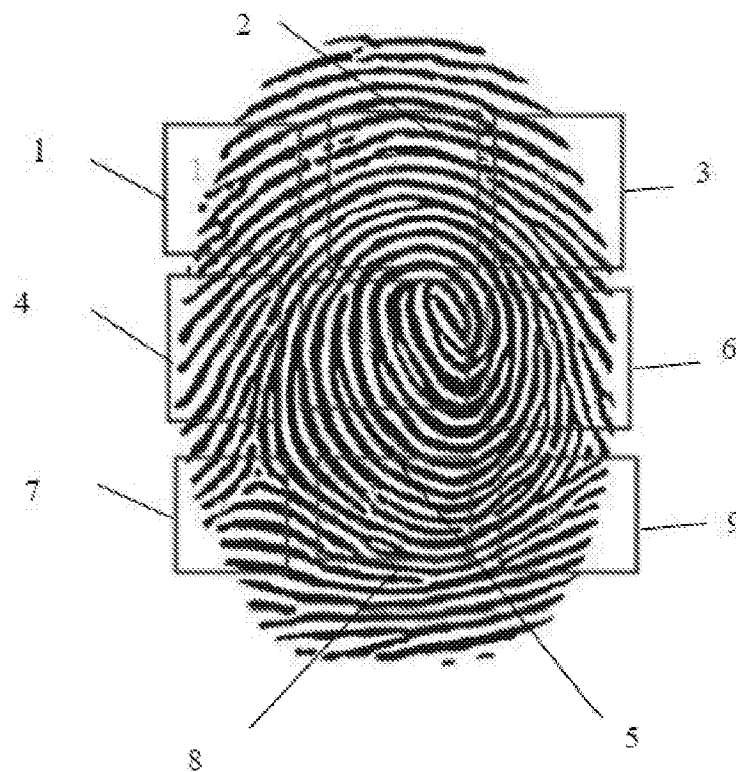


FIG. 7

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2017/083580

A. CLASSIFICATION OF SUBJECT MATTER

G06F 21/32(2013.01)i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

G06F

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

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

CNABS,CNKI,DWPI,SIPOABS: fingerprint, collect, gather, obtain, acquire, match, compare, contrast, adapt, unlock, parallel, concurrent, isochronous, simultaneous, template, partial

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2014359757 A1 (QUALCOMM INC.) 04 December 2014 (2014-12-04) description, paragraphs [0077] to [0082], [0199] to [0201] and figure 1A	1-3, 5, 7-9, 11, 13, 14
Y	CN 105205367 A (LENOVO BEIJING CO., LTD.) 30 December 2015 (2015-12-30) claim 1	1-3, 5, 7-9, 11, 13, 14
A	CN 105303090 A (GUANGDONG OPPO MOBILE COMMUNICATION CO., LTD.) 03 February 2016 (2016-02-03) the whole document	1-15
A	CN 105353965 A (VIVO MOBILE COMMUNICATION CO., LTD.) 24 February 2016 (2016-02-24) the whole document	1-15
PX	CN 105956448 A (GUANGDONG OPPO MOBILE COMMUNICATION CO., LTD.) 21 September 2016 (2016-09-21) claims 1-16	1-15



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

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

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

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

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

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

“&” document member of the same patent family

Date of the actual completion of the international search

25 July 2017

Date of mailing of the international search report

15 August 2017

Name and mailing address of the ISA/CN

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/CN2017/083580

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				EP	3066614	A1	14 September 2016
				IN	201647012219	A	22 July 2016
CN	105205367	A	30 December 2015	None			
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CN	105353965	A	24 February 2016	None			
CN	105956448	A	21 September 2016	IN	201734016809	A	16 June 2017