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(54) **ELECTRONIC DEVICE FOR PERFORMING SUBSCRIBER IDENTITY MODULE AUTHENTICATION, AND OPERATING METHOD AND STORAGE MEDIUM THEREOF**

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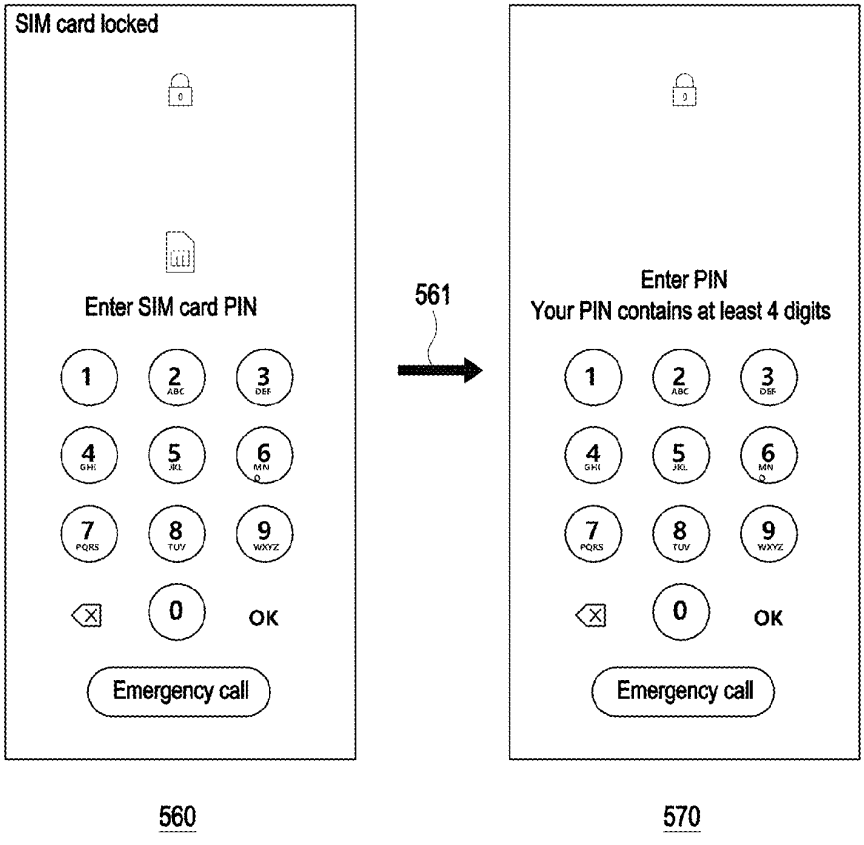
(57) **ABSTRACT**

An electronic device includes: a communication circuit; a display; at least one processor including processing circuitry; and memory storing instructions that, when executed by the at least one processor individually or collectively, cause the electronic device to: display a lock screen for user authentication through the display based on an event for subscriber identity module (SIM) authentication being generated, acquire a personal identification number (PIN) for an SIM unlock based on acquisition of user authentication information for releasing the lock screen, identify whether the acquired PIN corresponds to a stored PIN, and perform the SIM unlock, based on identifying that the acquired PIN corresponds to the stored PIN.



560 570

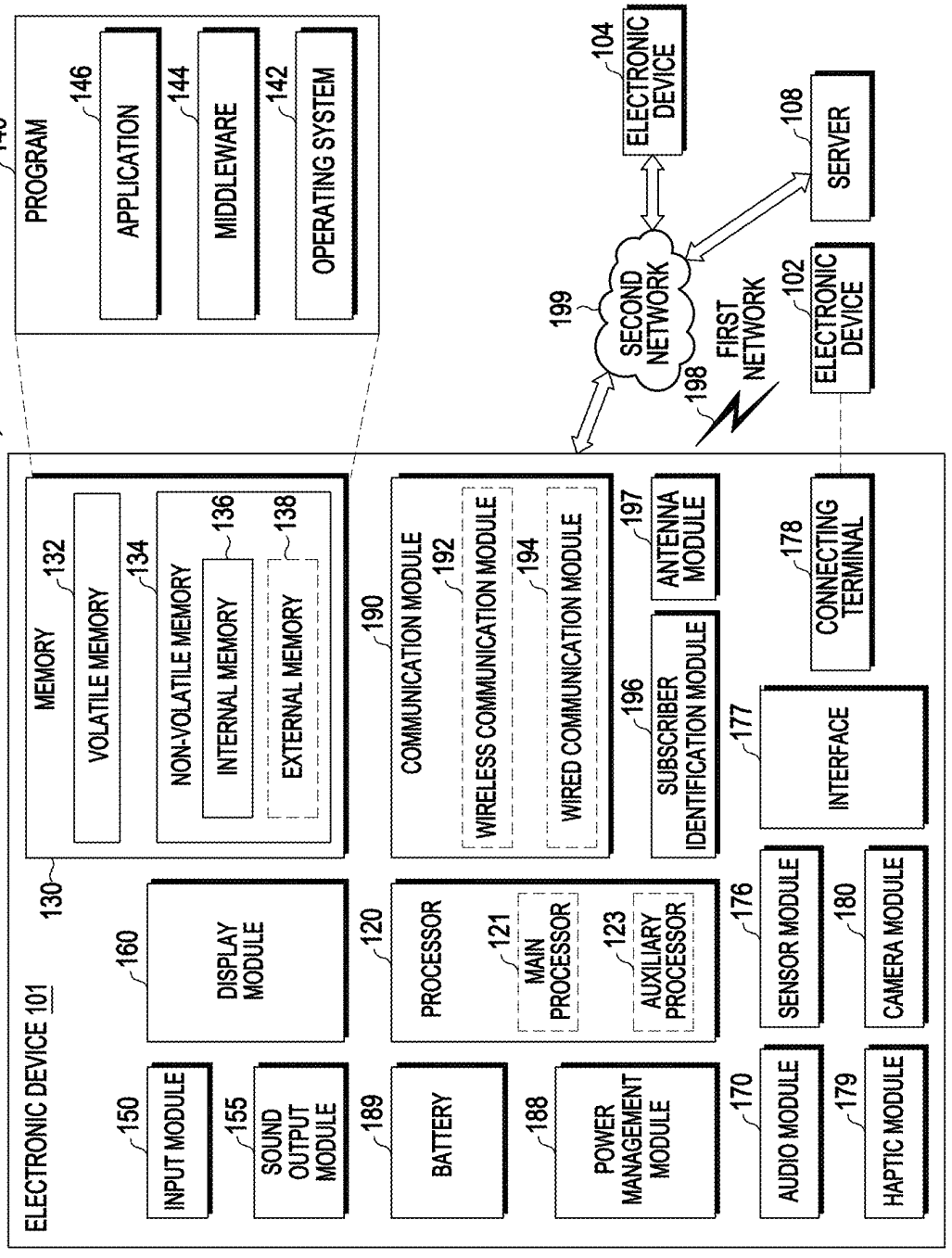

100
ELECTRONIC DEVICE 101
130
MEMORY
132
VOLATILE MEMORY
134
NON-VOLATILE MEMORY
136
INTERNAL MEMORY
138
EXTERNAL MEMORY
160
DISPLAY MODULE
120
PROCESSOR
121
MAIN PROCESSOR
123
AUXILIARY PROCESSOR
150
INPUT MODULE
155
SOUND OUTPUT MODULE
189
BATTERY
188
POWER MANAGEMENT MODULE
176
SENSOR MODULE
170
AUDIO MODULE
180
CAMERA MODULE
179
HAPTIC MODULE
190
COMMUNICATION MODULE
192
WIRELESS COMMUNICATION MODULE
194
WIRED COMMUNICATION MODULE
196
SUBSCRIBER IDENTIFICATION MODULE
197
ANTENNA MODULE
177
INTERFACE
178
CONNECTING TERMINAL
140
PROGRAM
146
APPLICATION
144
MIDDLEWARE
142
OPERATING SYSTEM
199
SECOND NETWORK
198
FIRST NETWORK
104
ELECTRONIC DEVICE
102
ELECTRONIC DEVICE
108
SERVER

FIG. 1

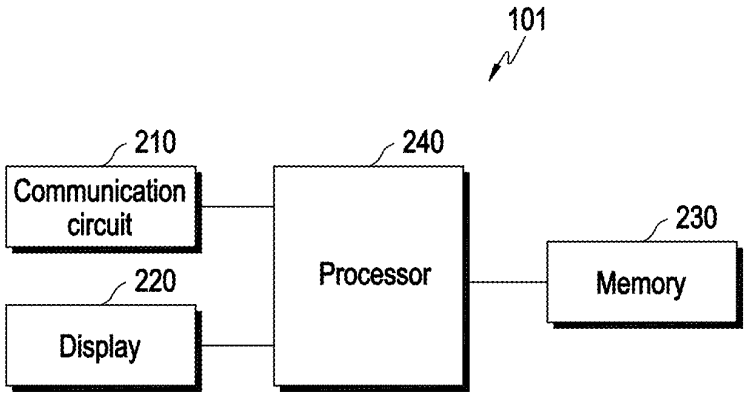

101
210
Communication circuit
220
Display
240
Processor
230
Memory

FIG. 2

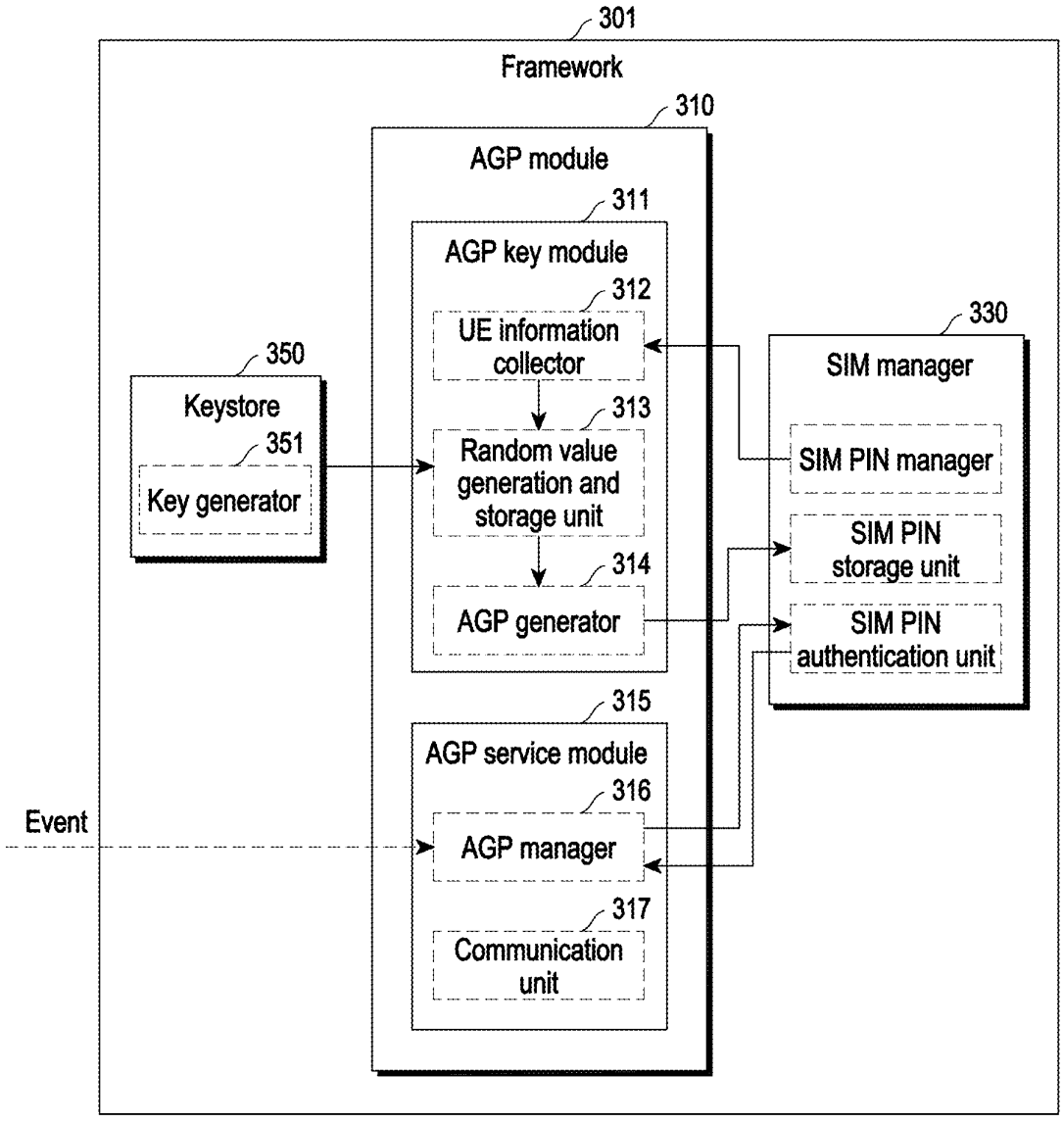

301
Framework
310
AGP module
311
AGP key module
312
UE information collector
313
Random value generation and storage unit
314
AGP generator
315
AGP service module
316
AGP manager
317
Communication unit
350
Keystore
351
Key generator
330
SIM manager
SIM PIN manager
SIM PIN storage unit
SIM PIN authentication unit
Event

FIG. 3

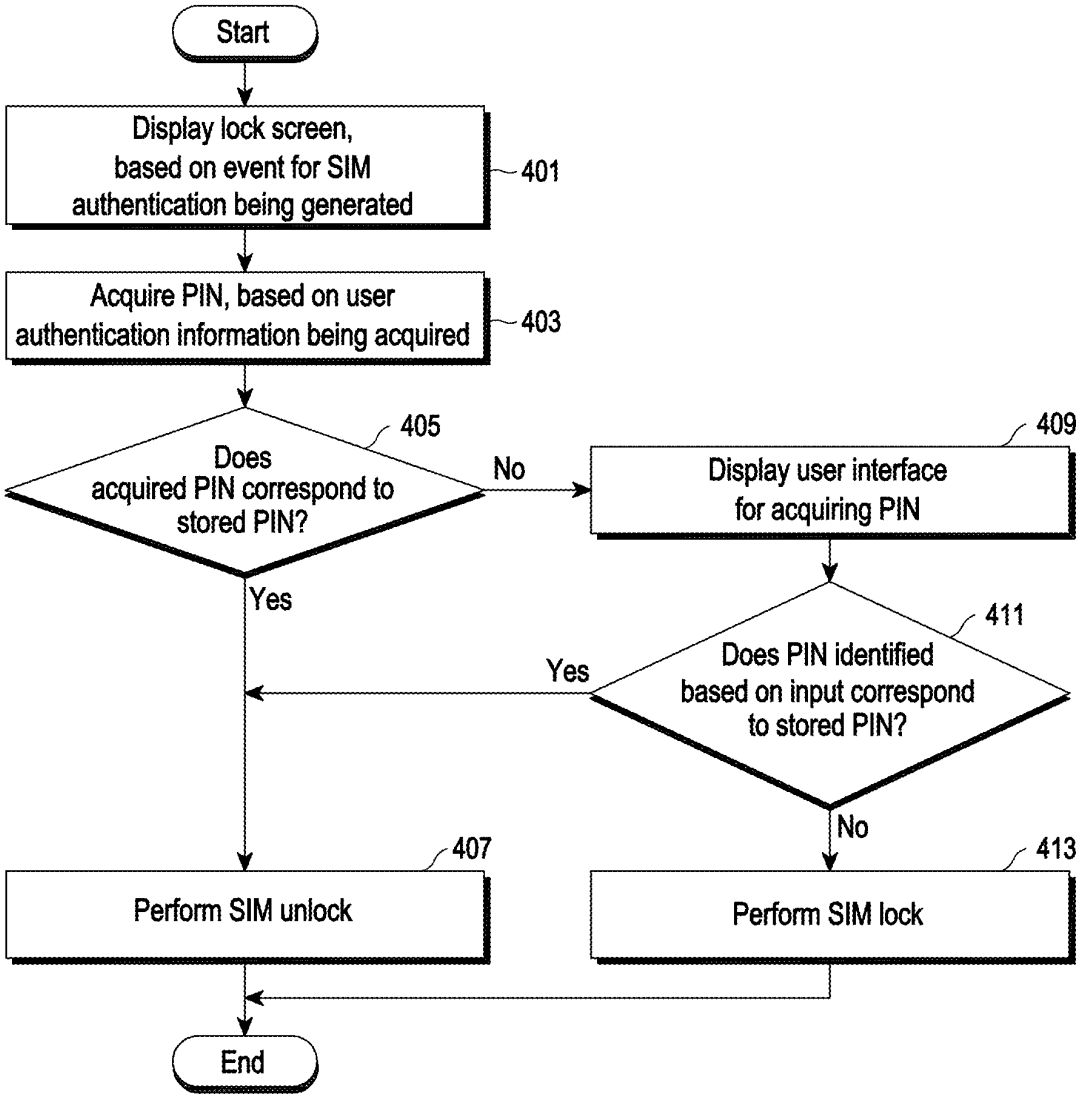

Start
Display lock screen, based on event for SIM authentication being generated
401
Acquire PIN, based on user authentication information being acquired
403
Does acquired PIN correspond to stored PIN?
405
No
Display user interface for acquiring PIN
409
Yes
Does PIN identified based on input correspond to stored PIN?
411
Yes
No
Perform SIM unlock
407
Perform SIM lock
413
End

FIG. 4

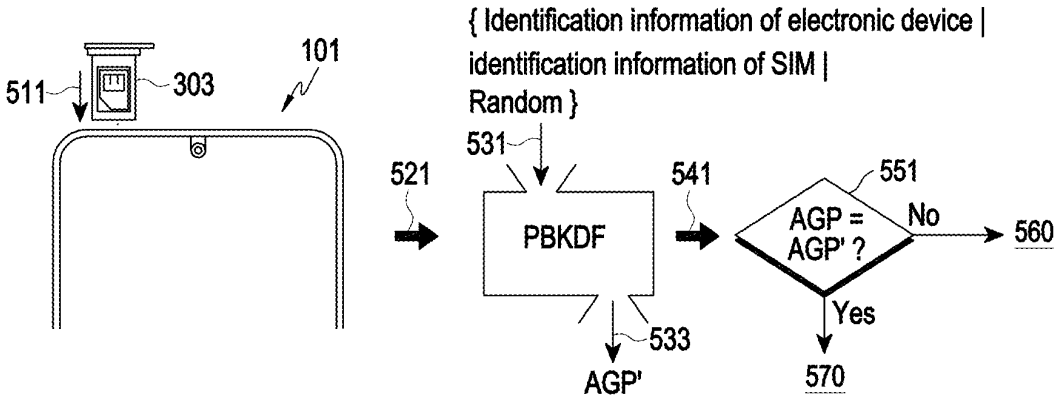

101
511
303
{ Identification information of electronic device |
identification information of SIM |
Random }
531
521
541
551
PBKDF
AGP =
AGP' ?
No
560
Yes
533
AGP'
570

FIG. 5A

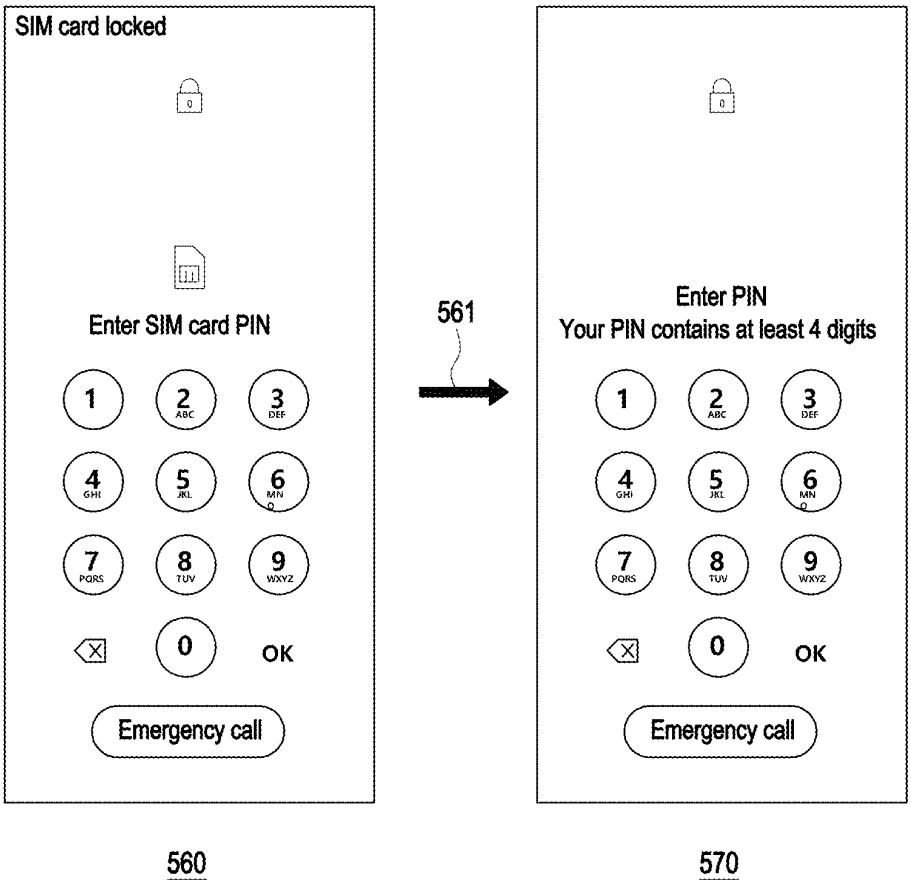

SIM card locked
Enter SIM card PIN
1
2 ABC
3 DEF
4 GHI
5 JKL
6 MN O
7 PQRS
8 TUV
9 WXYZ
0
OK
Emergency call
561
Enter PIN
Your PIN contains at least 4 digits
1
2 ABC
3 DEF
4 GHI
5 JKL
6 MN O
7 PQRS
8 TUV
9 WXYZ
0
OK
Emergency call
560
570

FIG. 5B

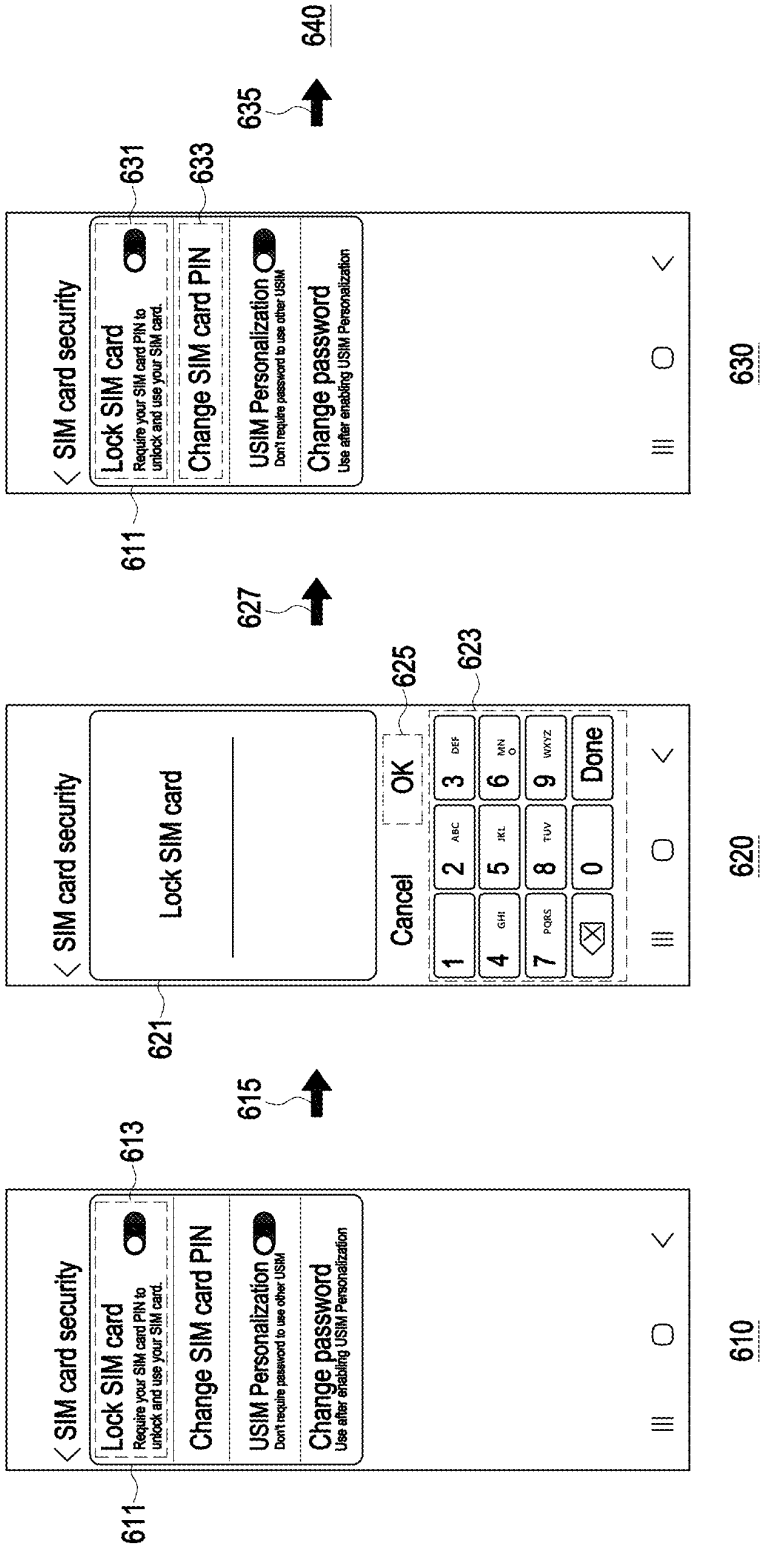

SIM card security
Lock SIM card
Require your SIM card PIN to unlock and use your SIM card.
Change SIM card PIN
USIM Personalization
Don't require password to use other USIM
Change password
Use after enabling USIM Personalization
Lock SIM card
Cancel
OK
Done
610
611
613
615
620
621
623
625
627
630
631
633
635
640

FIG. 6A

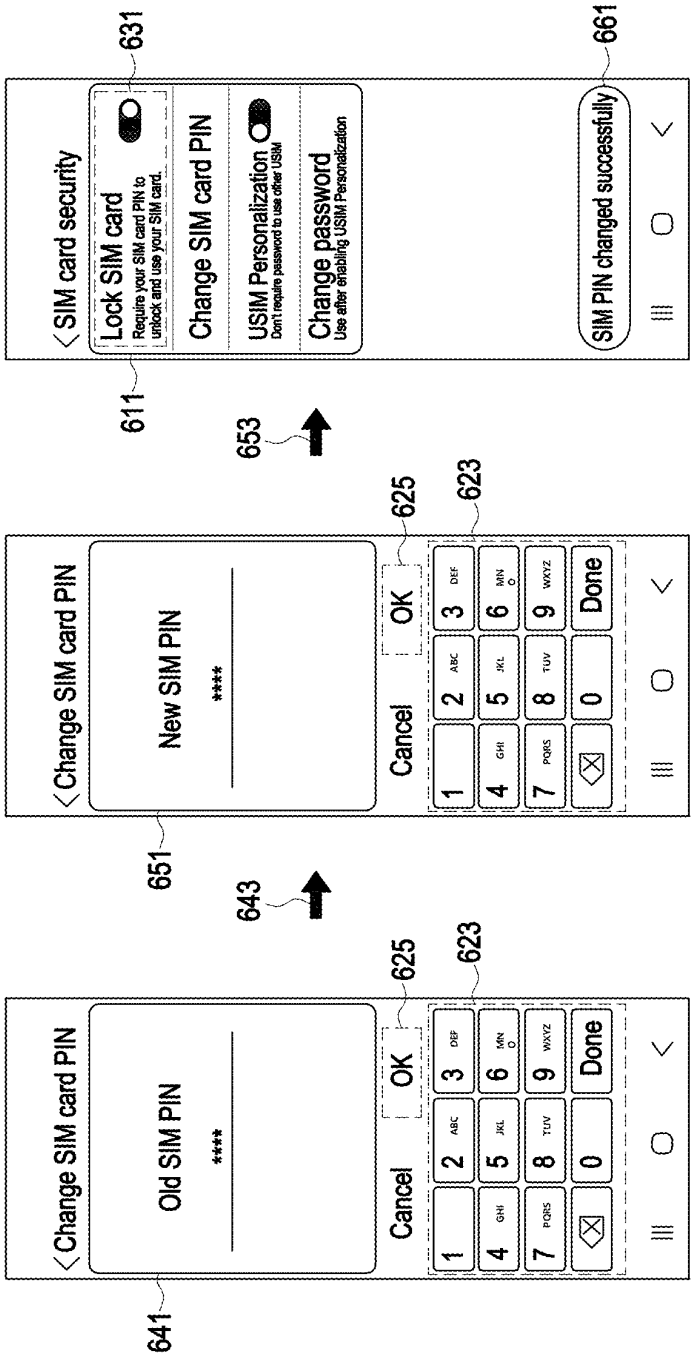

SIM card security
Lock SIM card
Require your SIM card PIN to unlock and use your SIM card.
Change SIM card PIN
USIM Personalization
Don't require password to use other USIM
Change password
Use after enabling USIM Personalization
SIM PIN changed successfully
Change SIM card PIN
New SIM PIN
****
Change SIM card PIN
Old SIM PIN
****
Cancel
OK
Done
631
661
611
653
625
623
651
643
641
660
650
640

FIG. 6B

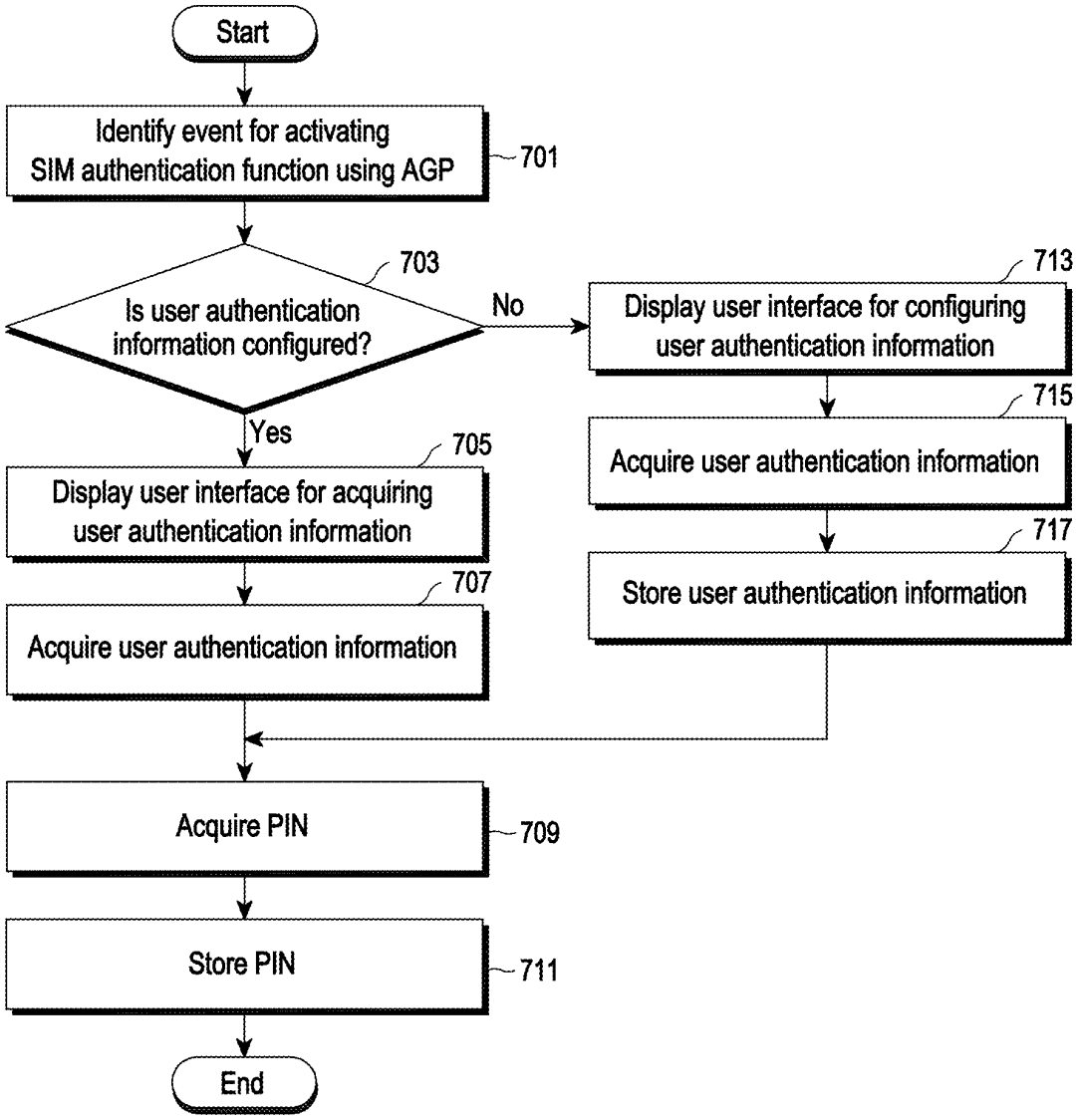

Start
Identify event for activating SIM authentication function using AGP
701
703
Is user authentication information configured?
No
Yes
713
Display user interface for configuring user authentication information
715
Acquire user authentication information
717
Store user authentication information
705
Display user interface for acquiring user authentication information
707
Acquire user authentication information
Acquire PIN
709
Store PIN
711
End

FIG. 7

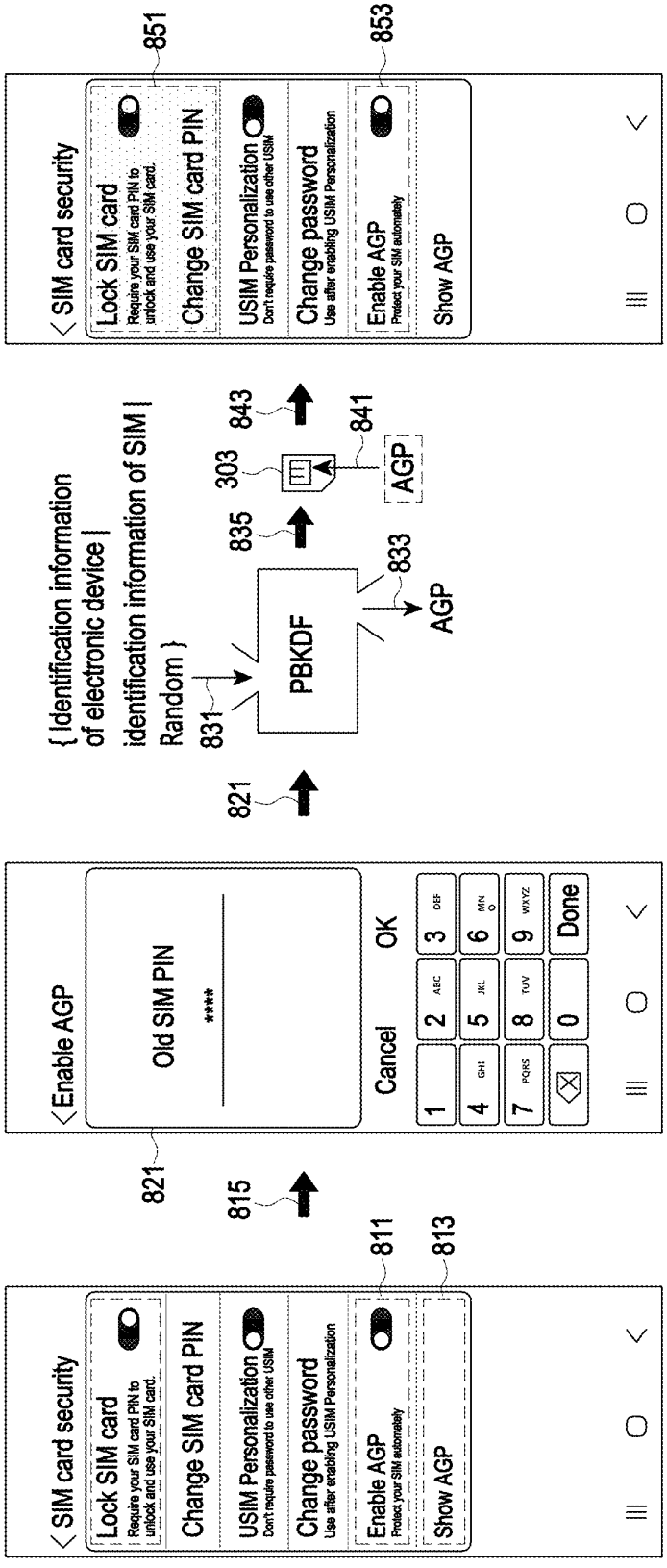

SIM card security
Lock SIM card
Require your SIM card PIN to unlock and use your SIM card.
Change SIM card PIN
USIM Personalization
Don't require password to use other USIM
Change password
Use after enabling USIM Personalization
Enable AGP
Protect your SIM automatically
Show AGP
810
811
813
815
Enable AGP
Old SIM PIN
****
Cancel
OK
820
821
{ Identification information of electronic device | identification information of SIM | Random }
831
PBKDF
833
AGP
835
303
841
AGP
843
851
853
850

FIG. 8

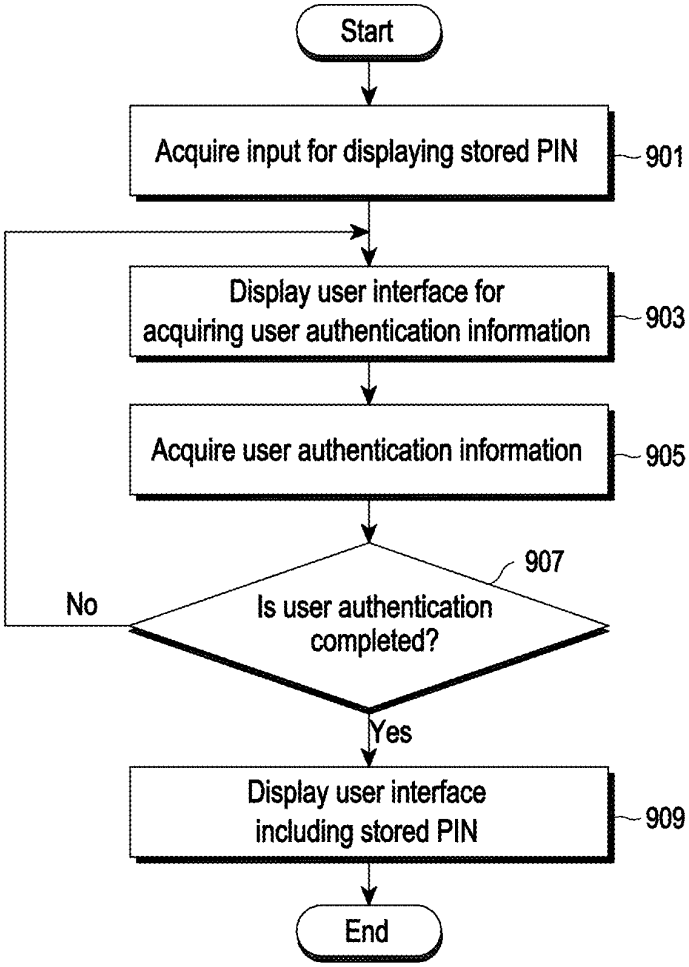

Start
Acquire input for displaying stored PIN
901
Display user interface for acquiring user authentication information
903
Acquire user authentication information
905
907
Is user authentication completed?
No
Yes
Display user interface including stored PIN
909
End

FIG. 9

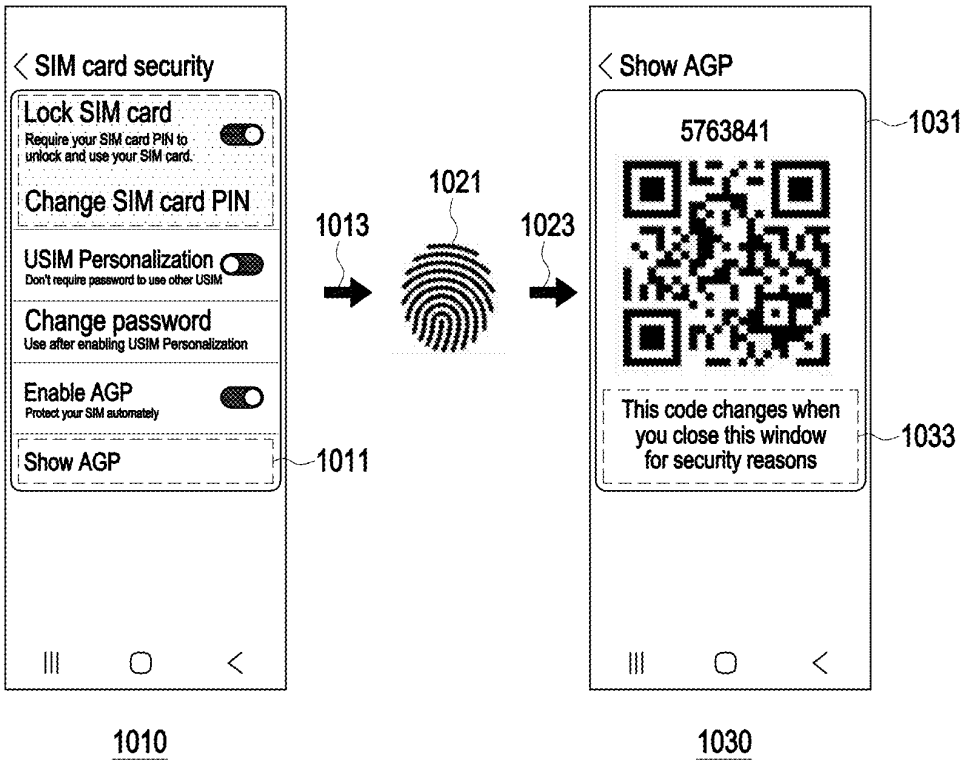

SIM card security
Lock SIM card
Require your SIM card PIN to unlock and use your SIM card.
Change SIM card PIN
USIM Personalization
Don't require password to use other USIM
Change password
Use after enabling USIM Personalization
Enable AGP
Protect your SIM automately
Show AGP
1011
1013
1021
1023
Show AGP
5763841
1031
This code changes when you close this window for security reasons
1033
1010
1030

FIG. 10

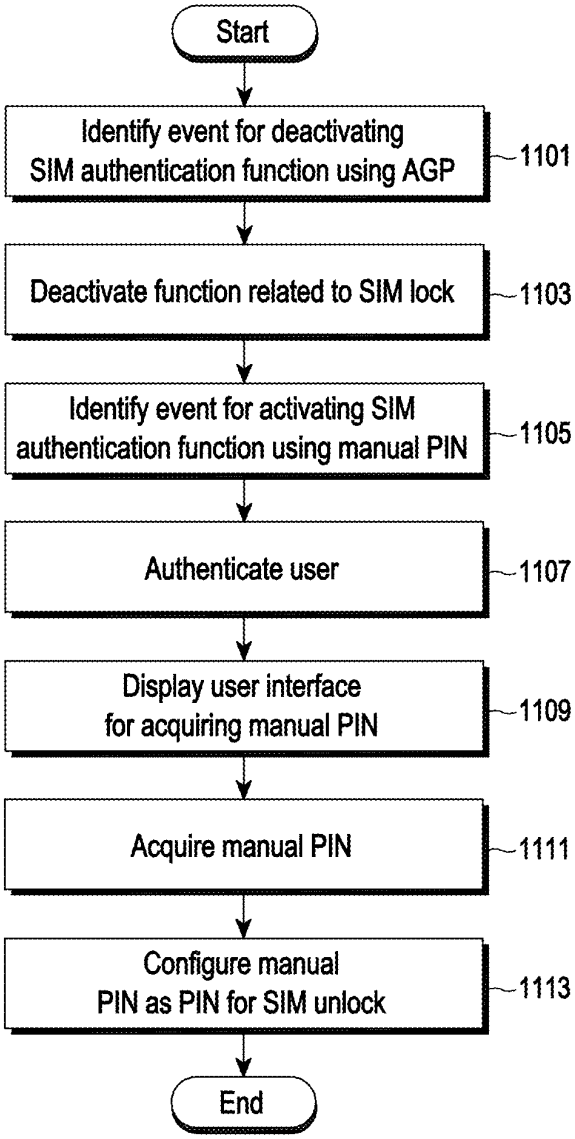

Start
Identify event for deactivating SIM authentication function using AGP
1101
Deactivate function related to SIM lock
1103
Identify event for activating SIM authentication function using manual PIN
1105
Authenticate user
1107
Display user interface for acquiring manual PIN
1109
Acquire manual PIN
1111
Configure manual PIN as PIN for SIM unlock
1113
End

FIG. 11

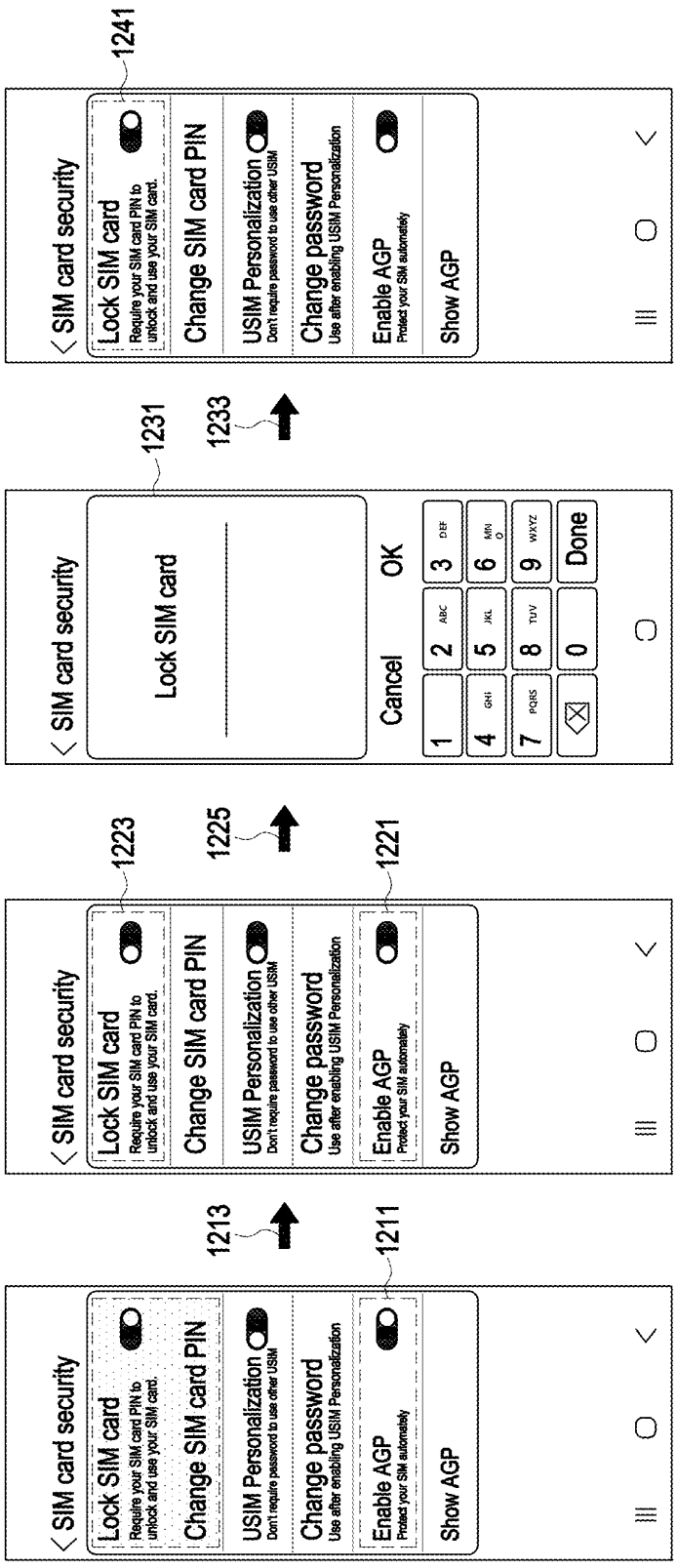

SIM card security
Lock SIM card
Require your SIM card PIN to unlock and use your SIM card.
Change SIM card PIN
USIM Personalization
Don't require password to use other USIM
Change password
Use after enabling USIM Personalization
Enable AGP
Protect your SIM automately
Show AGP
1210
1211
1213
1220
1221
1223
1225
1230
1231
1233
Lock SIM card
Cancel
OK
Done
1240
1241

FIG. 12

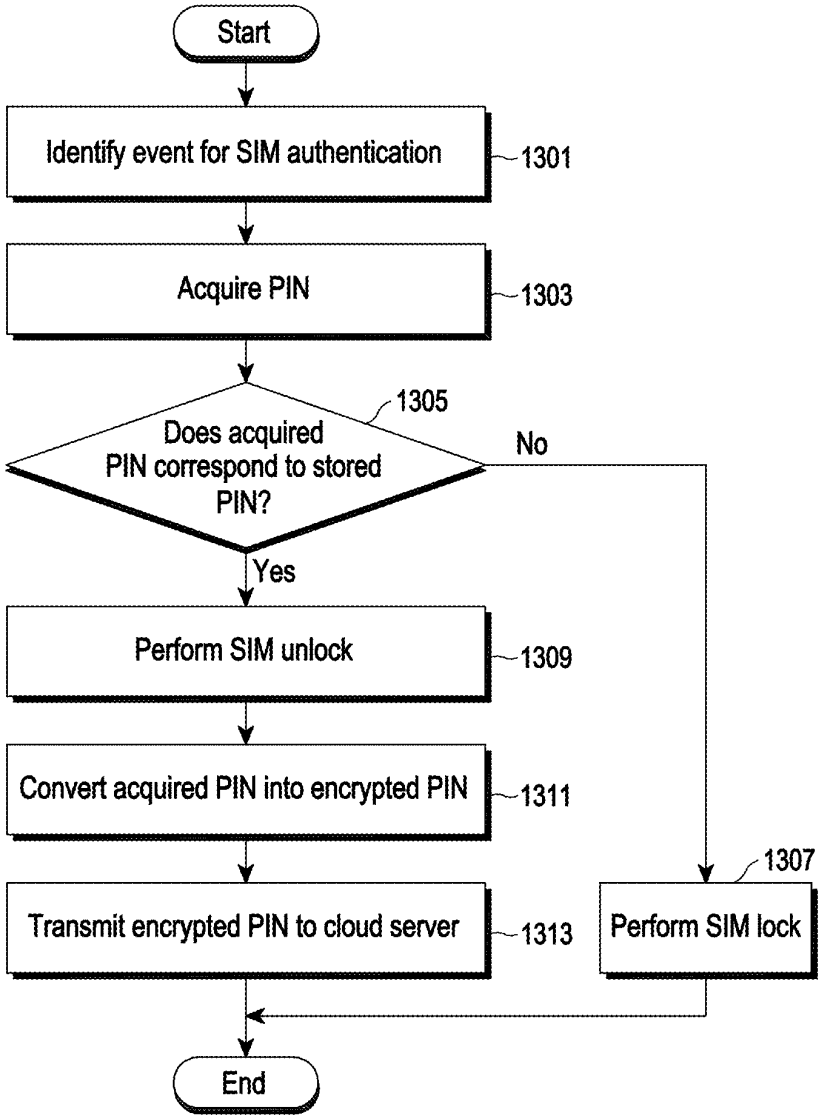

Start
Identify event for SIM authentication
1301
Acquire PIN
1303
1305
Does acquired PIN correspond to stored PIN?
No
Yes
Perform SIM unlock
1309
Convert acquired PIN into encrypted PIN
1311
1307
Transmit encrypted PIN to cloud server
1313
Perform SIM lock
End

FIG. 13

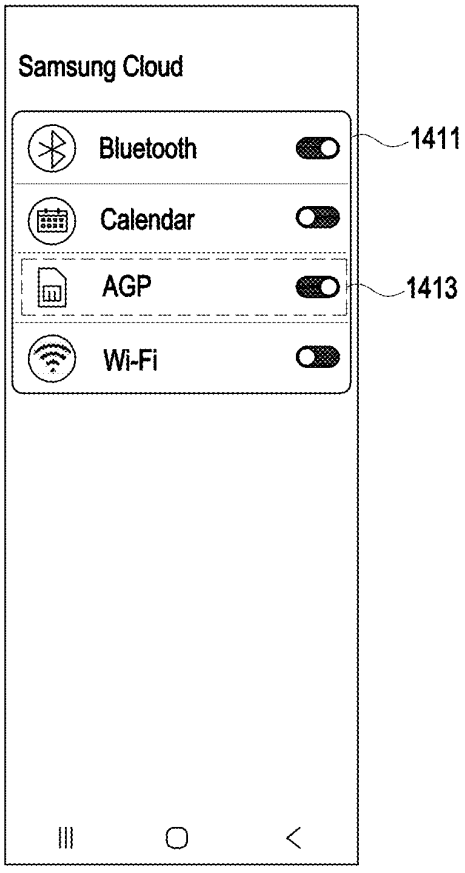


FIG. 14

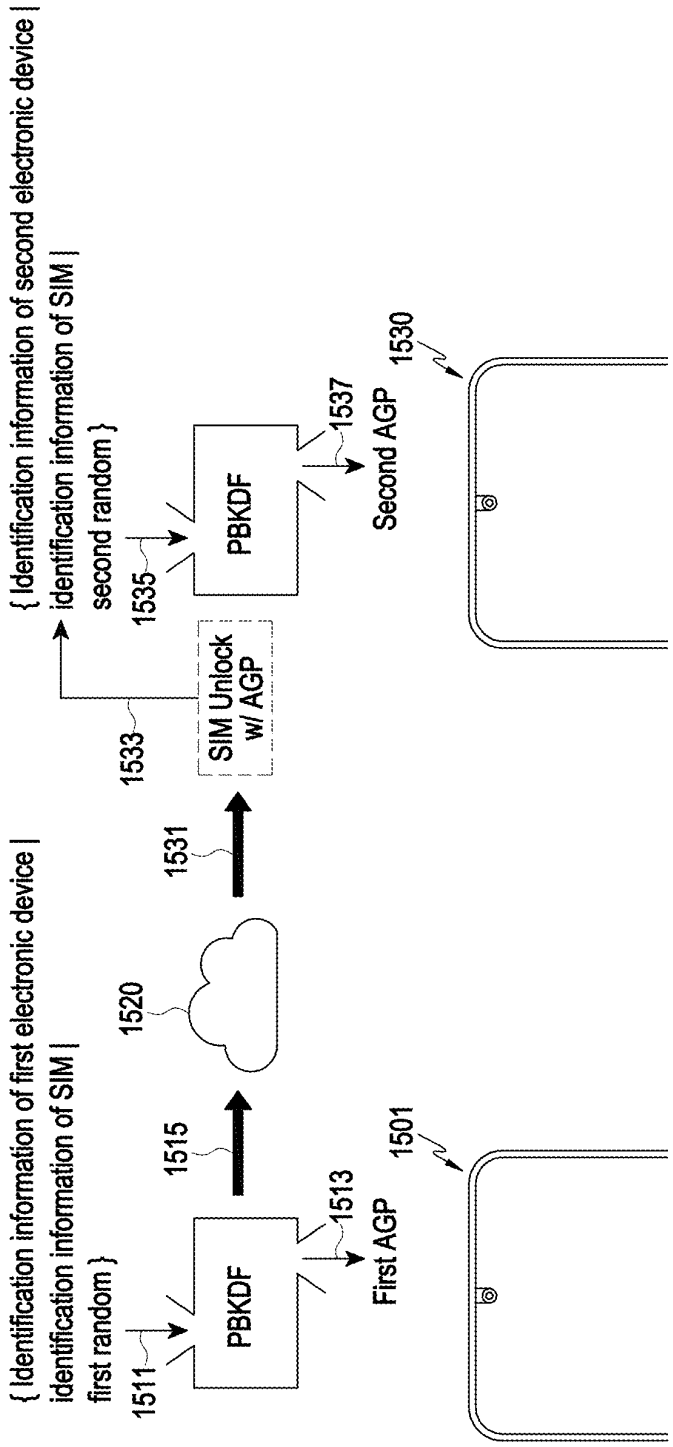

{ Identification information of first electronic device | identification information of SIM | first random }
1511
PBKDF
1513
First AGP
1501
1515
1520
1531
1533
SIM Unlock w/ AGP
{ Identification information of second electronic device | identification information of SIM | second random }
1535
PBKDF
1537
Second AGP
1530

FIG. 15

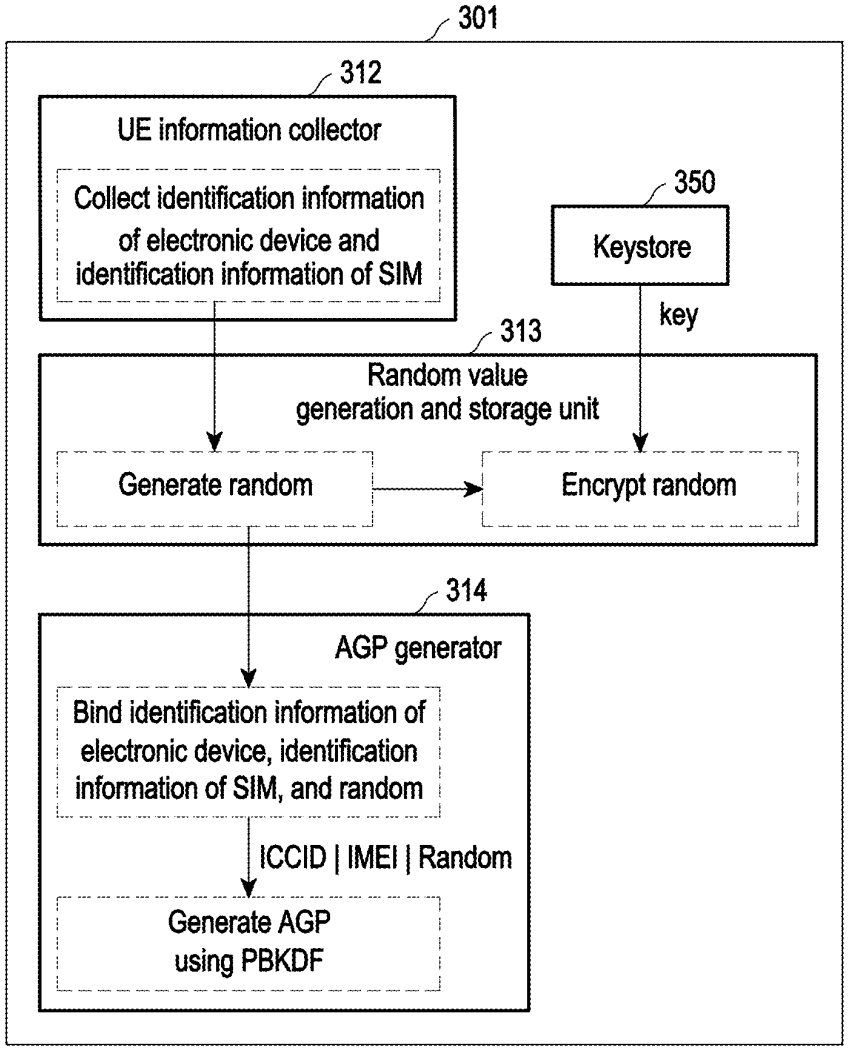

301
312
UE information collector
Collect identification information of electronic device and identification information of SIM
350
Keystore
key
313
Random value generation and storage unit
Generate random
Encrypt random
314
AGP generator
Bind identification information of electronic device, identification information of SIM, and random
ICCID | IMEI | Random
Generate AGP using PBKDF

FIG. 16

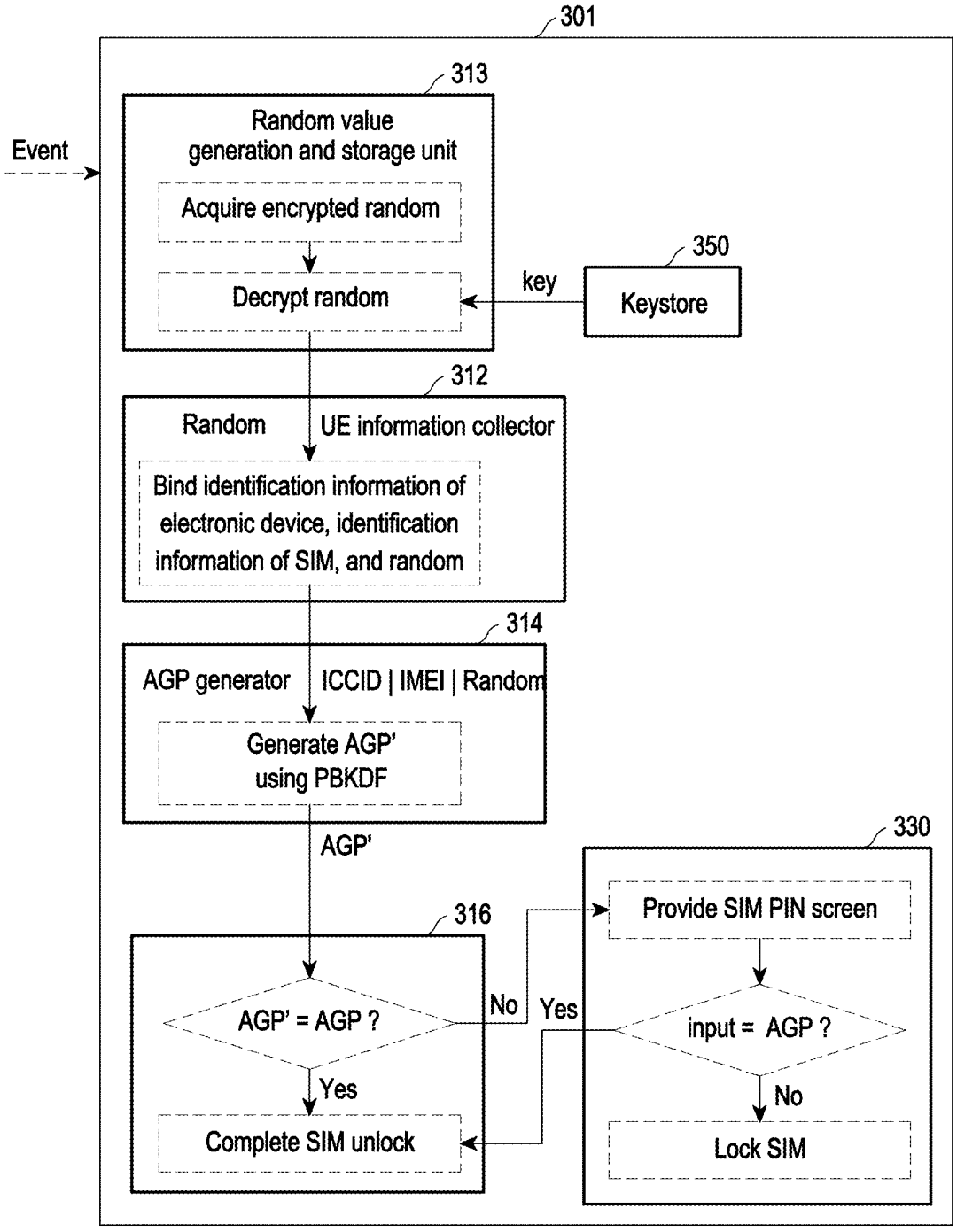

301
313
Random value generation and storage unit
Event
Acquire encrypted random
Decrypt random
key
350
Keystore
312
Random
UE information collector
Bind identification information of electronic device, identification information of SIM, and random
314
AGP generator
ICCID | IMEI | Random
Generate AGP' using PBKDF
AGP'
330
316
Provide SIM PIN screen
AGP' = AGP ?
No
Yes
input = AGP ?
Yes
No
Complete SIM unlock
Lock SIM

FIG. 17

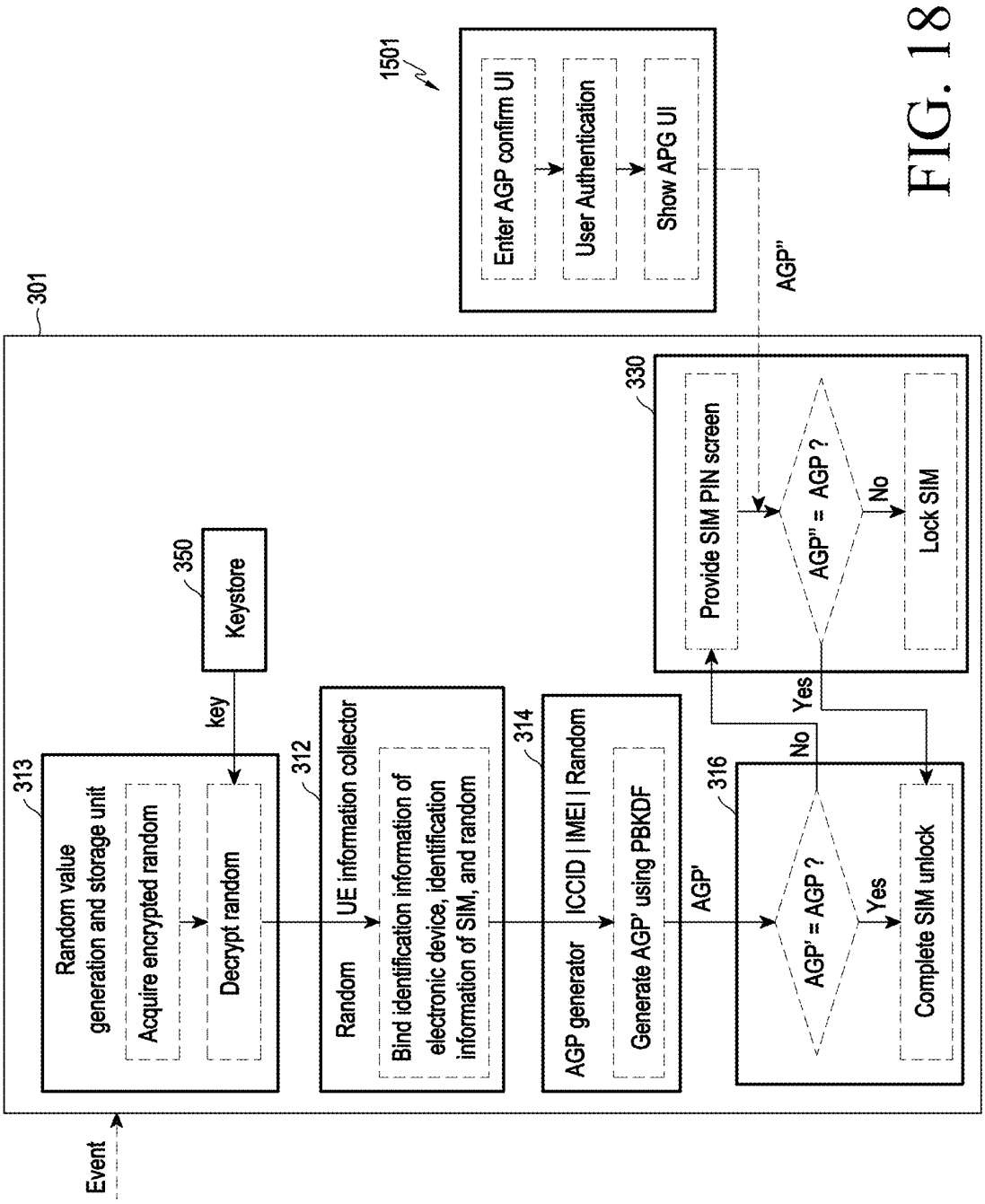

Event
301
313
Random value generation and storage unit
Acquire encrypted random
Decrypt random
key
350
Keystore
312
UE information collector
Random
Bind identification information of electronic device, identification information of SIM, and random
314
AGP generator
ICCID | IMEI | Random
Generate AGP' using PBKDF
AGP'
316
AGP' = AGP ?
Yes
No
Complete SIM unlock
330
Provide SIM PIN screen
AGP'' = AGP ?
No
Lock SIM
Yes
AGP''
1501
Enter AGP confirm UI
User Authentication
Show APG UI

FIG. 18

ELECTRONIC DEVICE FOR PERFORMING SUBSCRIBER IDENTITY MODULE AUTHENTICATION, AND OPERATING METHOD AND STORAGE MEDIUM THEREOF

CROSS-REFERENCE TO RELATED APPLICATION(S)

[0001] This application is a by-pass continuation application of International Application No. PCT/KR2025/011953, filed on Aug. 7, 2025, which is based on and claims priority to Korean Patent Application No. 10-2024-0124781, filed in the Korean Intellectual Property Office on Sep. 12, 2024, and Korean Patent Application No. 10-2024-0147462, filed in the Korean Intellectual Property Office on Oct. 25, 2024, the disclosures of which are incorporated by reference herein in their entireties.

BACKGROUND

1. Field

[0002] The disclosure relates to an electronic device for performing subscriber identity module (SIM) authentication, and an operating method and storage medium thereof.

2. Description of Related Art

[0003] In a wireless communication system, an electronic device (e.g., a user equipment (UE)) may access a wireless communication network to use a voice communication or data communication service at a predetermined location or during movement. In order to provide a communication service to an electronic device, an appropriate authentication process may be required. For example, a universal integrated circuit card (UICC) is inserted into the electronic device, and authentication may be performed between the electronic device and the server of a mobile network operator (MNO) through a universal subscriber identity module (USIM) installed inside the UICC. The UICC may be referred to as a subscriber identity module (SIM) card in a global system for mobile communications (GSM) scheme, and may be called a universal subscriber identity module (USIM) card in a wideband code division multiple access (WCDMA), long-term evolution (LTE), or new radio (NR) scheme.

[0004] A portable electronic device may include a storage medium such as a subscriber identity module (or a user authentication module card) or a memory card. The storage medium may be embedded into the electronic device or may be configured to be replaced and/or added easily by the user. For example, the electronic device may include a removable tray in the housing, and the storage medium may be coupled to the electronic device while being disposed on the tray.

[0005] When the user of the electronic device subscribes to the wireless communication service provided by the MNO, the MNO may provide the UICC (e.g., the SIM card or the USIM card) to the user and the user may insert the provided UICC into the electronic device. When the UICC is inserted into the electronic device, a USIM application installed in the UICC may be executed, and an appropriate authentication process using an international mobile subscriber identity (IMSI) value and an encryption key for authentication stored in the UICC may be performed with the server of the MNO storing the same values. After the appropriate authentication process, the wireless communication service may be used.

[0006] The information may be provided as the related art to help understanding of the disclosure. Any opinion or decision on whether the above-mentioned content can be applied as the prior art related to the disclosure has not been provided.

SUMMARY

[0007] According to an aspect of the disclosure, an electronic device includes: a communication circuit; a display; at least one processor including processing circuitry; and memory storing instructions that, when executed by the at least one processor individually or collectively, cause the electronic device to: display a lock screen for user authentication through the display based on an event for subscriber identity module (SIM) authentication being generated, acquire a personal identification number (PIN) for an SIM unlock based on acquisition of user authentication information for releasing the lock screen, identify whether the acquired PIN corresponds to a stored PIN, and perform the SIM unlock, based on identifying that the acquired PIN corresponds to the stored PIN.

[0008] The instructions, when executed by the at least one processor individually or collectively, cause the electronic device to: display a user interface for acquisition of the user authentication information through the display based on identification of an event for activating a SIM authentication function using an auto-generated PIN (AGP), acquire the user authentication information based on an input to the user interface for acquisition of the user authentication information, acquire identification information of the electronic device and identification information of the SIM based on user authentication being performed using the user authentication information, acquire a PIN for configuration of SIM authentication information based on (i) the identification information of the electronic device, (ii) the identification information of the SIM, and (iii) a random value, and store the PIN for configuration of the SIM authentication information.

[0009] The instructions, when executed by the at least one processor individually or collectively, cause the electronic device to: acquire the identification information of the electronic device and the identification information of the SIM based on acquistion of the user authentication information for releasing the lock screen, acquire the PIN for the SIM unlock based on (i) the identification information of the electronic device, (ii) the identification information of the SIM, and (iii) the random value, and establish a connection with a network through the communication circuit based on the PIN for the SIM unlock corresponding to the stored PIN.

[0010] The instructions, when executed by the at least one processor individually or collectively, cause the electronic device to: store, in the memory, an encrypted random value acquired using a key for encrypting the random value or decrypting the encrypted random value, acquire a decrypted random value by using the key on the encrypted random value based on acquisition of the user authentication information for releasing the lock screen, and acquire the PIN for the SIM unlock based on (i) the identification information of the electronic device, (ii) the identification information of the SIM, and (iii) the decrypted random value.

[0011] The instructions, when executed by the at least one processor individually or collectively, cause the electronic device to: identify whether the user authentication information for user authentication is configured based on identification of the event for activating an SIM authentication function using the PIN, display a user interface for configuration of the user authentication information through the display based on identifying that the user authentication information for user authentication is not configured, acquire the user authentication information based on an input to the user interface, and store the acquired user authentication information in the memory.

[0012] The instructions, when executed by the at least one processor individually or collectively, cause the electronic device to: display a user interface for acquisition of the user authentication information through the display based on acquisition of an input for displaying the stored PIN, acquire the user authentication information based on the input to the user interface, and display a user interface comprising the stored PIN through the display based on identifying that the acquired user authentication information corresponds to stored user authentication information.

[0013] The instructions, when executed by the at least one processor individually or collectively, cause the electronic device to: acquire, after displaying the user interface comprising the stored PIN, an updated PIN using a different random value generated from the random value, and configure the updated PIN as the PIN for the SIM unlock.

[0014] The instructions, when executed by the at least one processor (**240**) individually or collectively, cause the electronic device to: deactivate a function related to an SIM lock based on identificiation of an event for deactivating the SIM authentication function using the AGP, the function related to the SIM lock deactivated by changing the stored PIN to a configured value, display, while the function related to the SIM lock is deactivated, the user interface for acquisition of the user authentication information through the display based on identification of an event for activating the SIM authentication function using a manual PIN, acquire the user authentication information based on an input to the user interface, display a user interface for acquisition of the manual PIN through the display based on the user authentication information corresponding to the stored user authentication information, and configure the manual PIN acquired based on an input to the user interface for acquisition of the manual PIN as the PIN for the SIM unlock.

[0015] The instructions, when executed by the at least one processor individually or collectively, cause the electronic device to: display a user interface for acquisition of a PIN through the display, identify whether the PIN input to the user interface corresponds to the stored PIN, and perform an operation related to SIM lock based on identifying that the PIN acquired based on the input does not correspond to the stored PIN.

[0016] The identification information of the electronic device comprises an international mobile equipment identity (IMEI) of the electronic device, the identification information of the SIM comprises an integrated circuit card identifier (ICCID) of the SIM, and the instructions, when executed by the at least one processor individually or collectively, cause the electronic device to: input the IMEI, the ICCID, and the random value into a key derivation function to acquire the PIN for the SIM unlock based on information output from the key derivation function.

[0017] The instructions, when executed by the at least one processor individually or collectively, cause the electronic device to: start a timer for periodically updating the PIN based on acquisition of the PIN for the SIM unlock, acquire, based on elapse of a time interval corresponding to the timer, an updated PIN based on a different random value generated from the random value, and configure the updated PIN as the PIN for the SIM unlock.

[0018] The instructions, when executed by the at least one processor individually or collectively, cause the electronic device to: convert the acquired PIN into an encrypted PIN based on the acquired PIN corresponding to the stored PIN, and transmit the encrypted PIN to a cloud server through the communication circuit.

[0019] The event for an SIM authentication comprises an event of insertion of the SIM into the electronic device.

[0020] The event for the SIM authentication comprises an event of rebooting the electronic device.

[0021] According to an aspect of the disclosure, a method for operating an electronic device includes displaying a lock screen for user authentication through a display of the electronic device based on an event for subscriber identity module (SIM) authentication being generated; acquiring a personal identification number (PIN) for an SIM unlock based on acquiring user authentication information for releasing the lock screen; identifying whether the acquired PIN corresponds to a stored PIN; and performing the SIM unlock, based on identification that the acquired PIN corresponds to the stored PIN.

[0022] The method further includes displaying a user interface for acquisition of the user authentication information through the display based on identifying an event for activating a SIM authentication function using an auto-generated PIN (AGP); acquiring the user authentication information based on an input to the user interface; acquiring identification information of the electronic device and identification information of the SIM based on user authentication being performed using the user authentication information; acquiring a PIN for configuration of SIM authentication information based on (i) the identification information of the electronic device, (ii) the identification information of the SIM, and (iii) a random value; and storing the PIN for configuration of the SIM authentication information.

[0023] The acquiring of the PIN for the SIM unlock based on acquiring the user authentication information for releasing the lock screen, further includes: acquiring the identification information of the electronic device and the identification information of the SIM based on acquiring the user authentication information for releasing the lock screen; and acquiring the PIN for the SIM unlock based on (i) the identification information of the electronic device, (ii) the identification information of the SIM, and (iii) the random value, and the method further includes: establishing a connection with a network through a communication circuit of the electronic device, based on the PIN for the SIM unlock corresponding to the stored PIN.

[0024] The method further includes storing, in memory of the electronic device, an encrypted random value acquired using a key for encrypting the random value or decrypting the encrypted random value, the acquiring of the PIN for the SIM unlock based on the user authentication information for releasing the lock screen being acquired, further comprises: acquiring a decrypted random value by using the key on the encrypted random value based on the user authentication

information for releasing the lock screen being acquired; and acquiring the PIN for the SIM unlock based on (i) the identification information of the electronic device, (ii) the identification information of the SIM, and (iii) the decrypted random value.

[0025] The method further includes identifying whether the user authentication information for user authentication is configured based on identifying the event for activating an SIM authentication function using the PIN; displaying a user interface for configuration of the user authentication information through the display based on identifying that the user authentication information for the user authentication is not configured; acquiring the user authentication information, based on an input to the user interface for configuration of the user authentication information; and storing the acquired user authentication information in the memory of the electronic device.

[0026] According to an aspect of the disclosure, a non-transitory computer-readable storage medium recording computer-executable instructions, the computer-executable instructions, when executed by at least one processor including processing circuitry of an electronic device individually or collectively, causing the electronic device to: display a lock screen for user authentication through a display of the electronic device, based on an event for subscriber identity module (SIM) authentication being generated, acquire a personal identification number (PIN) for an SIM unlock, based on acquisition of user authentication information for releasing the lock screen, identify whether the acquired PIN corresponds to a stored PIN, and perform the SIM unlock, based on identifying that the acquired PIN corresponds to the stored PIN.

BRIEF DESCRIPTION OF THE DRAWINGS

[0027] The above and other aspects, features, and advantages of certain embodiments of the present disclosure will be more apparent from the following description taken in conjunction with the accompanying drawings, in which:

[0028] FIG. **1** is a block diagram of an electronic device within a network environment according to one or more embodiments.

[0029] FIG. **2** is a block diagram of the electronic device according to an embodiment.

[0030] FIG. **3** is a block diagram of a framework of the electronic device according to an embodiment.

[0031] FIG. **4** is a flowchart illustrating a method of performing SIM authentication by the electronic device according to an embodiment.

[0032] FIG. **5**A illustrates a method of performing SIM authentication by the electronic device according to an embodiment.

[0033] FIG. **5**B illustrates a method of performing SIM authentication by the electronic device according to an embodiment.

[0034] FIG. **6**A illustrates a method of configuring a SIM PIN by the electronic device according to an embodiment.

[0035] FIG. **6**B illustrates a method of configuring a SIM PIN by the electronic device according to an embodiment.

[0036] FIG. **7** is a flowchart illustrating a method of configuring the PIN of the electronic device according to an embodiment.

[0037] FIG. **8** illustrates a method of activating a SIM authentication function using the PIN by the electronic device according to an embodiment.

[0038] FIG. **9** is a flowchart illustrating a method of providing a stored PIN by the electronic device according to an embodiment.

[0039] FIG. **10** illustrates a method of providing the stored PIN by the electronic device according to an embodiment.

[0040] FIG. **11** is a flowchart illustrating a method of configuring the PIN by the electronic device according to an embodiment.

[0041] FIG. **12** illustrates a method of configuring the PIN by the electronic device according to an embodiment.

[0042] FIG. **13** is a flowchart illustrating a method of transmitting the PIN by the electronic device to a cloud server according to an embodiment.

[0043] FIG. **14** illustrates a method of activating a PIN management function through a cloud server by the electronic device according to an embodiment.

[0044] FIG. **15** illustrates a method of backing up or restoring the PIN through the cloud server by the electronic device according to an embodiment.

[0045] FIG. **16** illustrates a method of acquiring the PIN by the electronic device according to an embodiment.

[0046] FIG. **17** illustrates a method of performing SIM authentication by the electronic device according to an embodiment.

[0047] FIG. **18** illustrates a method of performing SIM authentication by using information acquired by another electronic device of the user of the electronic device according to an embodiment.

DETAILED DESCRIPTION

[0048] Various modifications may be made to the embodiments of the disclosure, and there may be various types of embodiments. Accordingly, specific embodiments will be illustrated in drawings, and the embodiments will be described in detail in the detailed description. However, it should be noted that the various embodiments are not for limiting the scope of the disclosure to a specific embodiment, but they should be interpreted to include various modifications, equivalents, and/or alternatives of the embodiments of the disclosure. Also, with respect to the detailed description of the drawings, similar components may be designated by similar reference numerals.

[0049] Also, in describing the disclosure, in case it is determined that detailed explanation of related known functions or features may unnecessarily confuse the gist of the disclosure, the detailed explanation will be omitted.

[0050] In addition, the embodiments described below may be modified in various different forms, and the scope of the technical idea of the disclosure is not limited to the embodiments below. Rather, these embodiments are provided to make the disclosure more sufficient and complete, and to fully convey the technical idea of the disclosure to those skilled in the art.

[0051] Also, the terms used in the disclosure are used only to explain specific embodiments, and are not intended to limit the scope of the disclosure. Further, singular expressions include plural expressions, unless defined obviously differently in the context.

[0052] In addition, in the disclosure, expressions such as "have," "may have," "include," and "may include" denote the existence of such characteristics (e.g.: elements such as numbers, functions, operations, and components), and do not exclude the existence of additional characteristics.

[0053] Also, in the disclosure, the expressions "A or B," "at least one of A and B," "at least one of A or B," or "one or more of A and/or B" and the like may include all possible combinations of the listed items. For example, "A or B," "at least one of A and B," or "at least one of A or B" may refer to all of the following cases: (1) including A, (2) including B, or (3) including A and B.

[0054] In addition, the expressions "first," "second," and the like used in the disclosure may describe various elements regardless of any order and/or degree of importance. Also, such expressions are used only to distinguish one element from another element, and are not intended to limit the elements.

[0055] Meanwhile, the description in the disclosure that one element (e.g.: a first element) is "(operatively or communicatively) coupled with/to" or "connected to" another element (e.g.: a second element) should be interpreted to include both the case where the one element is directly coupled to the another element, and the case where the one element is coupled to the another element through still another element (e.g.: a third element).

[0056] In contrast, the description that one element (e.g.: a first element) is "directly coupled" or "directly connected" to another element (e.g.: a second element) can be interpreted to mean that still another element (e.g.: a third element) does not exist between the one element and the another element.

[0057] Also, the expression "configured to" used in the disclosure may be interchangeably used with other expressions such as "suitable for," "having the capacity to," "designed to," "adapted to," "made to," and "capable of," depending on cases. Meanwhile, the term "configured to" may not necessarily mean that an apparatus is "specifically designed to" in terms of hardware.

[0058] Instead, under some circumstances, the expression "an apparatus configured to" may mean that the apparatus "is capable of" performing an operation together with another apparatus or component. For example, the phrase "a processor configured to perform A, B, and C" may mean a dedicated processor (e.g.: an embedded processor) for performing the corresponding operations, or a generic-purpose processor (e.g.: a CPU or an application processor) that can perform the corresponding operations by executing one or more software programs stored in a memory device.

[0059] Further, in the embodiments of the disclosure, 'a module' or 'a part' may perform at least one function or operation, and may be implemented as hardware or software, or as a combination of hardware and software. Also, a plurality of 'modules' or 'parts' may be integrated into at least one module and implemented as at least one processor, excluding 'a module' or 'a part' that needs to be implemented as specific hardware.

[0060] Meanwhile, various elements and areas in the drawings were illustrated schematically. Accordingly, the technical idea of the disclosure is not limited by the relative sizes or intervals illustrated in the accompanying drawings.

[0061] Hereinafter, embodiments of the disclosure will be described in detail with reference to the drawings so that those skilled in the art to which the disclosure pertains can easily implement the disclosure. However, the disclosure may be implemented in various forms and is not limited to embodiments set forth herein. With regard to the description of the drawings, the same or like reference signs may be used to designate the same or like elements. Also, in the drawings and the relevant descriptions, description of well-known functions and configurations may be omitted for the sake of clarity and brevity.

[0062] FIG. **1** is a block diagram illustrating an electronic device **101** in a network environment **100** according to various embodiments.

[0063] Referring to FIG. **1**, the electronic device **101** in the network environment **100** may communicate with an electronic device **102** via a first network **198** (e.g., a short-range wireless communication network), or at least one of an electronic device **104** or a server **108** via a second network **199** (e.g., a long-range wireless communication network). According to an embodiment, the electronic device **101** may communicate with the electronic device **104** via the server **108**. According to an embodiment, the electronic device **101** may include a processor **120**, memory **130**, an input module **150**, a sound output module **155**, a display module **160**, an audio module **170**, a sensor module **176**, an interface **177**, a connecting terminal **178**, a haptic module **179**, a camera module **180**, a power management module **188**, a battery **189**, a communication module **190**, a subscriber identification module (SIM) **196**, or an antenna module **197**. In some embodiments, at least one of the components (e.g., the connecting terminal **178**) may be omitted from the electronic device **101**, or one or more other components may be added in the electronic device **101**. In some embodiments, some of the components (e.g., the sensor module **176**, the camera module **180**, or the antenna module **197**) may be implemented as a single component (e.g., the display module **160**).

[0064] The processor **120** may execute, for example, software (e.g., a program **140**) to control at least one other component (e.g., a hardware or software component) of the electronic device **101** coupled with the processor **120**, and may perform various data processing or computation. According to one embodiment, as at least part of the data processing or computation, the processor **120** may store a command or data received from another component (e.g., the sensor module **176** or the communication module **190**) in volatile memory **132**, process the command or the data stored in the volatile memory **132**, and store resulting data in non-volatile memory **134**. According to an embodiment, the processor **120** may include a main processor **121** (e.g., a central processing unit (CPU) or an application processor (AP)), or an auxiliary processor **123** (e.g., a graphics processing unit (GPU), a neural processing unit (NPU), an image signal processor (ISP), a sensor hub processor, or a communication processor (CP)) that is operable independently from, or in conjunction with, the main processor **121**. For example, when the electronic device **101** includes the main processor **121** and the auxiliary processor **123**, the auxiliary processor **123** may be adapted to consume less power than the main processor **121**, or to be specific to a specified function. The auxiliary processor **123** may be implemented as separate from, or as part of the main processor **121**.

[0065] The auxiliary processor **123** may control at least some of functions or states related to at least one component (e.g., the display module **160**, the sensor module **176**, or the communication module **190**) among the components of the electronic device **101**, instead of the main processor **121** while the main processor **121** is in an inactive (e.g., sleep) state, or together with the main processor **121** while the main processor **121** is in an active state (e.g., executing an

application). According to an embodiment, the auxiliary processor **123** (e.g., an image signal processor or a communication processor) may be implemented as part of another component (e.g., the camera module **180** or the communication module **190**) functionally related to the auxiliary processor **123**. According to an embodiment, the auxiliary processor **123** (e.g., the neural processing unit) may include a hardware structure specified for artificial intelligence model processing. An artificial intelligence model may be generated by machine learning. Such learning may be performed, e.g., by the electronic device **101** where the artificial intelligence is performed or via a separate server (e.g., the server **108**). Learning algorithms may include, but are not limited to, e.g., supervised learning, unsupervised learning, semi-supervised learning, or reinforcement learning. The artificial intelligence model may include a plurality of artificial neural network layers. The artificial neural network may be a deep neural network (DNN), a convolutional neural network (CNN), a recurrent neural network (RNN), a restricted Boltzmann machine (RBM), a deep belief network (DBN), a bidirectional recurrent deep neural network (BRDNN), deep Q-network or a combination of two or more thereof but is not limited thereto. The artificial intelligence model may, additionally or alternatively, include a software structure other than the hardware structure.

[0066] The memory **130** may store various data used by at least one component (e.g., the processor **120** or the sensor module **176**) of the electronic device **101**. The various data may include, for example, software (e.g., the program **140**) and input data or output data for a command related thereto. The memory **130** may include the volatile memory **132** or the non-volatile memory **134**.

[0067] The program **140** may be stored in the memory **130** as software, and may include, for example, an operating system (OS) **142**, middleware **144**, or an application **146**.

[0068] The input module **150** may receive a command or data to be used by another component (e.g., the processor **120**) of the electronic device **101**, from the outside (e.g., a user) of the electronic device **101**. The input module **150** may include, for example, a microphone, a mouse, a keyboard, a key (e.g., a button), or a digital pen (e.g., a stylus pen).

[0069] The sound output module **155** may output sound signals to the outside of the electronic device **101**. The sound output module **155** may include, for example, a speaker or a receiver. The speaker may be used for general purposes, such as playing multimedia or playing record. The receiver may be used for receiving incoming calls. According to an embodiment, the receiver may be implemented as separate from, or as part of the speaker.

[0070] The display module **160** may visually provide information to the outside (e.g., a user) of the electronic device **101**. The display module **160** may include, for example, a display, a hologram device, or a projector and control circuitry to control a corresponding one of the display, hologram device, and projector. According to an embodiment, the display module **160** may include a touch sensor adapted to detect a touch, or a pressure sensor adapted to measure the intensity of force incurred by the touch.

[0071] The audio module **170** may convert a sound into an electrical signal and vice versa. According to an embodiment, the audio module **170** may obtain the sound via the input module **150**, or output the sound via the sound output module **155** or a headphone of an external electronic device (e.g., an electronic device **102**) directly (e.g., wiredly) or wirelessly coupled with the electronic device **101**.

[0072] The sensor module **176** may detect an operational state (e.g., power or temperature) of the electronic device **101** or an environmental state (e.g., a state of a user) external to the electronic device **101**, and then generate an electrical signal or data value corresponding to the detected state. According to an embodiment, the sensor module **176** may include, for example, a gesture sensor, a gyro sensor, an atmospheric pressure sensor, a magnetic sensor, an acceleration sensor, a grip sensor, a proximity sensor, a color sensor, an infrared (IR) sensor, a biometric sensor, a temperature sensor, a humidity sensor, or an illuminance sensor.

[0073] The interface **177** may support one or more specified protocols to be used for the electronic device **101** to be coupled with the external electronic device (e.g., the electronic device **102**) directly (e.g., wiredly) or wirelessly. According to an embodiment, the interface **177** may include, for example, a high definition multimedia interface (HDMI), a universal serial bus (USB) interface, a secure digital (SD) card interface, or an audio interface.

[0074] A connecting terminal **178** may include a connector via which the electronic device **101** may be physically connected with the external electronic device (e.g., the electronic device **102**). According to an embodiment, the connecting terminal **178** may include, for example, a HDMI connector, a USB connector, a SD card connector, or an audio connector (e.g., a headphone connector).

[0075] The haptic module **179** may convert an electrical signal into a mechanical stimulus (e.g., a vibration or a movement) or electrical stimulus which may be recognized by a user via his tactile sensation or kinesthetic sensation. According to an embodiment, the haptic module **179** may include, for example, a motor, a piezoelectric element, or an electric stimulator.

[0076] The camera module **180** may capture a still image or moving images. According to an embodiment, the camera module **180** may include one or more lenses, image sensors, image signal processors, or flashes.

[0077] The power management module **188** may manage power supplied to the electronic device **101**. According to one embodiment, the power management module **188** may be implemented as at least part of, for example, a power management integrated circuit (PMIC).

[0078] The battery **189** may supply power to at least one component of the electronic device **101**. According to an embodiment, the battery **189** may include, for example, a primary cell which is not rechargeable, a secondary cell which is rechargeable, or a fuel cell.

[0079] The communication module **190** may support establishing a direct (e.g., wired) communication channel or a wireless communication channel between the electronic device **101** and the external electronic device (e.g., the electronic device **102**, the electronic device **104**, or the server **108**) and performing communication via the established communication channel. The communication module **190** may include one or more communication processors that are operable independently from the processor **120** (e.g., the application processor (AP)) and supports a direct (e.g., wired) communication or a wireless communication. According to an embodiment, the communication module **190** may include a wireless communication module **192** (e.g., a cellular communication module, a short-range wire-

less communication module, or a global navigation satellite system (GNSS) communication module) or a wired communication module **194** (e.g., a local area network (LAN) communication module or a power line communication (PLC) module). A corresponding one of these communication modules may communicate with the external electronic device via the first network **198** (e.g., a short-range communication network, such as Bluetooth™, wireless-fidelity (Wi-Fi) direct, or infrared data association (IrDA)) or the second network **199** (e.g., a long-range communication network, such as a legacy cellular network, a 5G network, a next-generation communication network, the Internet, or a computer network (e.g., LAN or wide area network (WAN)). These various types of communication modules may be implemented as a single component (e.g., a single chip), or may be implemented as multi components (e.g., multi chips) separate from each other. The wireless communication module **192** may identify and authenticate the electronic device **101** in a communication network, such as the first network **198** or the second network **199**, using subscriber information (e.g., international mobile subscriber identity (IMSI)) stored in the subscriber identification module **196**.

[0080] The wireless communication module **192** may support a 5G network, after a 4G network, and next-generation communication technology, e.g., new radio (NR) access technology. The NR access technology may support enhanced mobile broadband (eMBB), massive machine type communications (mMTC), or ultra-reliable and low-latency communications (URLLC). The wireless communication module **192** may support a high-frequency band (e.g., the mmWave band) to achieve, e.g., a high data transmission rate. The wireless communication module **192** may support various technologies for securing performance on a high-frequency band, such as, e.g., beamforming, massive multiple-input and multiple-output (massive MIMO), full dimensional MIMO (FD-MIMO), array antenna, analog beam-forming, or large scale antenna. The wireless communication module **192** may support various requirements specified in the electronic device **101**, an external electronic device (e.g., the electronic device **104**), or a network system (e.g., the second network **199**). According to an embodiment, the wireless communication module **192** may support a peak data rate (e.g., 20 Gbps or more) for implementing eMBB, loss coverage (e.g., 164 dB or less) for implementing mMTC, or U-plane latency (e.g., 0.5 ms or less for each of downlink (DL) and uplink (UL), or a round trip of 1 ms or less) for implementing URLLC.

[0081] The antenna module **197** may transmit or receive a signal or power to or from the outside (e.g., the external electronic device) of the electronic device **101**. According to an embodiment, the antenna module **197** may include an antenna including a radiating element composed of a conductive material or a conductive pattern formed in or on a substrate (e.g., a printed circuit board (PCB)). According to an embodiment, the antenna module **197** may include a plurality of antennas (e.g., array antennas). In such a case, at least one antenna appropriate for a communication scheme used in the communication network, such as the first network **198** or the second network **199**, may be selected, for example, by the communication module **190** (e.g., the wireless communication module **192**) from the plurality of antennas. The signal or the power may then be transmitted or received between the communication module **190** and the external electronic device via the selected at least one antenna. According to an embodiment, another component (e.g., a radio frequency integrated circuit (RFIC)) other than the radiating element may be additionally formed as part of the antenna module **197**.

[0082] According to various embodiments, the antenna module **197** may form a mmWave antenna module. According to an embodiment, the mmWave antenna module may include a printed circuit board, a RFIC disposed on a first surface (e.g., the bottom surface) of the printed circuit board, or adjacent to the first surface and capable of supporting a designated high-frequency band (e.g., the mmWave band), and a plurality of antennas (e.g., array antennas) disposed on a second surface (e.g., the top or a side surface) of the printed circuit board, or adjacent to the second surface and capable of transmitting or receiving signals of the designated high-frequency band.

[0083] At least some of the above-described components may be coupled mutually and communicate signals (e.g., commands or data) therebetween via an inter-peripheral communication scheme (e.g., a bus, general purpose input and output (GPIO), serial peripheral interface (SPI), or mobile industry processor interface (MIPI)).

[0084] According to an embodiment, commands or data may be transmitted or received between the electronic device **101** and the external electronic device **104** via the server **108** coupled with the second network **199**. Each of the electronic devices **102** or **104** may be a device of a same type as, or a different type, from the electronic device **101**. According to an embodiment, all or some of operations to be executed at the electronic device **101** may be executed at one or more of the external electronic devices **102**, **104**, or **108**. For example, if the electronic device **101** should perform a function or a service automatically, or in response to a request from a user or another device, the electronic device **101**, instead of, or in addition to, executing the function or the service, may request the one or more external electronic devices to perform at least part of the function or the service. The one or more external electronic devices receiving the request may perform the at least part of the function or the service requested, or an additional function or an additional service related to the request, and transfer an outcome of the performing to the electronic device **101**. The electronic device **101** may provide the outcome, with or without further processing of the outcome, as at least part of a reply to the request. To that end, a cloud computing, distributed computing, mobile edge computing (MEC), or client-server computing technology may be used, for example. The electronic device **101** may provide ultra low-latency services using, e.g., distributed computing or mobile edge computing. In another embodiment, the external electronic device **104** may include an internet-of-things (IoT) device. The server **108** may be an intelligent server using machine learning and/or a neural network. According to an embodiment, the external electronic device **104** or the server **108** may be included in the second network **199**. The electronic device **101** may be applied to intelligent services (e.g., smart home, smart city, smart car, or healthcare) based on 5G communication technology or IoT-related technology.

[0085] FIG. **2** is a block diagram of the electronic device according to an embodiment.

[0086] Referring to FIG. **2**, in an embodiment, the electronic device **101** may be the electronic device **101** of FIG. **1**.

[0087] In an embodiment, the electronic device **101** may include a communication circuit **210**, a display **220**, memory **230**, and/or a processor **240**.

[0088] In an embodiment, the communication circuit **210** may be included in the communication module **190** of FIG. **1**.

[0089] In an embodiment, the display **220** may be included in the display module **160** of FIG. **1**. The display **220** may display a user interface associated with a configuration for SIM card security.

[0090] In an embodiment, the memory **230** may be included in the memory **130** of FIG. **1**.

[0091] In an embodiment, the memory **230** may store information for performing an operation of authenticating a subscriber identity module (SIM). For example, the memory **230** may store instructions for performing an operation of authenticating the SIM when executed by the processor **240**.

[0092] In an embodiment, the processor **240** may be included in the processor **120** of FIG. **1**.

[0093] In an embodiment, the processor **240** (e.g., a processor including "processing circuitry") may control the overall operation for authenticating the SIM. In an embodiment, the processor **240** may include one or more processors **240** for authenticating the SIM. For example, the processor **240** may correspond to a plurality of processors for performing a plurality of operations separately (or individually) or collectively between the processors **240**. The operation in which the processor **240** authenticates the SIM is described below in detail with reference to FIGS. **3** to **18**.

[0094] FIG. **2** illustrates that the electronic device **101** includes the communication circuit **210**, the display **220**, the memory **230**, and/or the processor **240**, but is not limited thereto. For example, the electronic device **101** may further include at least one element (e.g., the camera module **180**) among the one or more elements of the electronic device **101** illustrated in FIG. **1**. The electronic device **101** may be a portable electronic device capable of accommodating the SIM card. For example, the electronic device **101** may be a smartphone, a tablet, or a wearable electronic device (e.g., a smart watch or a video see-through (VST) device), but there is no limitation on a detailed example. As understood by one of ordinary skill in the art, the embodiments of the present disclosure are not limited to a single electronic device **101**. For example, the embodiments may be implemented on a distributed architecture that includes multiple processors. Furthermore, the embodiments may be implemented in which one or more tasks are split between the electronic device **101** and a server on a cloud.

[0095] FIG. **3** is a block diagram of a framework of the electronic device according to an embodiment.

[0096] In an embodiment, the framework **301** of the electronic device (e.g., the electronic device **101** of FIG. **2**) may include a plurality of modules. The plurality of modules may include, for example, an auto-generated PIN (AGP) module **310**, a SIM manager **330**, and/or a keystore **350**. The framework **301** may be implemented as at least a part of the operating system (e.g., the operating system **142** of FIG. **1**). In an embodiment, the plurality of modules included in the framework **301** (or framework layer) may be implemented in the form of an application, program, computer code, instructions, routines, processes, software, firmware, or a combination of at least two thereof that can be executed by a processor (e.g., the processor **240** of FIG. **2**). For example, when at least one or more modules of the AGP module **310**, the SIM manager **330**, and/or the keystore **350** are executed, the processor may perform an operation corresponding to each thereof. Accordingly, hereinafter, the expression of "a specific module performs an operation" may be understood that "the processor performs an operation corresponding to a specific module according to execution of the specific module." In an embodiment, at least some of the modules may include a plurality of programs but are not limited the above description. In an embodiment, modules and/or units may be implemented as services or applications when executed on the Android operating system, but there is no limitation thereon.

[0097] In an embodiment, the AGP module **310** may include an AGP key module **311** and an AGP service module **315**. In an embodiment, a function provided by the AGP module **310** may be implemented through a menu of a security service such as auto blocker.

[0098] In an embodiment, the AGP key module **311** may generate a PIN (or AGP) and store the generated PIN. The AGP key module **311** may collect information for generating the PIN. The AGP key module **311** may acquire identification information of the electronic device **101** and identification information of the SIM (e.g., the subscriber identity module **196** of FIG. **1**). The AGP key module **311** may generate a random value (or random) and encrypt the generated random value. The AGP key module **311** may store the encrypted random value. In one or more example, the AGP key module **311** may operate as a random number generator using a key as a seed to generate a random number.

[0099] In an embodiment, the AGP key module **311** may include a user equipment information collector **312**, a random value generation and storage unit **313**, and an AGP generator **314**. The UE information collector **312** may acquire a parameter for generating the PIN (e.g., AGP). The parameter for generating the PIN may include identification information of the electronic device **101** and identification information of the SIM. The UE information collector **312** may acquire identification information of the electronic device **101** from a system (e.g., an application programming interface (API) associated with system attributes or a system attribute menu). The identification information of the electronic device **101** may be, for example, a product serial number of the electronic device **101** or an international mobile equipment identity (IMEI). The IMEI may be a 15 digit unique code that identifies a mobile device and may be used for tracking, security, and network identification. However, the embodiments are not limited to these configurations and may include any suitable identity information known to one of ordinary skill in the art. The UE information collector **312** may acquire identification information of the SIM from a SIM PIN manager of the SIM. The identification information of the SIM may be an integrated circuit card identifier (ICCID) of the SIM, however, the embodiments are not limited to this configuration. The random value generation and storage unit **313** may generate a random value and store the generated random value. The random value generation and storage unit **313** may acquire a key for encrypting or decrypting the generated random value by the keystore **350** (e.g., a key generator **351**). The random value generation and storage unit **313** may encrypt the random value by using the key. The random value generation and storage unit **313** may store the encrypted random value in a secure storage (e.g., the memory **130** of FIG. **1**). When the PIN is generated by the AGP generator **314**, the random

value generation and storage unit **313** may decrypt the encrypted random value by using the key. The random value generation and storage unit **313** may acquire a random value from a parameter used to generate the PIN for SIM authentication, based on that information acquired by the UE information collector **312** can be exposed. The random value generation and storage unit **313** may generate a different PIN (e.g., AGP) whenever a random value is generated. The security may be improved in compared to the case where SIM unlock is performed based on a PIN for releasing a lock screen or a fixed SIM PIN. The AGP generator **314** may bind the identification information of the electronic device **101**, the identification information of the SIM, and the random value. "An operation of binding information" may correspond to an operation of "inputting information for generating a PIN." The AGP generator **314** may generate a PIN (e.g., AGP) by using a key derivation function such as a password-based key derivation function (PBKDF). The AGP generator **314** may provide the generated PIN to the SIM PIN storage unit of the SIM manager **330** so that the generated PIN is stored as the PIN of the SIM.

[0100] In an embodiment, the AGP service module **315** may compare the PIN (e.g., AGP') generated by the AGP key module **311** with the stored PIN (e.g., AGP). The AGP service module **315** may call a user interface corresponding to the comparison result. The AGP service module **315** may back up the PIN in a server (e.g., the server **108** of FIG. **1**), based on the comparison result or may restore the PIN from the server. The server may include, for example, a cloud server.

[0101] In an embodiment, the AGP service module **315** may include an AGP manager **316** and a communication unit **317**. The AGP manager **316** may identify whether SIM PIN authentication is required based on the generation of an event for SIM authentication. The event for SIM authentication may include, for example, a rebooting event of the electronic device **101**, an event of inserting (or attaching) the SIM into the electronic device **101**, or an event of removing the SIM from the electronic device **101**. However, the embodiments are not limited to these events where SIM authentication may be performed for any known events in which SIM authentication is suitable or appropriate. The AGP manager **316** may identify whether the SIM PIN has been authenticated. The AGP manager **316** may identify whether the stored PIN has expired based on validation of the stored PIN or based on that the stored PIN can be exposed. The AGP manager **316** may regenerate the PIN, based on identification that the stored PIN (or an expiration date of the AGP) has expired. The AGP manager **316** may provide the regenerated AGP to the SIM through the SIM manager **330** so that the PIN of the SIM is replaced by the regenerated AGP. The communication unit **317** may provide a function of backing up the generated PIN in the server (or cloud server) or restoring the PIN from the server. For example, the electronic device **101** may restore the PIN stored in the server, based on authentication of an account for the user of the electronic device **101**.

[0102] In an embodiment, the AGP generated by the AGP module **310** may be provided through a user interface (e.g., show APG UI). For example, when the user of the electronic device **101** desires to insert the SIM into another electronic device, the PIN which is stored in the electronic device **101** (or which can be accessed by the electronic device **101**) may be provided through the user interface. The stored PIN may be provided through the user interface, based on user authentication being performed.

[0103] FIG. **4** is a flowchart illustrating a method of performing SIM authentication by the electronic device according to an embodiment.

[0104] In the following embodiments, respective operations may be sequentially performed but the sequential performance is not necessary. For example, orders of the operations may be changed, and at least two operations may be performed in parallel.

[0105] According to an embodiment, operations **401** to **413** may be understood as being performed by a processor (e.g., the processor **240** of FIG. **2**) of an electronic device (e.g., the electronic device **101** of FIG. **2**).

[0106] Referring to FIG. **4**, in operation **401**, the electronic device **101** (e.g., the processor **240**) may display a lock screen, based on the generation of an event for SIM authentication in an embodiment. The event for SIM authentication may include, for example, a rebooting event of the electronic device **101**, an event of inserting (or attaching) a SIM (e.g., the subscriber identity module **196** of FIG. **1**) into the electronic device **101**, or an event of removing the SIM from the electronic device **101**, but there is no limitation. The lock screen may be a protection screen for receiving an input of user authentication information.

[0107] In operation **403**, in an embodiment, the electronic device **101** may acquire the PIN, based on user authentication information being acquired. The electronic device **101** may acquire user authentication information, based on an input to the lock screen. The electronic device **101** may perform user authentication, based on the user authentication information. The electronic device **101** may acquire the PIN, based on user authentication being completed. The electronic device **101** may acquire the PIN for SIM unlock, based on identification information of the electronic device **101**, identification information of the SIM, and a random value.

[0108] In operation **405**, in an embodiment, the electronic device **101** may identify whether the acquired PIN corresponds to the stored PIN. The electronic device **101** may identify whether the PIN (e.g., AGP') acquired based on the generation of the event for SIM authentication corresponds to pre-stored PIN (e.g., AGP). The electronic device **101** may compare, for example, an auto-generated PIN (AGP') acquired based on the generation of the event for SIM authentication with a pre-stored auto-generated PIN (AGP).

[0109] In an embodiment, based on the acquired PIN corresponding to the stored PIN (operation **405**—Yes), the electronic device **101** may perform SIM unlock in operation **407**. The electronic device **101** may establish, for example, the connection with the network. The electronic device **101** may perform operations that require establishment of the connection with the network of the MNO such as a call service, based on the SIM being unlocked. The electronic device **101** may provide a home screen, based on a lock screen being released according to user authentication information.

[0110] In an embodiment, the electronic device **101** may combine an authentication process based on the SIM PIN and an authentication process through a lock screen. In order to handle SIM swapping attack, the electronic device **101** may generate a PIN (e.g., AGP) by using a key derivation function such as a password-based key derivation function

(PBKDF), based on UE information of the user (e.g., IMEI), SIM information (e.g., ICCID), and random and replace SIM PIN authentication based on sequential inputs through a link with a lock screen function. The electronic device **101** may perform SIM unlock, based on the PIN comparison operation without sequentially receiving inputs of the SIM PIN and the user authentication information from the user. The user of the electronic device **101** may receive a service related to the SIM provided by the electronic device **101** in the state where the SIM unlock is completed based on only information for releasing the lock screen being input. The electronic device **101** may improve user experience by performing SIM unlock without two-factor authentication.

[0111] In an embodiment, based on identification that the acquired PIN does not correspond to the stored PIN (operation **405**—No), the electronic device **101** may display a user interface for acquiring the PIN in operation **409**. The electronic device **101** may display a user interface for acquiring the manual PIN, based on that the SIM unlock cannot be performed using the auto-generated PIN (AGP') acquired based on, for example, the event for SIM authentication being generated.

[0112] In operation **411**, in an embodiment, the electronic device **101** may identify whether the PIN identified based on the input corresponds to the stored PIN. The electronic device **101** may receive the input of the PIN provided by, for example, another electronic device (e.g., an electronic device operating based on the same user account as that of the electronic device **101**) or the cloud server. The electronic device **101** may identify whether the PIN corresponding to the input corresponds to the stored PIN.

[0113] In an embodiment, based on identification that the PIN identified based on the input corresponds to the stored PIN (operation **411**—Yes), the electronic device **101** may perform SIM unlock in operation **407**. Based on identification that the PIN identified based on the input does not correspond to the stored PIN (operation **411**—No), the electronic device **101** may perform SIM lock in operation **413**. When the SIM authentication fails, the electronic device **101** may improve the security of the SIM by performing the operation related to the SIM lock if SIM swapping attack is attempted.

[0114] FIGS. **5**A and **5**B illustrate a method of performing SIM authentication by an electronic device according to an embodiment.

[0115] Referring to FIG. **5**A, in an embodiment, the electronic device **101** may identify an event for SIM authentication. The electronic device **101** may identify the generation of, for example, an event of inserting (or attaching) a SIM (e.g., the subscriber identity module **196** of FIG. **1**) into the electronic device **101** as indicated by reference numeral **511**. The event for SIM authentication is not limited to the example of FIG. **5**A. For example, the event for SIM authentication may be a rebooting event of the electronic device **101**. In one or more examples, a rebooting event may occur when a device is restarted without turning on or off the device. In one or more examples, a rebooting event may occur when a device is turned off and then back on. In one or more examples a rebooting event may occur when a device is turned off for a predetermined amount of time and then turned back on. The electronic device **101** may acquire identification information of the electronic device **101** and identification information of the SIM, based on the event for SIM authentication as indicated by reference numeral **521**. The electronic device **101** may acquire a random value to improve the security of the PIN for performing SIM authentication. The electronic device **101** may encrypt the random value or pre-store the encrypted random value acquired using a key for decrypting the encrypted random value. The electronic device **101** may acquire the encrypted random value by using the key, based on the event for SIM authentication being identified. The electronic device **101** may acquire the PIN for SIM unlock, based on the identification information of the electronic device **101**, the identification information of the SIM, and the decrypted random value. The electronic device **101** may acquire the PIN (e.g., AGP') for SIM unlock, based on information **533** output from the key derivation function, by inputting, for example, a parameter for generating the AGP into the key derivation function as indicated by reference numeral **531**. The electronic device **101** may identify whether the acquired PIN corresponds to the stored PIN (e.g., AGP) as indicated by **551**, based on the PIN for SIM unlock being acquired as indicated by reference numeral **541**. The electronic device **101** may provide user interfaces **560** and **570** corresponding to the comparison result between the acquired PIN and the stored PIN.

[0116] Referring to FIG. **5**B, when the PIN (e.g., AGP') acquired based on the generation of the SIM authentication event corresponds to the stored PIN (e.g., AGP), the electronic device **101** may provide the lock screen **570**. The electronic device **101** may perform SIM unlock, based on the lock screen **570** only being performed based on user authentication information. For example, the electronic device **101** may establish the connection with the network, based on the PIN for SIM unlock corresponding to the stored PIN. When the PIN (e.g., AGP') acquired based on the generation of the SIM authentication event does not correspond to the stored PIN (e.g., AGP), the electronic device **101** may provide the screen **560** for receiving an input of the SIM PIN. The electronic device **101** may provide the lock screen **570**, based on the input of the SIM PIN being received as indicated by reference numeral **561**. When the AGP-based SIM authentication fails, the electronic device **101** may perform SIM unlock, based on SIM PIN authentication and lock screen authentication being sequentially performed. The PIN that requires the input during SIM PIN authentication may be a value corresponding to the pre-generated AGP. When the AGP-based SIM authentication fails, the input of the value corresponding to the AGP generated based on a random value is required, and thus, security of the SIM authentication may be improved.

[0117] FIGS. **6**A and **6**B illustrate a method of configuring a SIM PIN by the electronic device according to an embodiment.

[0118] Referring to FIG. **6**A, in an embodiment, the electronic device **101** may display a user interface **610** associated with a configuration for SIM card security through a display (e.g., the display **220** of FIG. **2**). The user interface **610** associated with the configuration for SIM card security may include a window **611** for security functions such as a SIM lock function, a change in the PIN of the SIM card, personalization of the USIM, or a change in the password. The SIM lock function may be referred to as a "SIM card lock function." The electronic device **101** may identify an event for activating the SIM lock function. The electronic device **101** may identify, for example, a touch event for an object **613** related to the SIM lock function (e.g., event where user explicitly activates the SIM lock function). The

electronic device **101** may provide a user interface **620** for receiving an input of the SIM PIN, based on the event for activating the SIM lock function being identified as indicated by reference numeral **615**. The electronic device **101** may display masked numbers or characters in a partial area **621** of the user interface **620**, based on an input on a keypad **623** included in the user interface **620**. The electronic device **101** may identify whether the input SIM PIN corresponds to an initially configured PIN, based on the touch event for an OK object **625**. The electronic device **101** may display a user interface **630** indicating activation of the SIM lock function, based on the input SIM PIN corresponding to the initially configured PIN being identified as indicated by reference numeral **627**. The user interface **630** may include an object **631** indicating activation of the SIM lock function. The electronic device **101** may identify a touch event for an object **633** related to a function of changing a SIM card PIN. The electronic device **101** may display a user interface **640** for receiving an input of the SIM PIN, based on the input on the object **633** being identified as indicated by reference numeral **635**.

[0119] Referring to FIG. **6**B, the user interface **640** may include a window **641** making a request for inputting the current SIM PIN. The electronic device **101** may identify whether the SIM PIN identified based on the input on the keypad object **623** corresponds to the current SIM PIN. The electronic device **101** may display a user interface **650** for receiving an input of a new SIM PIN, based on the input SIM PIN corresponding to the current SIM PIN being identified as indicated by reference numeral **643**. The user interface **650** may include a window **651** making a request for inputting the new SIM PIN. The electronic device **101** may acquire the new SIM PIN, based on the input on the keypad object **623** as indicated by reference numeral **653**. The electronic device **101** may store the new SIM PIN and display a user interface **660** including a message **661** indicating that the SIM PIN has successfully changed. In an embodiment, as illustrated in FIGS. **6**A and **6**B, when SIM authentication is performed based on the initially configured PIN or the PIN changed by the user, SIM PIN authentication and lock screen authentication may be sequentially performed.

[0120] FIG. **7** is a flowchart illustrating a method of configuring the PIN by the electronic device according to an embodiment.

[0121] In the following embodiments, respective operations may be sequentially performed but the sequential performance is not necessary. For example, orders of the operations may be changed, and at least two operations may be performed in parallel.

[0122] According to an embodiment, operations **701** to **717** may be understood as being performed by a processor (e.g., the processor **240** of FIG. **2**) of an electronic device (e.g., the electronic device **101** of FIG. **2**).

[0123] Referring to FIG. **7**, in operation **701**, the electronic device **101** (e.g., the processor **240**) may identify an event for activating a SIM authentication function using an auto-generated PIN (AGP) in an embodiment.

[0124] In operation **703**, in an embodiment, the electronic device **101** may identify whether user authentication information is configured. The electronic device **101** may identify whether the user authentication information is configured based on high security being required for the SIM authentication function using the auto-generated PIN. The user authentication information may include information for releasing the lock screen. The user authentication information may include, for example, user authentication such as 3P (e.g., PIN, password, or pattern), but there is no limitation. The configuration of the user authentication information may be a configuration of the lock screen (or activation of the lock screen function).

[0125] In an embodiment, based on identification that user authentication information is configured (operation **703**—Yes), the electronic device **101** may display a user interface for acquiring the user authentication information in operation **705**. In operation **707**, in an embodiment, the electronic device **101** may acquire the user authentication information.

[0126] In operation **709**, in an embodiment, the electronic device **101** may acquire a PIN. The electronic device **101** may acquire identification information of the electronic device **101** and identification information of the SIM, based on user authentication using the user authentication information being performed. The electronic device **101** may collect information for acquiring an AGP, based on the user authentication information corresponding to stored user authentication information being identified. The electronic device **101** may acquire the PIN for configuring SIM authentication information, based on the identification information of the electronic device **101**, the identification information of the SIM, and a random value. In operation **711**, in an embodiment, the electronic device **101** may store the PIN. The electronic device **101** may store the PIN for configuring SIM authentication information.

[0127] In an embodiment, based on identification that the user authentication information is not configured (operation **703**—No), the electronic device **101** may display a user interface for configuring the user authentication information in operation **713**. In operation **715**, in an embodiment, the electronic device **101** may acquire the user authentication information. The electronic device **101** may acquire the user authentication information, based on an input to the user interface. In operation **717**, in an embodiment, the electronic device **101** may store the user authentication information. The electronic device **101** may acquire the PIN for SIM authentication based on the AGP, based on the user authentication information being stored.

[0128] FIG. **8** illustrates a method of activating a SIM authentication function using the PIN by the electronic device according to an embodiment.

[0129] Referring to FIG. **8**, the electronic device **101** may display a user interface **810** including objects **811** and **813** related to an AGP function. The electronic device **101** may display a user interface **820** including a window **821** asking an input of the SIM PIN, based on an input on the object **811** indicating whether to activate the AGP function being identified as indicated by reference numeral **815**. The electronic device **101** may acquire the AGP, based on the current SIM PIN being received as indicated by reference numeral **821**. The electronic device **101** may acquire a PIN for configuring SIM authentication information, based on information including identification information of the electronic device **101**, identification information of the SIM, and a random value being input as indicated by reference numeral **831**. The electronic device **101** may configure the acquired AGP as the SIM PIN corresponding to the SIM (e.g., the subscriber identity module **196** of FIG. **1**) as indicated by reference numeral **841**, based on the acquired PIN being stored as indicated by reference numeral **835**. The electronic

device **101** may display a user interface **850** including an object **853** indicating that the AGP function (or menu) has been activated, based on SIM authentication information based on the AGP being configured as indicated by reference numeral **843**. In the user interface **850**, the object **851** for configuring or changing the SIM card PIN may be processed to be dim.

[0130] FIG. **9** is a flowchart illustrating a method of providing a stored PIN by the electronic device according to an embodiment.

[0131] In the following embodiments, respective operations may be sequentially performed but the sequential performance is not necessary. For example, orders of the operations may be changed, and at least two operations may be performed in parallel.

[0132] According to an embodiment, operations **901** to **909** may be understood as being performed by a processor (e.g., the processor **240** of FIG. **2**) of an electronic device (e.g., the electronic device **101** of FIG. **2**).

[0133] Referring to FIG. **9**, in operation **901**, the electronic device **101** (e.g., the processor **240**) may acquire an input for displaying a stored PIN in an embodiment. For example, when the user of the electronic device **101** desires to change the device for accommodating the SIM into a new electronic device, the stored PIN may be identified using the electronic device **101**.

[0134] In operation **903**, in an embodiment, the electronic device **101** may display a user interface for acquiring user authentication information. The electronic device **101** may identify whether to display the AGP, based on the user authentication information in order to reduce risk that the PIN (e.g., AGP) is exposed to others other than the user.

[0135] In operation **905**, in an embodiment, the electronic device **101** may acquire the user authentication information. In operation **907**, in an embodiment, the electronic device **101** may identify whether user authentication is completed. The electronic device **101** may identify whether the acquired user authentication information corresponds to the stored user authentication information. In an embodiment, based on identification that the user authentication is not completed (operation **907**—No), the electronic device **101** may display the user interface for acquiring the user authentication information in operation **903**.

[0136] In an embodiment, based on identification that the user authentication is completed (operation **907**—Yes), the electronic device **101** may display a user interface including the stored PIN in operation **909**. The electronic device **101** may display the stored PIN (e.g., AGP), based on identification that the acquired user authentication information corresponds to the stored user authentication information.

[0137] FIG. **10** illustrates a method of providing the stored PIN by the electronic device according to an embodiment.

[0138] Referring to FIG. **10**, the electronic device **101** may display a user interface **1010** including an object **1011** for displaying an AGP. The electronic device **101** may acquire user authentication information **1021**, based on identification that an input on the object **1011** being identified as indicated by reference numeral **1013**. FIG. **10** illustrates that the user authentication information may be a fingerprint, but there is no limitation. The electronic device **101** may identify whether the acquired user authentication information **1021** corresponds to the stored user authentication information. The electronic device **101** may display a user interface **1030** including the AGP (or code indicating the AGP) **1031**, based on identification that the acquired user authentication information **1021** corresponds to the stored user authentication information as indicated by reference numeral **1023**. The user interface **1030** may display a message **1033** indicating that the code indicating the AGP can be changed.

[0139] In an embodiment, after displaying the user interface **1030** including the stored PIN, the electronic device **101** may acquire an updated PIN, based on a random value different from the random value corresponding to the stored PIN. The electronic device **101** may acquire the updated PIN by using the different random value, based on that a different AGP can be acquired depending on the random value for generating the AGP. The electronic device **101** may configure the updated PIN as the PIN for SIM unlock. The electronic device **101** may improve security by updating the PIN after providing the user interface **1030** including the stored PIN (or code indicating the AGP) without sequential touches for changing the PIN by the user.

[0140] In an embodiment, the electronic device **101** may periodically update the PIN. The electronic device **101** may initiate a timer for periodically updating the PIN, based on the PIN for SIM unlock being acquired. The electronic device **101** may acquire the updated PIN, based on a random value different from the random value corresponding to the stored PIN, based on the lapse of a time interval corresponding to the timer. The electronic device **101** may configure the updated PIN as the PIN for SIM unlock.

[0141] FIG. **11** is a flowchart illustrating a method of configuring the PIN by the electronic device according to an embodiment.

[0142] In the following embodiments, respective operations may be sequentially performed but the sequential performance is not necessary. For example, orders of the operations may be changed, and at least two operations may be performed in parallel.

[0143] According to an embodiment, operations **1101** to **1113** may be understood as being performed by a processor (e.g., the processor **240** of FIG. **2**) of an electronic device (e.g., the electronic device **101** of FIG. **2**).

[0144] Referring to FIG. **11**, in operation **1101**, the electronic device **101** (e.g., the processor **240**) may identify an event for deactivating a SIM authentication function using an AGP in an embodiment.

[0145] In operation **1103**, in an embodiment, the electronic device **101** may deactivate a function related to SIM lock. The electronic device **101** may deactivate the function related to SIM lock by changing the stored PIN into a configured value, based on the event for deactivating the SIM authentication function using an auto-generated PIN being identified. The operation of changing the stored PIN into the configured value may include an operation of removing (or discarding) the stored PIN or an operation of changing the stored PIN into a null value. The electronic device **101** may also deactivate the SIM lock function, based on the event for deactivating the SIM authentication function using the AGP being identified.

[0146] In operation **1105**, in an embodiment, the electronic device **101** may identify an event for activating the SIM authentication function using a manual PIN. The electronic device **101** may display a user interface for acquiring user authentication information through a display (e.g., the display **220** of FIG. **2**), based on the event for activating the SIM authentication function using the manual PIN being identified while the function related to SIM lock is deacti-

vated. The electronic device **101** may identify, for example, the event for activating the function related to SIM lock. In operation **1107**, in an embodiment, the electronic device **101** may perform user authentication. The electronic device **101** may activate the function related to the SIM lock after performing user authentication, based on a high security level being required for the function related to the SIM lock. The electronic device **101** may acquire user authentication information. The electronic device **101** may identify whether the acquired user authentication information corresponds to the stored user authentication information. The electronic device **101** may identify that user authentication is completed based on identification that the acquired user authentication information corresponds to the stored user authentication information.

[0147] In operation **1109**, in an embodiment, the electronic device **101** may display the user interface for acquiring the manual PIN. In operation **1111**, in an embodiment, the electronic device **101** may acquire the manual PIN, based on an input to the user interface for acquiring the manual PIN. In operation **1113**, in an embodiment, the electronic device **101** may configure the manual PIN as a PIN for SIM unlock.

[0148] FIG. **12** illustrates a method of configuring the PIN by the electronic device according to an embodiment.

[0149] Referring to FIG. **12**, in an embodiment, the electronic device **101** may identify an event for deactivating a SIM authentication function using an AGP, based on an input to a user interface **1210** related to a configuration for SIM card security. The electronic device **101** may deactivate both the SIM authentication function using AGP and the SIM lock function, based on an input on an object **1211** related to the SIM authentication function using AGP being identified as indicated by reference numeral **1213**. A user interface **1220** may include objects **1221** and **1223** indicating that both the SIM authentication function using the AGP and the SIM lock function have been deactivated. The electronic device **101** may display a user interface **1230** including a window **1231** asking an input of an initially configured PIN, based on an input on the object **1223** related to the SIM lock function being identified as indicated by reference numeral **1225**. The electronic device **101** may activate the SIM lock function, based on identification that the input PIN corresponds to the configured PIN as indicated by reference numeral **1233**. The user interface **1240** may include an object **1241** indicating activation of the SIM lock function.

[0150] FIG. **13** is a flowchart illustrating a method of transmitting the PIN to a cloud server by the electronic device according to an embodiment.

[0151] In the following embodiments, respective operations may be sequentially performed but the sequential performance is not necessary. For example, orders of the operations may be changed, and at least two operations may be performed in parallel.

[0152] According to an embodiment, operations **1301** to **1313** may be understood as being performed by a processor (e.g., the processor **240** of FIG. **2**) of an electronic device (e.g., the electronic device **101** of FIG. **2**).

[0153] Referring to FIG. **13**, in operation **1301**, the electronic device **101** (e.g., the processor **240**) may identify an event for SIM authentication in an embodiment. The event for SIM authentication may include a rebooting event of the electronic device **101**, an event for inserting (or attaching) a SIM into the electronic device **101**, or an event for removing the SIM from the electronic device **101**, but there is no limitation.

[0154] In operation **1303**, in an embodiment, the electronic device **101** may acquire a PIN, based on the event for SIM authentication being identified. The electronic device **101** may acquire the PIN for SIM unlock, based on identification information of the electronic device **101**, identification information of the SIM, and a random value. In operation **1305**, in an embodiment, the electronic device **101** may identify whether the acquired PIN corresponds to the stored PIN. The electronic device **101** may identify whether the acquired PIN (e.g., AGP') corresponds to the configured PIN (e.g., AGP) based on the event for SIM authentication being identified. In an embodiment, based on identification that the acquired PIN does not correspond to the stored PIN (operation **1305**—No), the electronic device may perform a SIM lock in operation **1307**. The electronic device **101** may improve security by performing the SIM lock when the SIM authentication based on the AGP fails.

[0155] In an embodiment, based on identification that the acquired PIN corresponds to the stored PIN (operation **1305**—Yes), the electronic device may perform SIM unlock in operation **1309**.

[0156] In operation **1311**, in an embodiment, the electronic device **101** may convert the acquired PIN into an encrypted PIN. The electronic device **101** may encrypt the acquired PIN so as to transmit the PIN through the network. In operation **1313**, in an embodiment, the electronic device **101** may transmit the encrypted PIN to the cloud server. The electronic device **101** may restore a PIN (or identification information of a SIM identified from the PIN) transmitted from another electronic device, based on a user account.

[0157] FIG. **14** illustrates a method of activating a PIN management function through a cloud server by the electronic device according to an embodiment.

[0158] Referring to FIG. **14**, the electronic device **101** may display a user interface **1410** including a window **1411** related to a function of sharing information with another electronic device through the cloud server. The electronic device **101** may transmit the acquired AGP (or encrypted AGP) to the cloud server, based on an input on an object **1413** indicating whether to activate a backup function of the AGP using the cloud.

[0159] FIG. **15** illustrates a method of backing up or restoring the PIN through the cloud server by the electronic device according to an embodiment.

[0160] Referring to FIG. **15**, a first electronic device **1501** may acquire a first AGP as indicated by reference numeral **1513**, based on an input parameter **1511** including identification information of the first electronic device **1501**, identification information of the SIM, and a first random value. The electronic device **101** may transmit the AGP to the cloud server **1520** as indicated by reference numeral **1515**, based on the backup function of the AGP of FIG. **14** being activated. The electronic device **101** may transmit, for example, an encrypted AGP to the could server **1520**. The operation of transmitting the encrypted AGP to the cloud server may be referred to as an operation of "performing end-to-end encrypted (E2EE) key backup." After removing the SIM from the first electronic device **1501**, a user of the first electronic device **1501** may insert the SIM into a new electronic device. For example, the SIM of the user may be inserted into a second electronic device **1530**. The second

electronic device **1530** may perform SIM authentication, based on information related to SIM authentication being received from the cloud server **1520** as indicated by reference numeral **1531** without manually receiving an input of the SIM PIN. The operation of receiving information related to SIM authentication from the cloud may be referred to as an operation of "performing end-to-end encrypted (E2EE) key restore."

[0161] In an embodiment, the second electronic device **1530** may receive the encrypted AGP. The second electronic device **1530** may acquire the AGP, based on decryption of the encrypted AGP. The second electronic device **1530** may acquire identification information of the second electronic device **1530**, identification information of the SIM, and a second random value as indicated by reference numeral **1533**, based on the acquired AGP. The second electronic device **1530** may acquire a second AGP as indicated by reference numeral **1537**, based on an input parameter **1535** including the identification information of the second electronic device **1530**, the identification information of the SIM, and the second random value. The second electronic device **1530** may receive information configured by the cloud server **1520** as well as the AGP from the cloud server **1520**.

[0162] FIG. **16** illustrates a method of acquiring the PIN by the electronic device according to an embodiment.

[0163] Referring to FIG. **16**, in an embodiment, the UE information collector **312** may collect identification information of the electronic device **101** and identification information of a SIM (e.g., the subscriber identity module **196** of FIG. **1**). The electronic device **101** may perform lock screen authentication, based on an event for activating an AGP function being identified. The UE information collector **312** may collect the identification information of the electronic device **101** and the identification information of the SIM, based on lock screen authentication being performed.

[0164] The random value generation and storage unit **313** may generate a random value and encrypt the generated random value. The random value generation and storage unit **313** may encrypt the random value by using a key provided by the keystore **350**. The random value generation and storage unit **313** may store the encrypted random value in a secure storage.

[0165] The AGP generator **314** may bind the identification information of the electronic device, the identification information of the SIM, and the random value. The AGP generator **314** may generate an AGP by using a PBKDF. The AGP generator **314** may transfer the generated AGP to the SIM. The AGP generator **314** may configure the generated AGP as a SIM PIN corresponding to the SIM.

[0166] FIG. **17** illustrates a method of performing SIM authentication by the electronic device according to an embodiment.

[0167] Referring to FIG. **17**, in an embodiment, the random value generation and storage unit **313** may acquire an encrypted random value from the secure storage (e.g., memory **130**), based on an event for SIM authentication being identified. The random value generation and storage unit **313** may decrypt the encrypted random value by using the key provided by the keystore **350**.

[0168] The UE information collector **312** may bind identification information of the electronic device **101**, identification information of a SIM (e.g., the subscriber identity module **196** of FIG. **1**), and a random value. The AGP generator **314** may generate an AGP' by using a PBKDF. The AGP manager **316** may compare the generated AGP' with the stored AGP. The AGP manager **316** may complete SIM unlock, based on identification that the generated AGP' corresponds to the stored AGP. The SIM manager **330** may provide a SIM PIN screen, based on that the generated AGP' does not correspond to the stored AGP. The SIM manager **330** may identify whether the input value corresponds to the AGP. The SIM manager **330** may complete SIM unlock, based on identification that the input value corresponds to the AGP. The SIM manager **330** may perform SIM lock, based on identification that the input value does not correspond to the AGP.

[0169] FIG. **18** illustrates a method of performing SIM authentication by using information acquired by another electronic device of the user of the electronic device according to an embodiment.

[0170] Referring to FIG. **18**, in an embodiment, the random value generation and storage unit **313** may acquire an encrypted random value from the secure storage (e.g., memory **130**), based on an event for SIM authentication being identified. The random value generation and storage unit **313** may decrypt the encrypted random value by using the key provided by the keystore **350**.

[0171] The UE information collector **312** may bind identification information of the electronic device **101**, identification information of a SIM (e.g., the subscriber identity module **196** of FIG. **1**), and a random value. The AGP generator **314** may generate an AGP' by using a PBKDF. The AGP manager **316** may compare the generated AGP' with the stored AGP. The AGP manager **316** may complete SIM unlock, based on identification that the generated AGP' corresponds to the stored AGP. The SIM manager **330** may provide a SIM PIN screen, based on that the generated AGP' does not correspond to the stored AGP. In an embodiment, the user of the electronic device **101** may identify the AGP value by using another electronic device **1501** into which the SIM was previously inserted. For example, the user may acquire an AGP" from the other electronic device by using a show AGP function. The electronic device **101** may receive an input of the AGP" from the user. The electronic device **101** may receive the AGP" from the other electronic device **1501**. The SIM manager **330** may identify whether the input AGP" corresponds to the AGP. The SIM manager **330** may complete SIM unlock, based on identification that the AGPP" corresponds to the AGP. The SIM manager **330** may perform SIM lock, based on identification that the AGP" does not correspond to the AGP.

[0172] An electronic device (e.g., the electronic device **101** of FIG. **2**) according to an embodiment may include a communication circuit (e.g., the communication circuit **210** of FIG. **2**). The electronic device **101** may include a display (e.g., the display **220** of FIG. **2**). The electronic device **101** may include at least one processor (e.g., the processor **240** of FIG. **2**) including processing circuitry. The electronic device **101** may include memory (e.g., the memory **230** of FIG. **2**) storing instructions. The instructions, when executed by the at least one processor **240** individually or collectively, may cause the electronic device **101** to display a lock screen for user authentication through the display **220**, based on an event for subscriber identity module (SIM) authentication being generated. The instructions, when executed by the at least one processor **240** individually or collectively, may cause the electronic device **101** to acquire a personal iden-

tification number (PIN) for SIM unlock, based on user authentication information for releasing the lock screen being acquired. The instructions, when executed by the at least one processor **240** individually or collectively, may cause the electronic device **101** to identify whether the acquired PIN corresponds to a stored PIN. The instructions, when executed by the at least one processor **240** individually or collectively, may cause the electronic device **101** to perform the SIM unlock, based on identification that the acquired PIN corresponds to the stored PIN.

[0173] In an embodiment, instructions, when executed by the at least one processor **240** individually or collectively, may cause the electronic device **101** to display a user interface for acquiring user authentication information through the display **220**, based on an event for activating a SIM authentication function using an auto-generated PIN (AGP) being identified. The instructions, when executed by the at least one processor **240** individually or collectively, may cause the electronic device **101** to acquire the user authentication information, based on an input to the user interface. The instructions, when executed by the at least one processor **240** individually or collectively, may cause the electronic device **101** to acquire identification information of the electronic device **101** and identification information of the SIM, based on user authentication being performed using the user authentication information. The instructions, when executed by the at least one processor **240** individually or collectively, may cause the electronic device **101** to acquire a PIN for configuring SIM authentication information, based on the identification information of the electronic device **101**, the identification information of the SIM, and a random value. The instructions, when executed by the at least one processor **240** individually or collectively, may cause the electronic device **101** to store the PIN for configuring the SIM authentication information.

[0174] In an embodiment, instructions, when executed by the at least one processor **240** individually or collectively, may cause the electronic device **101** to acquire the identification information of the electronic device **101** and the identification information of the SIM, based on the user authentication information for releasing the lock screen being acquired. The instructions, when executed by the at least one processor **240** individually or collectively, may cause the electronic device **101** to acquire the PIN for the SIM unlock, based on the identification information of the electronic device **101**, the identification information of the SIM, and the random value. The instructions, when executed by the at least one processor **240** individually or collectively, may cause the electronic device **101** to establish a connection with a network through the communication circuit **210**, based on the PIN for the SIM unlock corresponding to the stored PIN.

[0175] In an embodiment, instructions, when executed by the at least one processor **240** individually or collectively, may cause the electronic device **101** to store, in the memory **230** of the electronic device **101**, an encrypted random value acquired using a key for encrypting the random value or decrypting the encrypted random value. The instructions, when executed by the at least one processor **240** individually or collectively, may cause the electronic device **101** to acquire the decrypted random value by using the key, based on the user authentication information for releasing the lock screen being acquired. The instructions, when executed by the at least one processor **240** individually or collectively, may cause the electronic device **101** to acquire the PIN for the SIM unlock, based on the identification information of the electronic device **101**, the identification information of the SIM, and the decrypted random value.

[0176] In an embodiment, instructions, when executed by the at least one processor **240** individually or collectively, may cause the electronic device **101** to identify whether user authentication information for user authentication is configured based on the event for activating the SIM authentication function using the PIN being identified. The instructions, when executed by the at least one processor **240** individually or collectively, may cause the electronic device **101** to display a user interface for configuring the user authentication information through the display **220**, based on identification that the user authentication information for the user authentication is not configured. The instructions, when executed by the at least one processor **240** individually or collectively, may cause the electronic device **101** to acquire the user authentication information, based on an input to the user interface. The instructions, when executed by the at least one processor **240** individually or collectively, may cause the electronic device **101** to store the acquired user authentication information in the memory **230**.

[0177] In an embodiment, the instructions, when executed by the at least one processor **240** individually or collectively, may cause the electronic device **101** to display a user interface for acquiring user authentication information through the display **220**, based on an input for displaying the stored PIN being acquired. The instructions, when executed by the at least one processor **240** individually or collectively, may cause the electronic device **101** to acquire the user authentication information, based on an input to the user interface. The instructions, when executed by the at least one processor **240** individually or collectively, may cause the electronic device **101** to display a user interface including the stored PIN through the display **220**, based on the acquired user authentication information corresponding to stored user authentication information.

[0178] In an embodiment, the instructions, when executed by the at least one processor **240** individually or collectively, may cause the electronic device **101** to acquire an update PIN, based on a random value different from the random value after displaying the user interface including the stored PIN. The instructions, when executed by the at least one processor **240** individually or collectively, may cause the electronic device **101** to configure the updated PIN as the PIN for the SIM unlock.

[0179] In an embodiment, the instructions, when executed by the at least one processor **240** individually or collectively, may cause the electronic device **101** to deactivate the function related to the SIM lock by changing the stored PIN into a configured value, based on an event for deactivating the SIM authentication function using the auto-generated PIN being identified. The instructions, when executed by the at least one processor **240** individually or collectively, may cause the electronic device **101** to display a user interface for acquiring user authentication information through the display **220**, based on an event for activating a SIM authentication function using a manual PIN being identified while the function related to the SIM lock is deactivated. The instructions, when executed by the at least one processor **240** individually or collectively, may cause the electronic device **101** to acquire the user authentication information, based on an input to the user interface. The instructions, when

executed by the at least one processor **240** individually or collectively, may cause the electronic device **101** to display a user interface for acquiring the manual PIN through the display **220**, based on the user authentication information corresponding to stored user authentication information. The instructions, when executed by the at least one processor **240** individually or collectively, may cause the electronic device **101** to configure the manual PIN acquired based on the input to the user interface for acquiring the manual PIN as the PIN for the SIM unlock.

[0180] In an embodiment, instructions, when executed by the at least one processor **240** individually or collectively, may cause the electronic device **101** to display a user interface for acquiring a PIN through the display **220**, based on identification that the acquired PIN does not correspond to the stored PIN. The instructions, when executed by the at least one processor **240** individually or collectively, may cause the electronic device **101** to identify whether the PIN identified based on an input to the user interface corresponds to the stored PIN. The instructions, when executed by the at least one processor **240** individually or collectively, may cause the electronic device **101** to perform an operation related to the SIM lock, based on identification that the PIN identified based on the input does not correspond to the stored PIN.

[0181] In an embodiment, the identification information of the electronic device **101** may include an international mobile equipment identity (IMEI) of the electronic device **101**. The identification information of the SIM may include an integrated circuit card identifier (ICCID) of the SIM. The instructions, when executed by the at least one processor **240** individually or collectively, may cause the electronic device **101** to input the IMEI, the ICCID, and the random value into a key derivation function so as to acquire the PIN for the SIM unlock, based on information output from the key derivation function.

[0182] In an embodiment, the instructions, when executed by the at least one processor **240** individually or collectively, may cause the electronic device **101** to initiate a timer for periodically updating the PIN, based on the PIN for the SIM unlock being acquired. The instructions, when executed by the at least one processor **240** individually or collectively, may cause the electronic device **101** to acquire the updated PIN, based on a random value different from the random value, based on lapse of a time interval corresponding to the timer. The instructions, when executed by the at least one processor **240** individually or collectively, may cause the electronic device **101** to configure the updated PIN as the PIN for the SIM unlock.

[0183] In an embodiment, the instructions, when executed by the at least one processor **240** individually or collectively, may cause the electronic device **101** to convert the acquired PIN into an encrypted PIN, based on identification that the acquired PIN corresponds to the stored PIN. The instructions, when executed by the at least one processor **240** individually or collectively, may cause the electronic device **101** to transmit the encrypted PIN to a cloud server through the communication circuit **210**.

[0184] In an embodiment, the event for the SIM authentication may include an event of inserting the SIM into the electronic device **101**.

[0185] In an embodiment, the event for the SIM authentication may include an event of rebooting the electronic device **101**.

[0186] A method of operating the electronic device **101** according to an embodiment may include an operation of displaying a lock screen for user authentication through a display **220** of the electronic device **101**, based on an event for subscriber identity module (SIM) authentication being generated. The method may include an operation of acquiring a personal identification number (PIN) for SIM unlock, based on user authentication information for releasing the lock screen being acquired. The method may include an operation of identifying whether the acquired PIN corresponds to a stored PIN. The method may include an operation of performing the SIM unlock, based on identification that the acquired PIN corresponds to the stored PIN.

[0187] In an embodiment, the method may further include an operation of displaying a user interface for acquiring user authentication information through the display **220**, based on an event for activating a SIM authentication function using an auto-generated PIN (AGP) being identified. The method may further include an operation of acquiring the user authentication information, based on an input to the user interface. The method may further include an operation of acquiring identification information of the electronic device **101** and identification information of the SIM, based on user authentication being performed using the user authentication information. The method may further include an operation of acquiring a PIN for configuring SIM authentication information, based on the identification information of the electronic device **101**, the identification information of the SIM, and a random value. The method may further include an operation of storing the PIN for configuring the SIM authentication information.

[0188] In an embodiment, the operation of acquiring the PIN for the SIM unlock, based on the user authentication information for releasing the lock screen being acquired may include an operation of acquiring the identification information of the electronic device **101** and the identification information of the SIM, based on the user authentication information for releasing the lock screen being acquired. The operation of acquiring the PIN for the SIM unlock, based on the user authentication information for releasing the lock screen being acquired may include an operation of acquiring the PIN for the SIM unlock, based on the identification information of the electronic device **101**, the identification information of the SIM, and the random value. The method may further include an operation of establishing a connection with a network through a communication circuit **210** of the electronic device **101**, based on the PIN for the SIM unlock corresponding to the stored PIN.

[0189] In an embodiment, the method may further include an operation of storing, in memory **230** of the electronic device **101**, an encrypted random value acquired using a key for encrypting the random value or decrypting the encrypted random value. The operation of acquiring the PIN for the SIM unlock, based on the user authentication information for releasing the lock screen being acquired may include an operation of acquiring the decrypted random value by using the key, based on the user authentication information for releasing the lock screen being acquired. The operation of acquiring the PIN for the SIM unlock, based on the user authentication information for releasing the lock screen being acquired may include an operation of acquiring the PIN for the SIM unlock, based on the identification information of the electronic device **101**, the identification information of the SIM, and the decrypted random value.

[0190] In an embodiment, the method may further include an operation of identifying whether user authentication information for user authentication is configured based on the event for activating the SIM authentication function using the PIN being identified. The method may further include an operation of displaying a user interface for configuring the user authentication information through the display **220**, based on identification that the user authentication information for the user authentication is not configured. The method may further include an operation of acquiring the user authentication information, based on an input to the user interface. The method may further include an operation of storing the acquired user authentication information in the memory **230** of the electronic device **101**.

[0191] A non-transitory computer-readable storage medium recording computer-executable instructions according to an embodiment may be provided. The computer-executable instructions, when executed by at least one processor **240** including processing circuitry of an electronic device **101** individually or collectively, may cause the electronic device **101** to display a lock screen for user authentication through a display **220** of the electronic device **101**, based on an event for subscriber identity module (SIM) authentication being generated. The computer-executable instructions may be configured to, when individually or collectively executed by at least one processor **240**, cause the electronic device **101** to acquire a personal identification number (PIN) for SIM unlock, based on user authentication information for releasing the lock screen being acquired. The computer-executable instructions may be configured to, when individually or collectively executed by at least one processor, cause the electronic device **101** to identify whether the acquired PIN corresponds to a stored PIN. The computer-executable instructions may be configured to, when individually or collectively executed by at least one processor **240**, cause the electronic device **101** to perform the SIM unlock, based on identification that the acquired PIN corresponds to the stored PIN.

[0192] The structure of data used in the embodiments of the disclosure may be recorded in a computer-readable recording medium through various means. The computer-readable recording medium includes a magnetic storage medium (e.g., a ROM, a floppy disk, and a hard disk) and an optical reading medium (e.g., a CD-ROM and a DVD).

[0193] The electronic device according to various embodiments may be one of various types of electronic devices. The electronic devices may include, for example, a portable communication device (e.g., a smartphone), a computer device, a portable multimedia device, a portable medical device, a camera, a wearable device, or a home appliance. According to an embodiment of the disclosure, the electronic devices are not limited to those described above.

[0194] It should be appreciated that various embodiments of the present disclosure and the terms used therein are not intended to limit the technological features set forth herein to particular embodiments and include various changes, equivalents, or replacements for a corresponding embodiment. With regard to the description of the drawings, similar reference numerals may be used to refer to similar or related elements. It is to be understood that a singular form of a noun corresponding to an item may include one or more of the things, unless the relevant context clearly indicates otherwise. As used herein, each of such phrases as "A or B," "at least one of A and B," "at least one of A or B," "A, B, or C," "at least one of A, B, and C," and "at least one of A, B, or C," may include any one of, or all possible combinations of the items enumerated together in a corresponding one of the phrases. As used herein, such terms as "1st" and "2nd," or "first" and "second" may be used to simply distinguish a corresponding component from another, and does not limit the components in other aspect (e.g., importance or order). It is to be understood that if an element (e.g., a first element) is referred to, with or without the term "operatively" or "communicatively", as "coupled with," "coupled to," "connected with," or "connected to" another element (e.g., a second element), it means that the element may be coupled with the other element directly (e.g., wiredly), wirelessly, or via a third element.

[0195] As used in connection with various embodiments of the disclosure, the term "module" may include a unit implemented in hardware, software, or firmware, and may interchangeably be used with other terms, for example, "logic," "logic block," "part," or "circuitry". A module may be a single integral component, or a minimum unit or part thereof, adapted to perform one or more functions. For example, according to an embodiment, the module may be implemented in a form of an application-specific integrated circuit (ASIC).

[0196] Various embodiments as set forth herein may be implemented as software (e.g., the program **140**) including one or more instructions that are stored in a storage medium (e.g., internal memory **136** or external memory **138**) that is readable by a machine (e.g., the electronic device **101**). For example, a processor (e.g., the processor **120**) of the machine (e.g., the electronic device **101**) may invoke at least one of the one or more instructions stored in the storage medium, and execute it, with or without using one or more other components under the control of the processor. This allows the machine to be operated to perform at least one function according to the at least one instruction invoked. The one or more instructions may include a code generated by a complier or a code executable by an interpreter. The machine-readable storage medium may be provided in the form of a non-transitory storage medium. Wherein, the term "non-transitory" simply means that the storage medium is a tangible device, and does not include a signal (e.g., an electromagnetic wave), but this term does not differentiate between where data is semi-permanently stored in the storage medium and where the data is temporarily stored in the storage medium.

[0197] According to an embodiment, a method according to various embodiments of the disclosure may be included and provided in a computer program product. The computer program product may be traded as a product between a seller and a buyer. The computer program product may be distributed in the form of a machine-readable storage medium (e.g., compact disc read only memory (CD-ROM)), or be distributed (e.g., downloaded or uploaded) online via an application store (e.g., PlayStore™), or between two user devices (e.g., smart phones) directly. If distributed online, at least part of the computer program product may be temporarily generated or at least temporarily stored in the machine-readable storage medium, such as memory of the manufacturer's server, a server of the application store, or a relay server.

[0198] According to various embodiments, each component (e.g., a module or a program) of the above-described components may include a single entity or multiple entities,

and some of the multiple entities may be separately disposed in different components. According to various embodiments, one or more of the above-described components may be omitted, or one or more other components may be added. Alternatively or additionally, a plurality of components (e.g., modules or programs) may be integrated into a single component. In such a case, according to various embodiments, the integrated component may still perform one or more functions of each of the plurality of components in the same or similar manner as they are performed by a corresponding one of the plurality of components before the integration. According to various embodiments, operations performed by the module, the program, or another component may be carried out sequentially, in parallel, repeatedly, or heuristically, or one or more of the operations may be executed in a different order or omitted, or one or more other operations may be added.

What is claimed is:

1. An electronic device comprising:

a communication circuit;

a display;

at least one processor including processing circuitry; and

memory storing instructions that, when executed by the at least one processor individually or collectively, cause the electronic device to:

display a lock screen for user authentication through the display based on an event for subscriber identity module (SIM) authentication being generated,

acquire a personal identification number (PIN) for an SIM unlock based on acquisition of user authentication information for releasing the lock screen,

identify whether the acquired PIN corresponds to a stored PIN, and

perform the SIM unlock, based on identifying that the acquired PIN corresponds to the stored PIN.

2. The electronic device of claim **1**, wherein the instructions, when executed by the at least one processor individually or collectively, cause the electronic device to:

display a user interface for acquisition of the user authentication information through the display based on identification of an event for activating a SIM authentication function using an auto-generated PIN (AGP),

acquire the user authentication information based on an input to the user interface for acquisition of the user authentication information,

acquire identification information of the electronic device and identification information of the SIM based on user authentication being performed using the user authentication information,

acquire a PIN for configuration of SIM authentication information based on (i) the identification information of the electronic device, (ii) the identification information of the SIM, and (iii) a random value, and

store the PIN for configuration of the SIM authentication information.

3. The electronic device of claim **2**, wherein the instructions, when executed by the at least one processor individually or collectively, cause the electronic device to:

acquire the identification information of the electronic device and the identification information of the SIM based on acquistion of the user authentication information for releasing the lock screen,

acquire the PIN for the SIM unlock based on (i) the identification information of the electronic device, (ii) the identification information of the SIM, and (iii) the random value, and

establish a connection with a network through the communication circuit based on the PIN for the SIM unlock corresponding to the stored PIN.

4. The electronic device of claim **3**, wherein the instructions, when executed by the at least one processor individually or collectively, cause the electronic device to:

store, in the memory, an encrypted random value acquired using a key for encrypting the random value or decrypting the encrypted random value,

acquire a decrypted random value by using the key on the encrypted random value based on acquisition of the user authentication information for releasing the lock screen, and

acquire the PIN for the SIM unlock based on (i) the identification information of the electronic device, (ii) the identification information of the SIM, and (iii) the decrypted random value.

5. The electronic device of claim **1**, wherein the instructions, when executed by the at least one processor individually or collectively, cause the electronic device to:

identify whether the user authentication information for user authentication is configured based on identification of the event for activating an SIM authentication function using the PIN,

display a user interface for configuration of the user authentication information through the display based on identifying that the user authentication information for user authentication is not configured,

acquire the user authentication information based on an input to the user interface, and

store the acquired user authentication information in the memory.

6. The electronic device of claim **1**, wherein the instructions, when executed by the at least one processor individually or collectively, cause the electronic device to:

display a user interface for acquisition of the user authentication information through the display based on acquisition of an input for displaying the stored PIN,

acquire the user authentication information based on the input to the user interface, and

display a user interface comprising the stored PIN through the display based on the acquired user authentication information corresponding to stored user authentication information.

7. The electronic device of claim **2**, wherein the instructions, when executed by the at least one processor individually or collectively, cause the electronic device to:

acquire, after displaying the user interface comprising the stored PIN, an updated PIN using a different random value generated from the random value,, and

configure the updated PIN as the PIN for the SIM unlock.

8. The electronic device of any claim **2**, wherein the instructions, when executed by the at least one processor (**240**) individually or collectively, cause the electronic device to:

deactivate a function related to an SIM lock based on identificiation of an event for deactivating the SIM authentication function using the AGP, the function related to the SIM lock deactivated by changing the stored PIN to a configured value,

display, while the function related to the SIM lock is deactivated, the user interface for acquisition of the user authentication information through the display based on identification of an event for activating the SIM authentication function using a manual PIN,

acquire the user authentication information based on an input to the user interface,

display a user interface for acquisition of the manual PIN through the display based on the user authentication information corresponding to the stored user authentication information, and

configure the manual PIN acquired based on an input to the user interface for acquisition of the manual PIN as the PIN for the SIM unlock.

9. The electronic device of claim **1**, wherein the instructions, when executed by the at least one processor individually or collectively, cause the electronic device to:

display a user interface for acquisition of a PIN through the display,

identify whether the PIN input to the user interface corresponds to the stored PIN, and

perform an operation related to SIM lock based on identifying that the PIN acquired based on the input does not correspond to the stored PIN.

10. The electronic device of claim **2**, wherein the identification information of the electronic device comprises an international mobile equipment identity (IMEI) of the electronic device,

wherein the identification information of the SIM comprises an integrated circuit card identifier (ICCID) of the SIM, and

wherein the instructions, when executed by the at least one processor individually or collectively, cause the electronic device to:

input the IMEI, the ICCID, and the random value into a key derivation function to acquire the PIN for the SIM unlock based on information output from the key derivation function.

11. The electronic device of claim **10**, wherein the instructions, when executed by the at least one processor individually or collectively, cause the electronic device to:

start a timer for periodically updating the PIN based on acquisition of the PIN for the SIM unlock,

acquire, based on elapse of a time interval corresponding to the timer, an updated PIN based on a different random value generated from the random value, and

configure the updated PIN as the PIN for the SIM unlock.

12. The electronic device of claim **1**, wherein the instructions, when executed by the at least one processor individually or collectively, cause the electronic device to:

convert the acquired PIN into an encrypted PIN based on identifying that the acquired PIN corresponds to the stored PIN, and

transmit the encrypted PIN to a cloud server through the communication circuit.

13. The electronic device of claim **1**, wherein the event for an SIM authentication comprises an event of insertion of the SIM into the electronic device.

14. The electronic device of claim **13**, wherein the event for the SIM authentication comprises an event of rebooting the electronic device.

15. A method for operating an electronic device, the method comprising:

displaying a lock screen for user authentication through a display of the electronic device based on an event for subscriber identity module (SIM) authentication being generated;

acquiring a personal identification number (PIN) for an SIM unlock based on acquiring user authentication information for releasing the lock screen;

identifying whether the acquired PIN corresponds to a stored PIN; and

performing the SIM unlock, based on identification that the acquired PIN corresponds to the stored PIN.

16. The method of claim **15**, further comprising:

displaying a user interface for acquisition of the user authentication information through the display based on identifying an event for activating a SIM authentication function using an auto-generated PIN (AGP);

acquiring the user authentication information based on an input to the user interface;

acquiring identification information of the electronic device and identification information of the SIM based on user authentication being performed using the user authentication information;

acquiring a PIN for configuration of SIM authentication information based on (i) the identification information of the electronic device, (ii) the identification information of the SIM, and (iii) a random value; and

storing the PIN for configuration of the SIM authentication information.

17. The method of claim **16**, wherein the acquiring of the PIN for the SIM unlock based on acquiring the user authentication information for releasing the lock screen, further comprises:

acquiring the identification information of the electronic device and the identification information of the SIM based on acquiring the user authentication information for releasing the lock screen; and

acquiring the PIN for the SIM unlock based on (i) the identification information of the electronic device, (ii) the identification information of the SIM, and (iii) the random value, and

wherein the method further comprises:

establishing a connection with a network through a communication circuit of the electronic device, based on the PIN for the SIM unlock corresponding to the stored PIN.

18. The method of claim **16**, further comprising:

storing, in memory of the electronic device, an encrypted random value acquired using a key for encrypting the random value or decrypting the encrypted random value,

wherein the acquiring of the PIN for the SIM unlock based on the user authentication information for releasing the lock screen being acquired, further comprises:

acquiring a decrypted random value by using the key on the encrypted random value based on the user authentication information for releasing the lock screen being acquired; and

acquiring the PIN for the SIM unlock based on (i) the identification information of the electronic device, (ii) the identification information of the SIM, and (iii) the decrypted random value.

19. The method of claim **18**, further comprising:

identifying whether the user authentication information for user authentication is configured based on identifying the event for activating an SIM authentication function using the PIN;

displaying a user interface for configuration of the user authentication information through the display based on identifying that the user authentication information for the user authentication is not configured;

acquiring the user authentication information, based on an input to the user interface for configuration of the user authentication information; and

storing the acquired user authentication information in the memory of the electronic device.

20. A non-transitory computer-readable storage medium recording computer-executable instructions, the computer-executable instructions, when executed by at least one processor including processing circuitry of an electronic device individually or collectively, causing the electronic device to:

display a lock screen for user authentication through a display of the electronic device, based on an event for subscriber identity module (SIM) authentication being generated,

acquire a personal identification number (PIN) for an SIM unlock, based on acquisition of user authentication information for releasing the lock screen,

identify whether the acquired PIN corresponds to a stored PIN, and

perform the SIM unlock, based on identifying that the acquired PIN corresponds to the stored PIN.

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