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(54) **ELECTRONIC DEVICE FOR ENCRYPTING CONTENT AND OPERATING METHOD THEREOF**

(71) Applicant: **SAMSUNG ELECTRONICS CO., LTD.**, Suwon-si (KR)

(72) Inventor: **Jinsu KIM**, Suwon-si (KR)

(73) Assignee: **SAMSUNG ELECTRONICS CO., LTD.**, Suwon-si (KR)

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(52) **U.S. Cl.**

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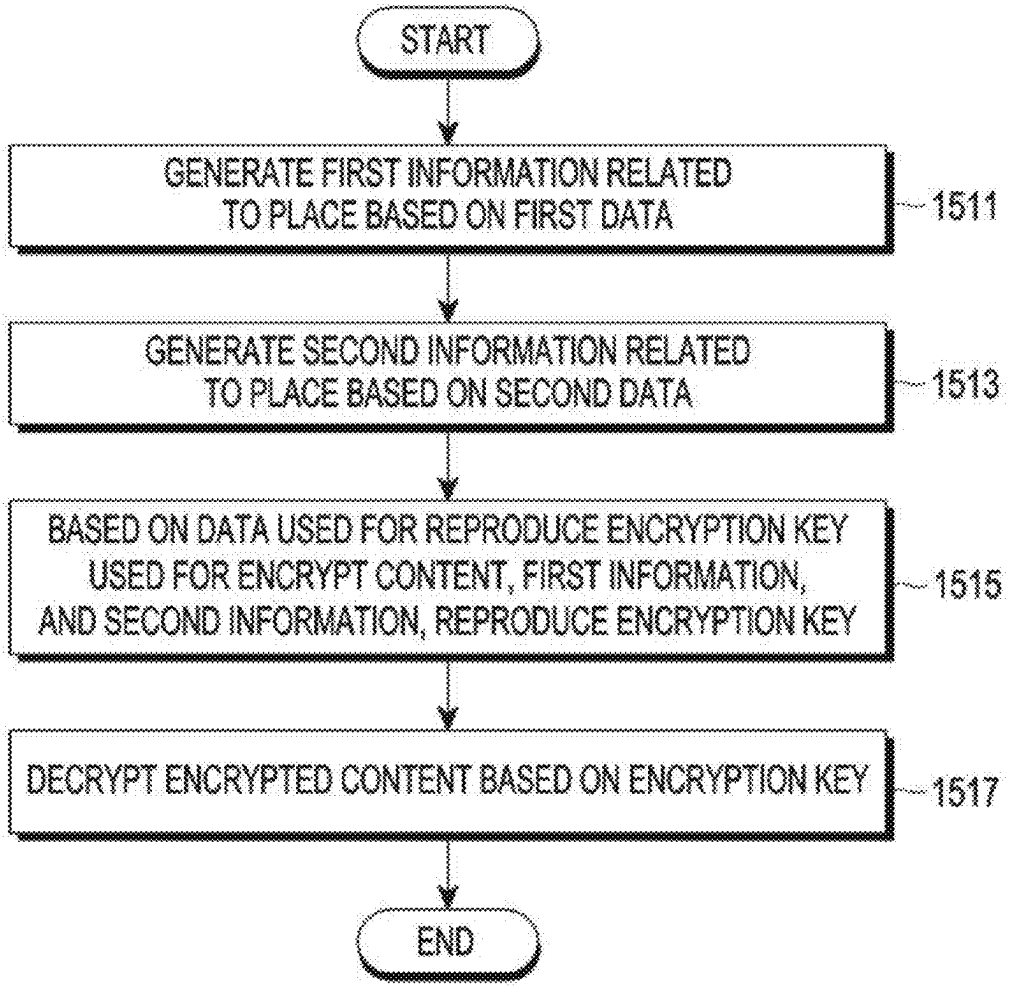
(57) **ABSTRACT**

An electronic device, may include: at least one communication interface; a camera or at least one sensor; at least one processor connected to the at least one communication interface, and the camera or the at least one sensor; and memory storing instructions that, when executed by the at least one processor, cause the at least one processor to: based on first data obtained via the camera or the at least one sensor, generate first information related to a location of the electronic device; based on second data obtained via the at least one communication interface, generate second information related to the location; based on the first information and the second information, generate an encryption key used for encrypting content, and data used for reproducing the encryption key; and encrypt the content based on the encryption key.



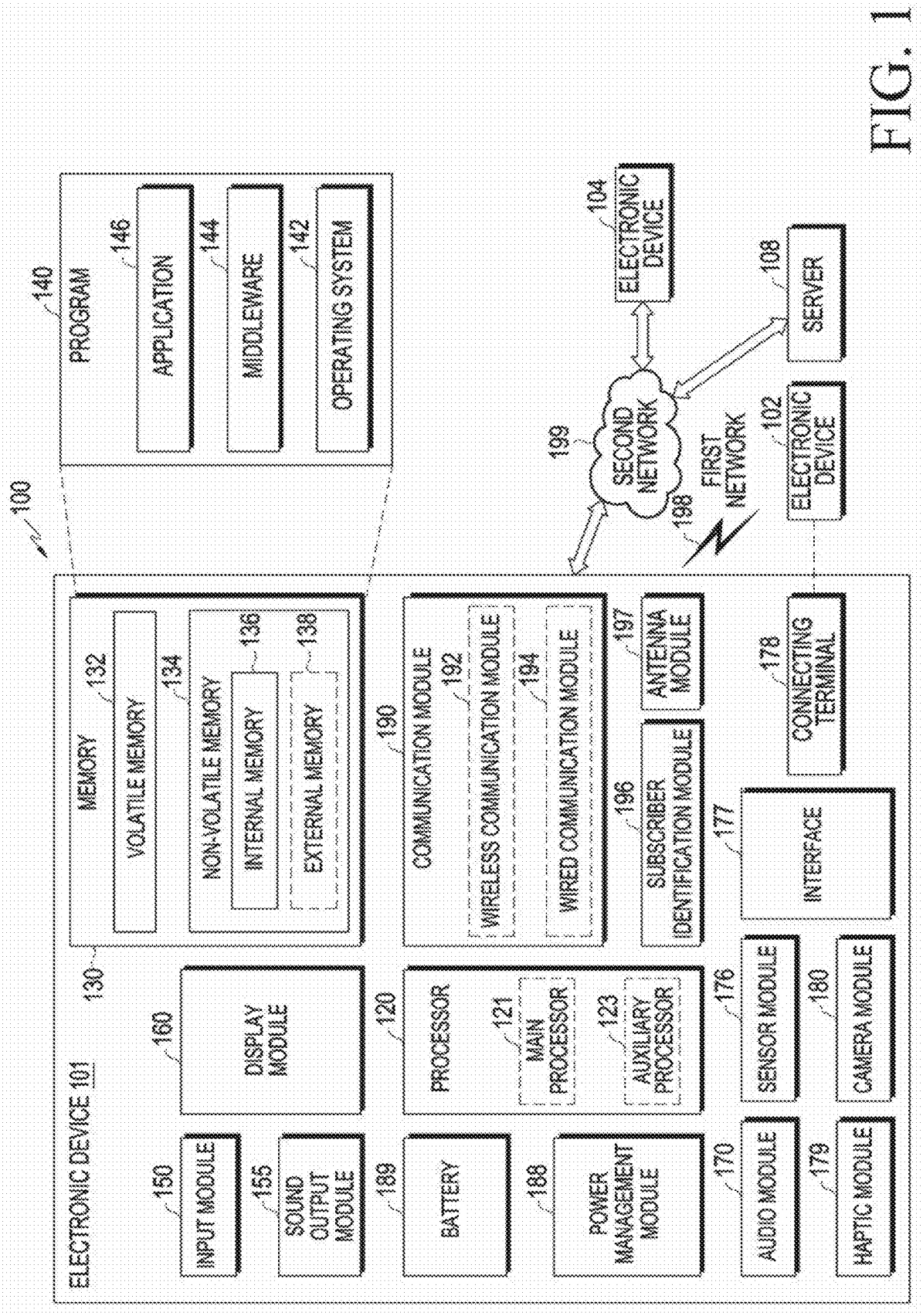

100
ELECTRONIC DEVICE 101
130
MEMORY
132
VOLATILE MEMORY
134
NON-VOLATILE MEMORY
136
INTERNAL MEMORY
138
EXTERNAL MEMORY
190
COMMUNICATION MODULE
192
WIRELESS COMMUNICATION MODULE
194
WIRED COMMUNICATION MODULE
197
ANTENNA MODULE
196
SUBSCRIBER IDENTIFICATION MODULE
177
INTERFACE
178
CONNECTING TERMINAL
160
DISPLAY MODULE
120
PROCESSOR
121
MAIN PROCESSOR
123
AUXILIARY PROCESSOR
176
SENSOR MODULE
180
CAMERA MODULE
150
INPUT MODULE
155
SOUND OUTPUT MODULE
189
BATTERY
188
POWER MANAGEMENT MODULE
170
AUDIO MODULE
179
HAPTIC MODULE
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

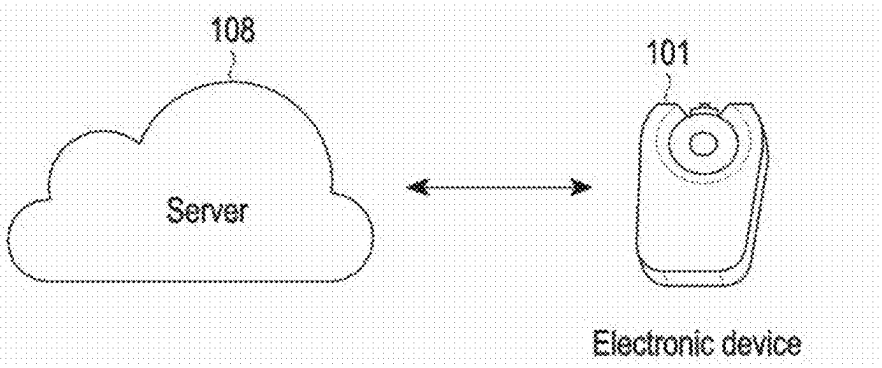

108
101
Server
Electronic device

FIG. 2

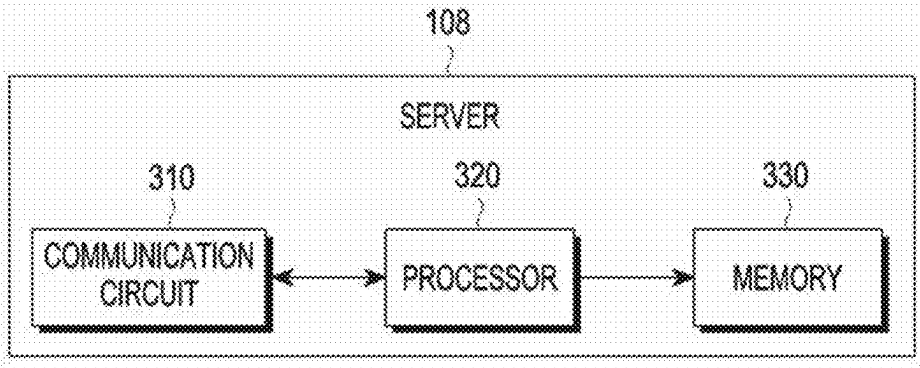

108
SERVER
310
320
330
COMMUNICATION CIRCUIT
PROCESSOR
MEMORY

FIG. 3

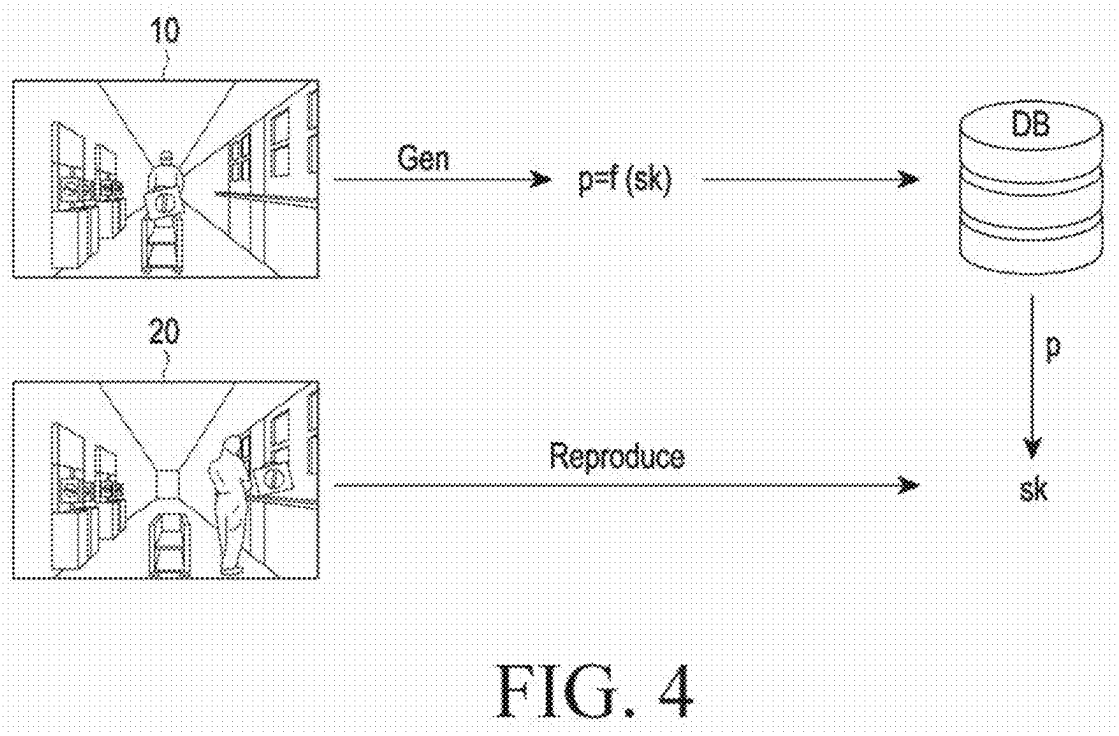


FIG. 4

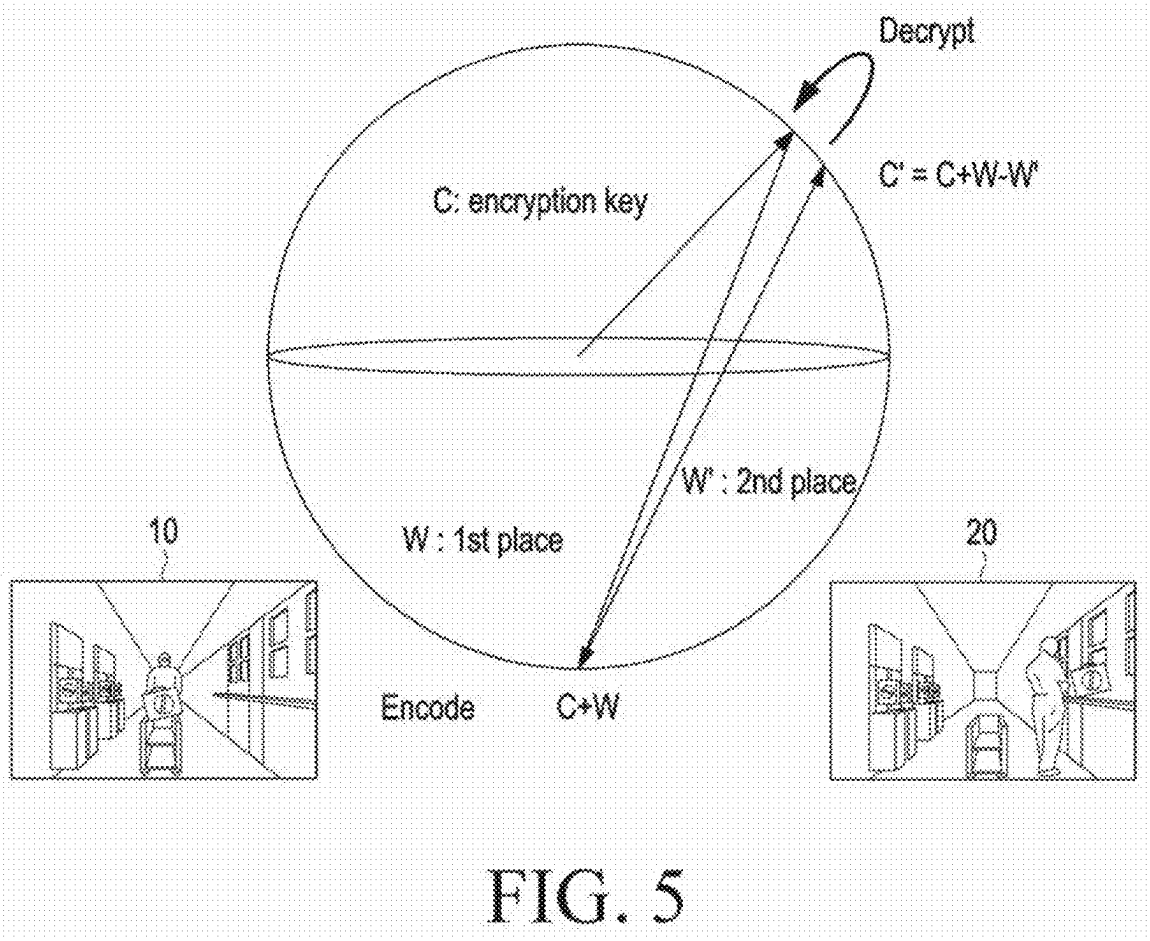

Decrypt
C' = C+W-W'
C: encryption key
W' : 2nd place
W : 1st place
10
20
Encode
C+W

FIG. 5

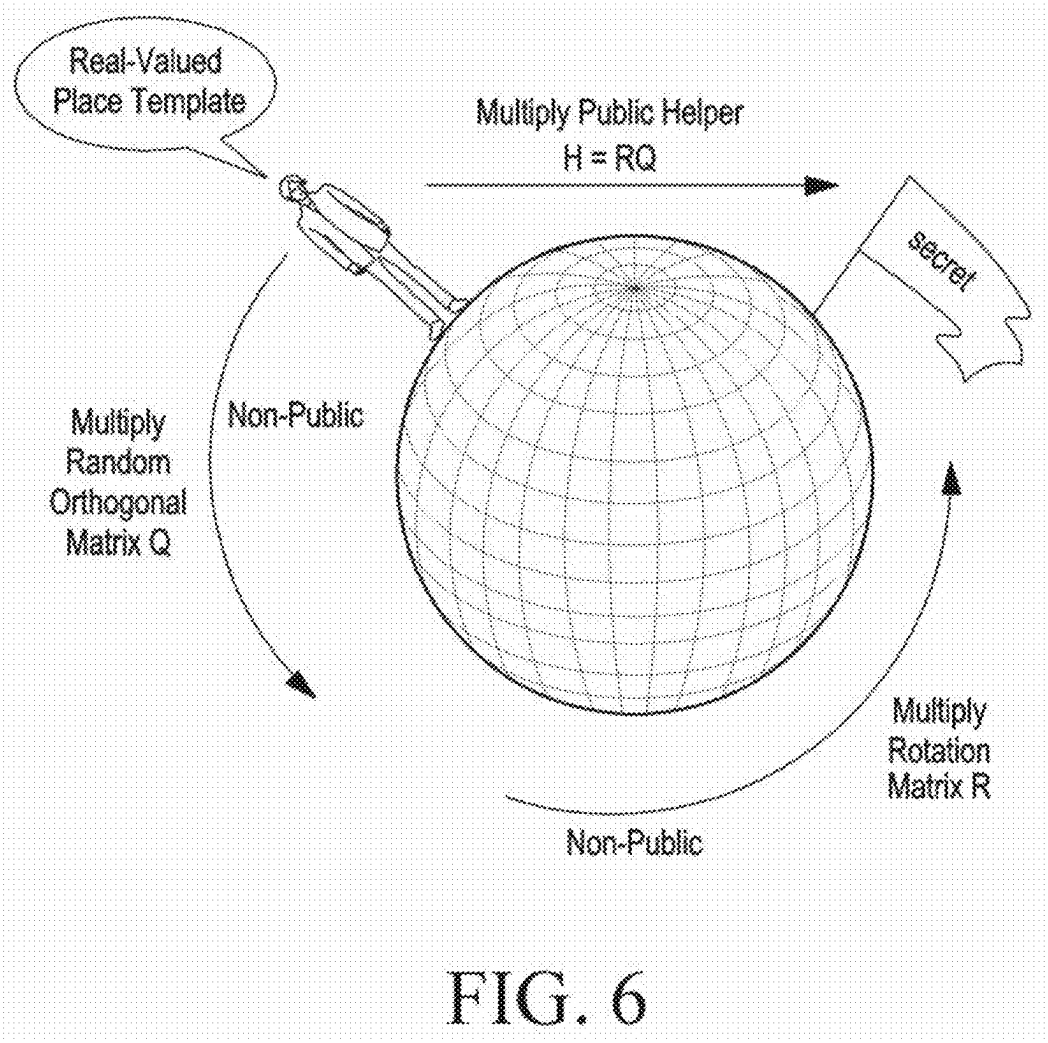

Real-Valued
Place Template
Multiply Public Helper
H = RQ
secret
Multiply
Random
Orthogonal
Matrix Q
Non-Public
Multiply
Rotation
Matrix R
Non-Public

FIG. 6

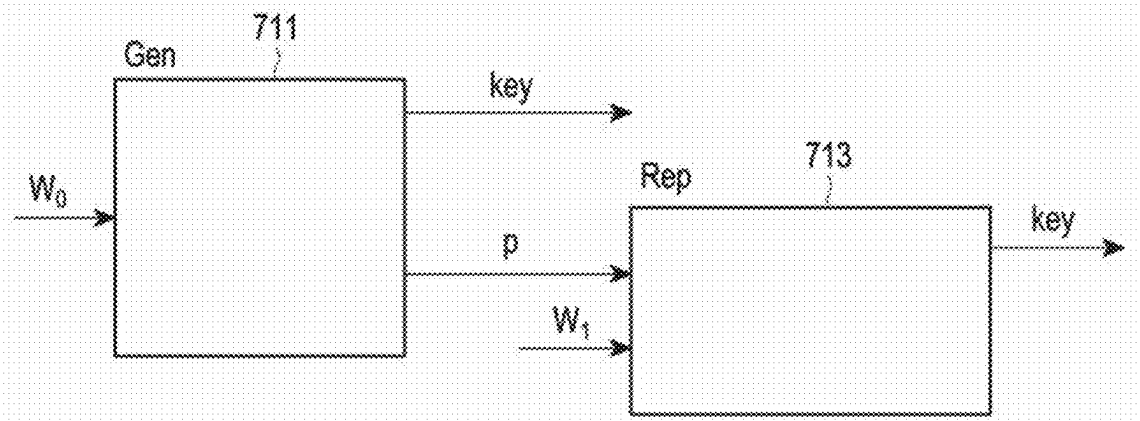


FIG. 7

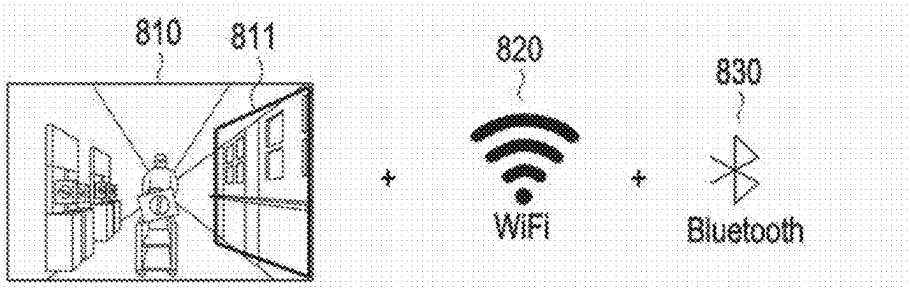


FIG. 8

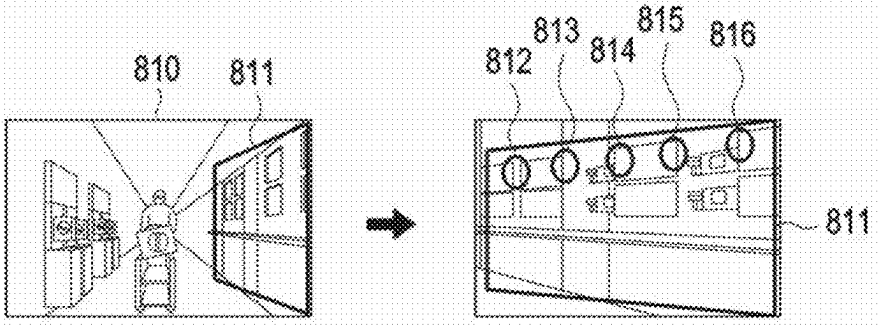


FIG. 9

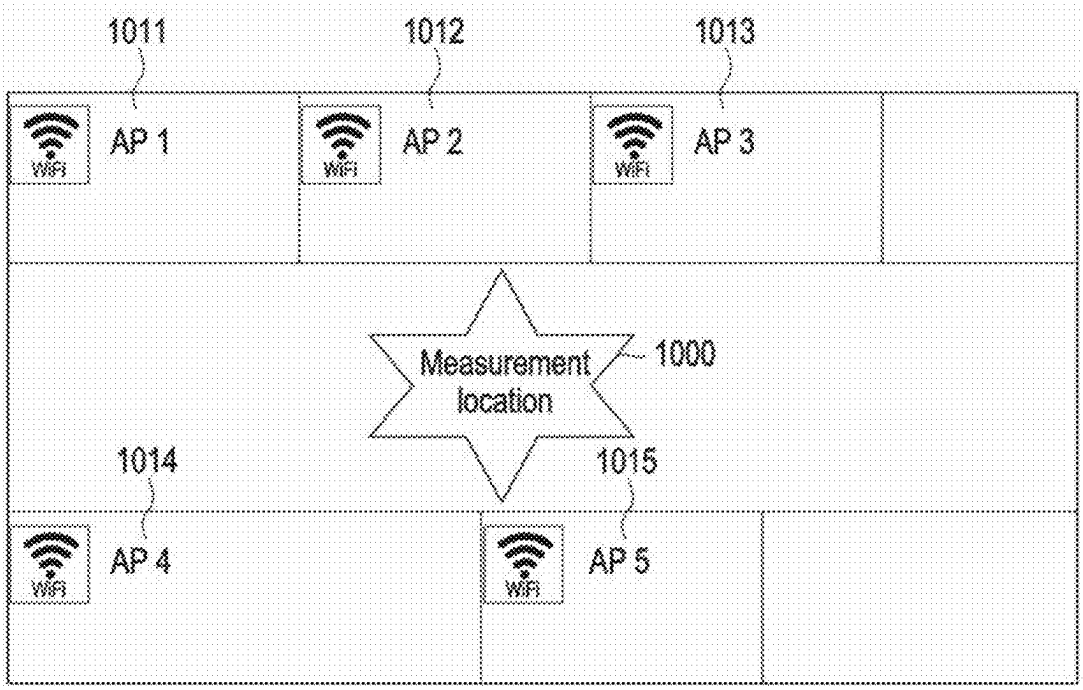

1011
1012
1013
AP 1
AP 2
AP 3
Measurement location
1000
1014
1015
AP 4
AP 5

FIG. 10

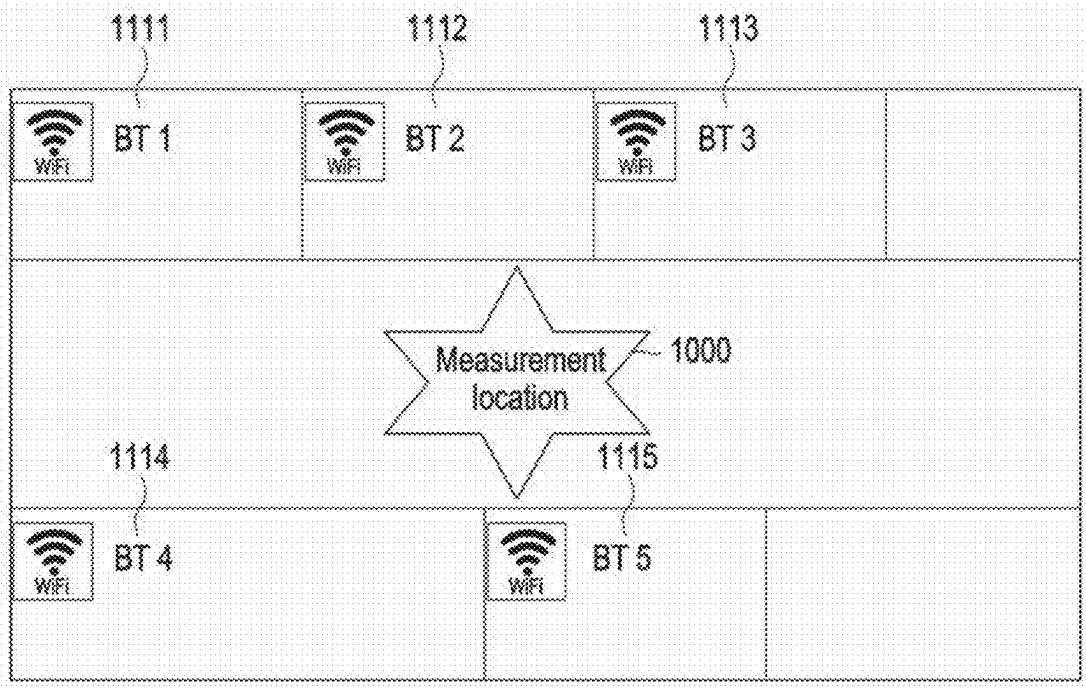

1111
1112
1113
WiFi
BT 1
WiFi
BT 2
WiFi
BT 3
Measurement location
1000
1114
1115
WiFi
BT 4
WiFi
BT 5

FIG. 11

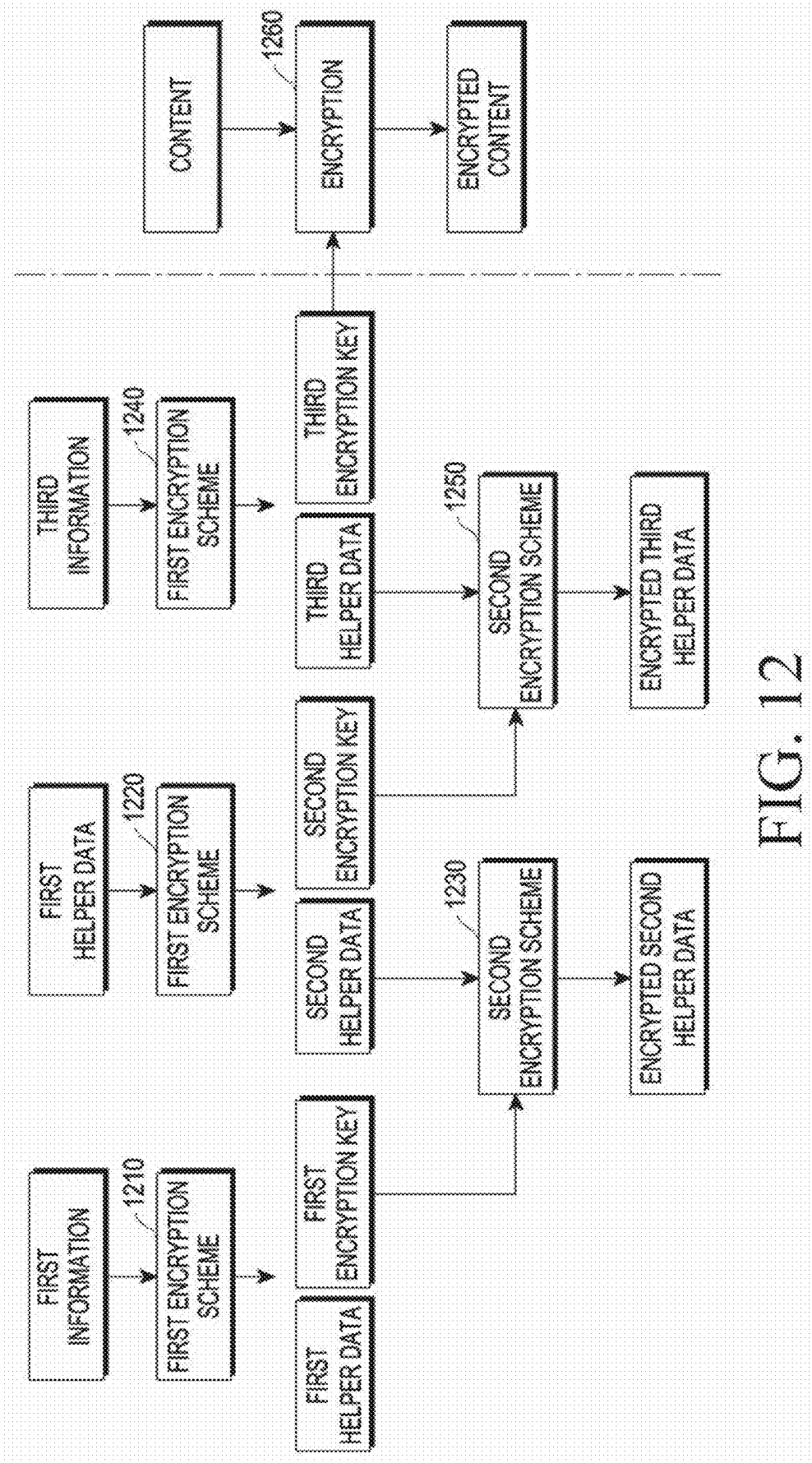

FIRST INFORMATION
1210
FIRST ENCRYPTION SCHEME
FIRST HELPER DATA
FIRST ENCRYPTION KEY
FIRST HELPER DATA
1220
FIRST ENCRYPTION SCHEME
SECOND HELPER DATA
SECOND ENCRYPTION KEY
THIRD INFORMATION
1240
FIRST ENCRYPTION SCHEME
THIRD HELPER DATA
THIRD ENCRYPTION KEY
1230
SECOND ENCRYPTION SCHEME
ENCRYPTED SECOND HELPER DATA
1250
SECOND ENCRYPTION SCHEME
ENCRYPTED THIRD HELPER DATA
CONTENT
1260
ENCRYPTION
ENCRYPTED CONTENT

FIG. 12

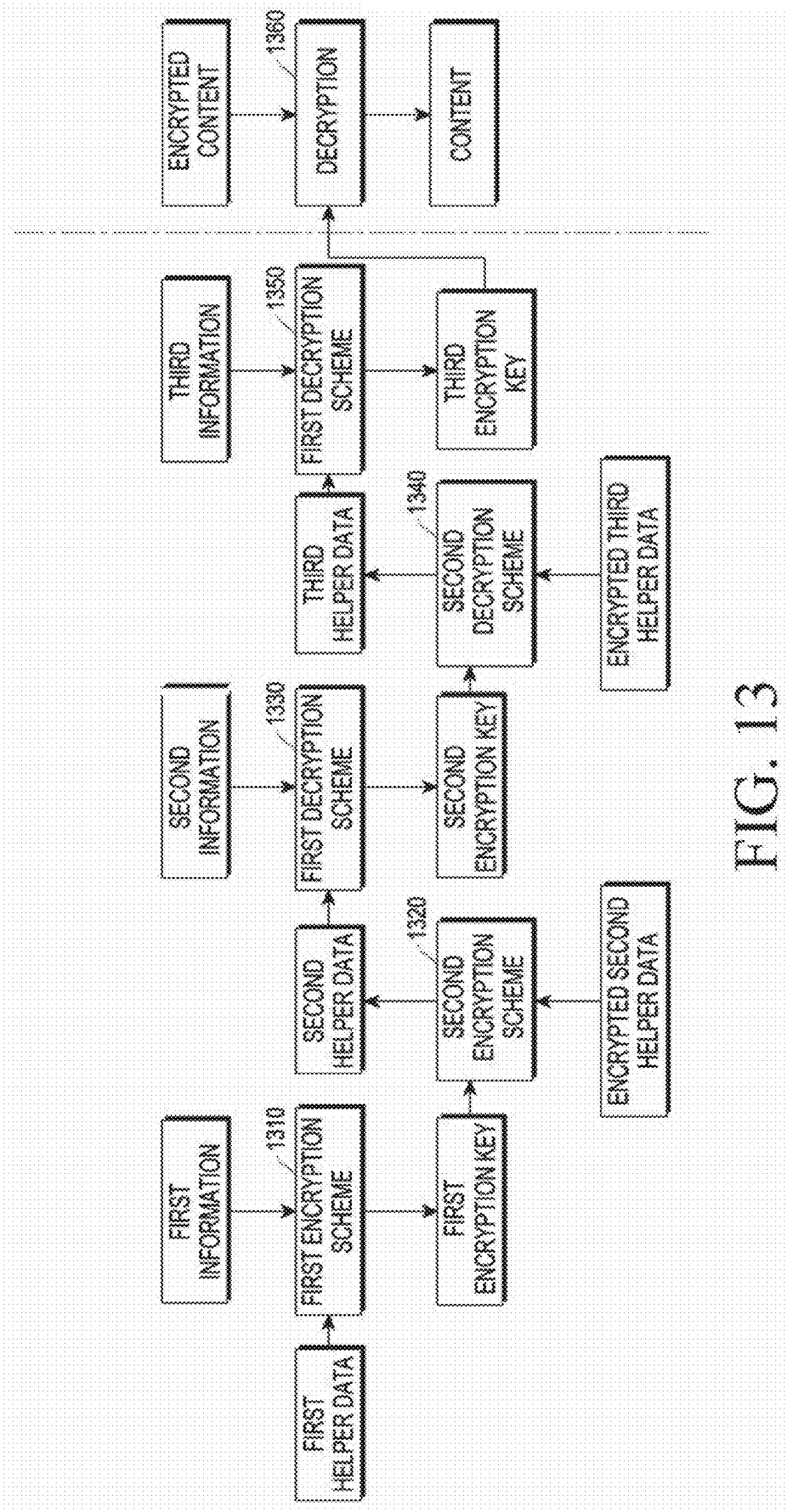

ENCRYPTED CONTENT
1360
DECRYPTION
CONTENT
THIRD INFORMATION
1350
FIRST DECRYPTION SCHEME
THIRD ENCRYPTION KEY
THIRD HELPER DATA
1340
SECOND DECRYPTION SCHEME
ENCRYPTED THIRD HELPER DATA
SECOND INFORMATION
1330
FIRST DECRYPTION SCHEME
SECOND ENCRYPTION KEY
SECOND HELPER DATA
1320
SECOND ENCRYPTION SCHEME
ENCRYPTED SECOND HELPER DATA
FIRST INFORMATION
1310
FIRST ENCRYPTION SCHEME
FIRST ENCRYPTION KEY
FIRST HELPER DATA

FIG. 13

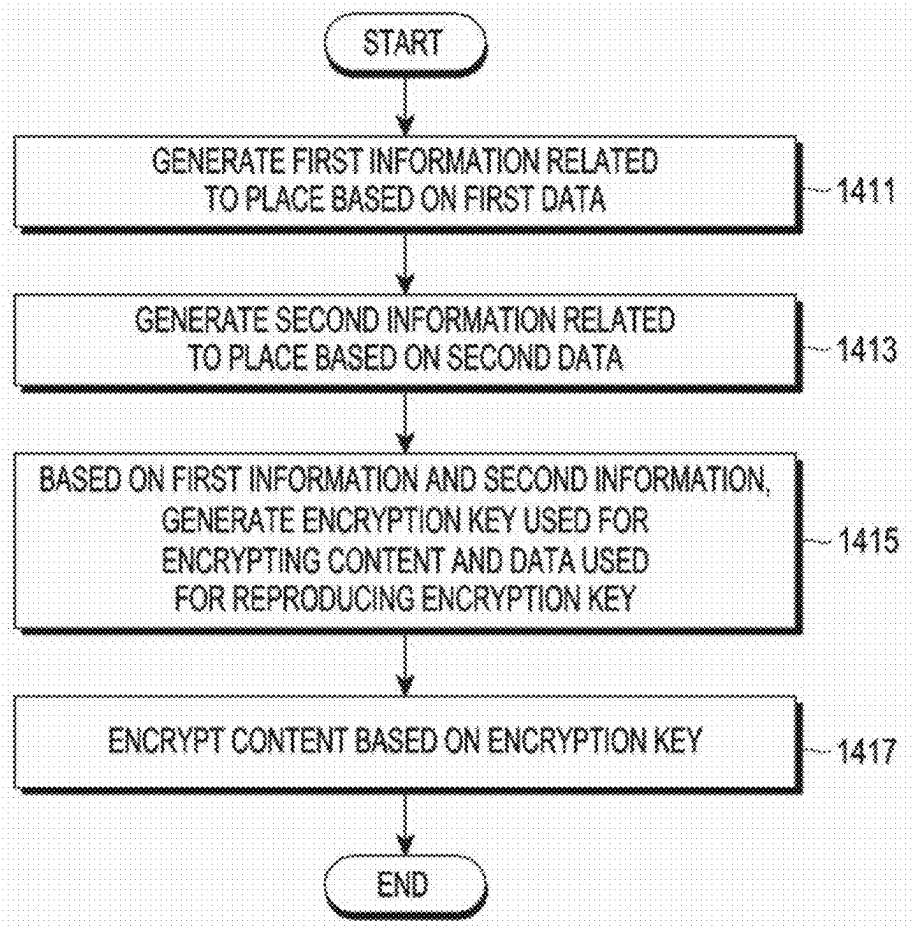

START
GENERATE FIRST INFORMATION RELATED TO PLACE BASED ON FIRST DATA
1411
GENERATE SECOND INFORMATION RELATED TO PLACE BASED ON SECOND DATA
1413
BASED ON FIRST INFORMATION AND SECOND INFORMATION, GENERATE ENCRYPTION KEY USED FOR ENCRYPTING CONTENT AND DATA USED FOR REPRODUCING ENCRYPTION KEY
1415
ENCRYPT CONTENT BASED ON ENCRYPTION KEY
1417
END

FIG. 14

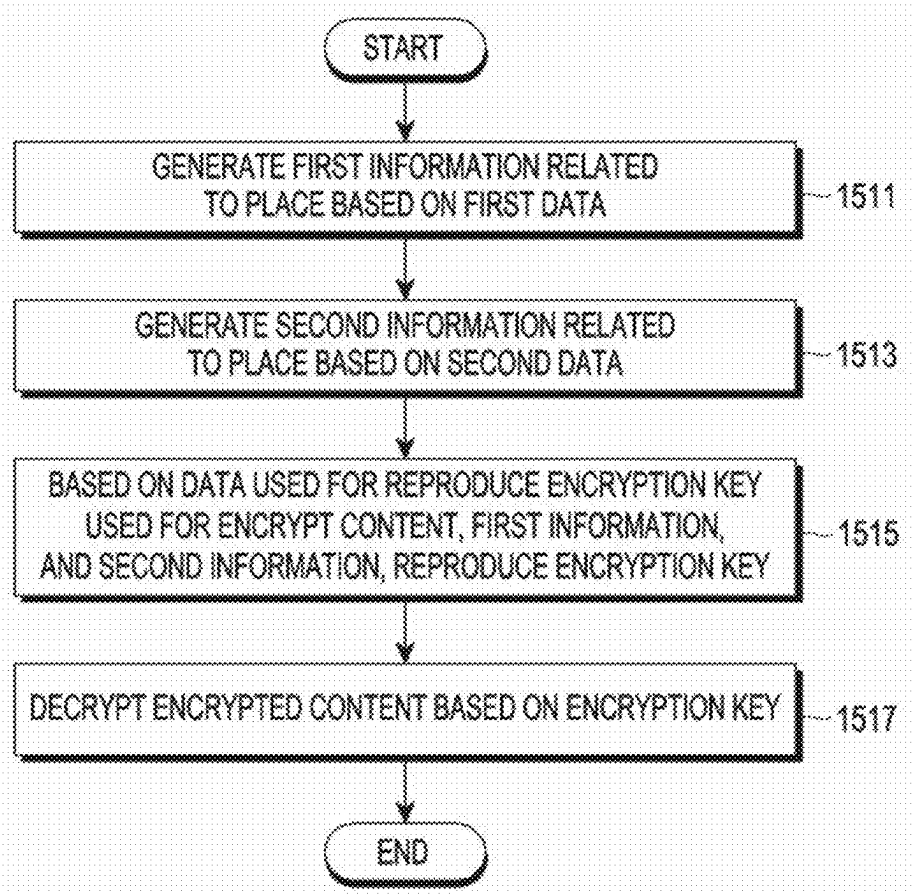

START
GENERATE FIRST INFORMATION RELATED TO PLACE BASED ON FIRST DATA
1511
GENERATE SECOND INFORMATION RELATED TO PLACE BASED ON SECOND DATA
1513
BASED ON DATA USED FOR REPRODUCE ENCRYPTION KEY USED FOR ENCRYPT CONTENT, FIRST INFORMATION, AND SECOND INFORMATION, REPRODUCE ENCRYPTION KEY
1515
DECRYPT ENCRYPTED CONTENT BASED ON ENCRYPTION KEY
1517
END

FIG. 15

ELECTRONIC DEVICE FOR ENCRYPTING CONTENT AND OPERATING METHOD THEREOF

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is a continuation application, claiming priority under § 365(c), of an International application No. PCT/KR2025/002069, filed on Feb. 12, 2025, which is based on and claims the benefit of a Korean patent application number 10-2024-0022615, filed on Feb. 16, 2024, in the Korean Intellectual Property Office, the disclosure of which is incorporated by reference herein in its entirety.

BACKGROUND

1. Field

[0002] The disclosure relates to an electronic device for encrypting content and an operating method thereof.

2. Description of Related Art

[0003] Recently, the amount of damage to individuals and companies due to information leaks has increased exponentially. In particular, in the case of companies, the costs related to information leaks, such as response procedures and loss of sales, are increased, and this may lead to an increase in the price of services or products of the companies. This means that the companies themselves have not been able to resolve the damage costs due to information leaks, and the companies may lose customers due to decreased competitiveness.

[0004] Although various schemes have been introduced to prevent damage caused by the information leaks, not only direct damages such as the amount of damage caused by the information leaks, but also indirect damages such as decreased reliability and competitiveness due to the information leaks, damages are continuously increasing.

[0005] The above information may be provided as a related art for the purpose of aiding understanding of the disclosure. No claim or determination has been made as to whether any of the foregoing may be applied as a prior art related to the disclosure.

SUMMARY

[0006] One or more embodiments of the disclosure may provide an electronic device for encrypting content and an operating method thereof.

[0007] One or more embodiments of the disclosure may provide an electronic device for encrypting content based on data related to a place and an operating method thereof.

[0008] According to one or more example embodiments, an electronic device, may include: at least one communication interface; a camera or at least one sensor; at least one processor connected to the at least one communication interface, and the camera or the at least one sensor; and memory storing instructions that, when executed by the at least one processor, cause the at least one processor to: based on first data obtained via the camera or the at least one sensor, generate first information related to a location of the electronic device; based on second data obtained via the at least one communication interface, generate second information related to the location; based on the first information and the second information, generate an encryption key used for encrypting content, and data used for reproducing the encryption key; and encrypt the content based on the encryption key.

[0009] The instructions may further cause the at least one processor to: transmit the encrypted content and the data used for reproducing the encryption key to a server via the at least one communication interface.

[0010] The instructions may further cause the at least one processor to: apply a first encryption scheme to the first information to generate a first encryption key and data used for reproducing the first encryption key; apply the first encryption scheme to the second information to generate a second encryption key and data used for reproducing the second encryption key; and generate data used for reproducing an encrypted second encryption key which is generated by applying a second encryption scheme to the first encryption key and the data used for reproducing the second encryption key. The encryption key may include the second encryption key, and the data used for reproducing the encryption key may include the data used for reproducing the first encryption key and the data used for reproducing the encrypted second encryption key.

[0011] The instructions may further cause the at least one processor to: based on the first data being an image obtained via the camera, extract feature information including feature points from the image; set one of the feature points as a reference feature point; based on a location and a color of the reference feature point, determine a location value and a color value of the reference feature point; based on the location of the reference feature point, determine location values of remaining feature points other than the reference feature point among the feature points, and determine color values of the remaining feature points; and generate the first information including the location values and the color values of the feature points.

[0012] The instructions may further cause the at least one processor to: based on the second data being at least one signal obtained via the at least one communication interface, identify an identifier of another electronic device transmitting the at least one signal; measure received signal strength of the at least one signal; and generate the second information including the identifier of the other electronic device and the received signal strength.

[0013] The at least one signal may be a wireless fidelity (Wi-Fi) signal, the identifier of the other electronic device may be a service set identifier (SSID), and the received signal strength may be a received signal strength indicator (RSSI).

[0014] The at least one signal may be a Bluetooth signal, the identifier of the other electronic device may be a universally unique identifier (UUID), and the received signal strength may be a received signal strength indicator (RSSI).

[0015] According to one or more example embodiments, an electronic device, may include: at least one communication interface; a camera or at least one sensor; at least one processor connected to the at least one communication interface, and the camera or the at least one sensor; and memory storing instructions that, when executed by the at least one processor, cause the at least one processor to: based on first data obtained via the camera or the at least one sensor, generate first information related to a location of the electronic device; based on second data obtained via the at least one communication interface, generate second infor-

mation related to the location; based on data used for reproducing an encryption key used for encrypting content, the first information, and the second information, reproduce the encryption key; and based on the encryption key, decrypt the encrypted content.

[0016] The instructions further may cause the at least one processor to: receive the encrypted content and the data used for reproducing the encryption key from a server via the at least one communication interface.

[0017] The data used for reproducing the encryption key may include data used for reproducing a first encryption key and data used for reproducing an encrypted second encryption key, and the instructions may further cause the at least one processor to: reproduce the first encryption key by applying a first decryption scheme to the first information and the data used for reproducing the first encryption key; reproduce data used for reproducing a second encryption key by applying a second decryption scheme to the first encryption key and the data used for the encrypted second encryption key; and reproduce the second encryption key by applying the first decryption scheme to the data used for reproducing the second encryption key and the second information. The encryption key may include the second encryption key.

[0018] The data used for reproducing the first encryption key may be generated by applying a first encryption scheme corresponding to the first decryption scheme to the first information, the data used for reproducing the encrypted second encryption key may be generated by applying a second encryption scheme corresponding to the second decryption scheme to the data used for reproducing the first encryption key and the data used for reproducing the second encryption key, the data used for reproducing the first encryption key may be generated by applying the first encryption scheme to the first information, and the data used for reproducing the second encryption key may be generated by applying the first encryption scheme to the second information.

[0019] The instructions may further cause the at least one processor to: based on the first data being an image obtained via the camera, extract feature information including feature points from the image; and set any one of the feature points as a reference feature point; based on a location and a color of the reference feature point, determine a location value and a color value of the reference feature point; based on the location of the reference feature point, determine location values of remaining feature points other than the reference feature point among the feature points, and determine color values of the remaining feature points; and generate the first information including the location values and the color values of the feature points.

[0020] The instructions may further cause the at least one processor to: based on the second data being at least one signal obtained via the at least one communication interface, identify an identifier of another electronic device transmitting the at least one signal; measure received signal strength of the at least one signal; and generate the second information including the identifier of the other electronic device and the received signal strength.

[0021] The at least one signal may be a wireless fidelity (Wi-Fi) signal, the identifier of the other electronic device may be a service set identifier (SSID), and the received signal strength may be a received signal strength indicator (RSSI).

[0022] The at least one signal may be a Bluetooth signal, the identifier of the other electronic device may be a universally unique identifier (UUID), and the received signal strength may be a received signal strength indicator (RSSI).

[0023] According to one or more example embodiments, a method, may include: based on first data obtained via a camera or at least one sensor, generating first information related to a location of an electronic device; based on second data obtained via at least one communication interface, generating second information related to the location; based on the first information and the second information, generating an encryption key used for encrypting content and data used for reproducing the encryption key; and encrypting the content based on the encryption key.

[0024] The method may further include: transmitting the encrypted content and the data used for reproducing the encryption key to a server.

[0025] Generating the encryption key and the data used for reproducing the encryption key may include: applying a first encryption scheme to the first information to generate a first encryption key and data used for reproducing the first encryption key; applying the first encryption scheme to the second information to generate a second encryption key and data used for reproducing the second encryption key; and generating data used for reproducing an encrypted second encryption key which is generated by applying a second encryption scheme to the first encryption key and the data used for reproducing the second encryption key. The encryption key may include the second encryption key, and the data used for reproducing the encryption key may include the data used for reproducing the first encryption key and the data used for reproducing the encrypted second encryption key.

[0026] Generating the first information may include: based on the first data being an image obtained via the camera, extracting feature information including feature points from the image; setting any one of the feature points as a reference feature point; based on a location and a color of the reference feature point, determining a location value and a color value of the reference feature point; based on the location of the reference feature point, determining location values of remaining feature points other than the reference feature point among the feature points, and determining color values of the remaining feature points; and generating the first information including the location values and the color values of the feature points.

[0027] Generating the first information may include: based on the second data being at least one signal obtained via the at least one communication interface, identifying an identifier of another electronic device transmitting the at least one signal; measuring received signal strength of the at least one signal; and generating the second information including the identifier of the other electronic device and the received signal strength.

BRIEF DESCRIPTION OF THE DRAWINGS

[0028] The above and other aspects, features, and advantages of the present disclosure will be more clearly understood from the following detailed description, taken in conjunction with the accompanying drawings, in which:

[0029] FIG. **1** is a block diagram illustrating an electronic device in a network environment according to one or more embodiments;

[0030] FIG. **2** is a diagram schematically illustrating a wireless communication system according to one or more embodiments of the disclosure;

[0031] FIG. **3** is a block diagram schematically illustrating configuration of a server according to one or more embodiments of the disclosure;

[0032] FIG. **4** is a diagram for explaining a fuzzy extractor scheme according to one or more embodiments of the disclosure;

[0033] FIG. **5** is a diagram for explaining a fuzzy extractor scheme according to one or more embodiments of the disclosure;

[0034] FIG. **6** is a diagram for explaining a fuzzy extractor scheme according to one or more embodiments of the disclosure;

[0035] FIG. **7** is a diagram for explaining an operation of a key generator and a reproducer according to one or more embodiments of the disclosure;

[0036] FIG. **8** is a diagram for explaining data related to a place used for encrypting content according to one or more embodiments of the disclosure;

[0037] FIG. **9** is a diagram for explaining an operation of generating information related to a place corresponding to an image according to one or more embodiments of the disclosure;

[0038] FIG. **10** is a diagram for explaining an operation of generating information related to a place corresponding to a first signal according to one or more embodiments of the disclosure;

[0039] FIG. **11** is a diagram for explaining an operation of generating information related to a place corresponding to a second signal according to one or more embodiments of the disclosure;

[0040] FIG. **12** is a diagram for explaining a scheme of encrypting content according to one or more embodiments of the disclosure;

[0041] FIG. **13** is a diagram for explaining a scheme of decrypting content according to one or more embodiments of the disclosure;

[0042] FIG. **14** is a flowchart schematically illustrating an operating method of an electronic device according to one or more embodiments of the disclosure; and

[0043] FIG. **15** is a flowchart schematically illustrating an operating method of an electronic device according to one or more embodiments of the disclosure.

DETAILED DESCRIPTION

[0044] Hereinafter, one or more embodiments of the disclosure will be described in detail with reference to the accompanying drawings. In the following description of one or more embodiments of the disclosure, a detailed description of relevant known functions or configurations incorporated herein will be omitted when it is determined that the description may make the subject matter of one or more embodiments of the disclosure unnecessarily unclear. The terms which will be described below are terms defined in consideration of the functions in the disclosure, and may be different according to users, intentions of the users, or customs. Therefore, the definitions of the terms should be made based on the contents throughout the specification.

[0045] It should be noted that the technical terms used herein are only used to describe a specific embodiment, and are not intended to limit one or more embodiments of the disclosure. Alternatively, the technical terms used herein should be interpreted to have the same meaning as those commonly understood by a person skilled in the art to which the disclosure pertains, and should not be interpreted have excessively comprehensive or excessively restricted meanings unless particularly defined as other meanings. Alternatively, when the technical terms used herein are wrong technical terms that cannot correctly represent the idea of the disclosure, it should be appreciated that they are replaced by technical terms correctly understood by those skilled in the art. Alternatively, the general terms used in one or more embodiments of the disclosure should be interpreted as defined in dictionaries or interpreted in the context of the relevant part, and should not be interpreted to have excessively restricted meanings.

[0046] Alternatively, a singular expression used herein may include a plural expression unless they are definitely different in the context. As used herein, such an expression as "comprises" or "include", or the like should not be interpreted to necessarily include all elements or all operations described in the specification, and should be interpreted to be allowed to exclude some of them or further include additional elements or operations.

[0047] Alternatively, the terms including an ordinal number, such as expressions "a first" and "a second" may be used to describe various elements, but the corresponding elements should not be limited by such terms. These terms are used merely to distinguish between one element and any other element. For example, a first element may be termed a second element, and similarly, a second element may be termed a first element without departing from the scope of the disclosure.

[0048] It should be understood that when an element is referred to as being "connected" or "coupled" to another element, it may be connected or coupled directly to the other element, or any other element may be interposer between them. In contrast, it should be understood that when an element is referred to as being "directly connected" or "directly coupled" to another element, there are no element interposed between them.

[0049] Hereinafter, one or more embodiments of the disclosure will be described in detail with reference to the accompanying drawings. Regardless of drawing signs, the same or like elements are provided with the same reference numeral, and a repeated description thereof will be omitted. Alternatively, in describing one or more embodiments of the disclosure, a detailed description of relevant known technologies will be omitted when it is determined that the description may make the subject matter of the disclosure unclear. Alternatively, it should be noted that the accompanying drawings are presented merely to help easy understanding of the technical idea of the disclosure, and should not be construed to limit the technical idea of the disclosure. The technical idea of the disclosure should be construed to cover all changes, equivalents, and alternatives, in addition to the drawings.

[0050] Hereinafter, an electronic device will be described in one or more embodiments of the disclosure, but the electronic device may be referred to as a terminal, a mobile station, a mobile equipment (ME), a user equipment (UE), a user terminal (UT), a subscriber station (SS), a wireless device, a handheld device, or an access terminal (AT). Alternatively, in one or more embodiments of the disclosure, the electronic device may be a device having a communication function such as, for example, a mobile phone, a

personal digital assistant (PDA), a smart phone, a wireless MODEM, or a notebook. Alternatively, in one or more embodiments of the disclosure, the electronic device may be a device which may be connected to a plurality of electronic devices, such as a server (e.g., a cloud server).

[0051] FIG. **1** is a block diagram illustrating an electronic device **101** in a network environment **100** according to an embodiment.

[0052] 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 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**).

[0053] 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 an 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**.

[0054] The auxiliary processor **123** may control, for example, 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 (e.g., executing an application) state. 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 model 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.

[0055] 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**.

[0056] 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**.

[0057] 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).

[0058] 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.

[0059] 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.

[0060] The audio module **170** may convert a sound into an electrical signal and vice versa. According to an embodi-

ment, the audio module **170** may obtain the sound via the input module **150**, or output the sound via the sound output module **155** or an external electronic device (e.g., an electronic device **102** (e.g., a speaker or a headphone)) directly or wirelessly coupled with the electronic device **101**.

[0061] 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.

[0062] 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 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.

[0063] 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).

[0064] 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.

[0065] 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.

[0066] The power management module **188** may manage power supplied to the electronic device **101**. According to an embodiment, the power management module **188** may be implemented as at least part of, for example, a power management integrated circuit (PMIC).

[0067] 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.

[0068] 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 wireless 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 **104** 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 or 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**.

[0069] 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.

[0070] 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** 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**.

[0071] According to an embodiment, the antenna module **197** may form a mmWave antenna module. According to an embodiment, the mmWave antenna module may include a printed circuit board, an 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.

[0072] 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)).

[0073] 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.

[0074] FIG. **2** is a diagram schematically illustrating a wireless communication system according to one or more embodiments of the disclosure.

[0075] Referring to FIG. **2**, a wireless communication system may include an electronic device **101** (e.g., an electronic device **101** in FIG. **1**) and a server **108** (e.g., a server **108** in FIG. **1**).

[0076] In one or more embodiments, the electronic device **101** generates input data (e.g., real number data). In one or more embodiments, the real number data may include data related to a place at which the electronic device **101** is located (i.e. a location of the electronic device **101**). The data related to the place at which the electronic device **101** is located may include an image, signal strength, sound, and/or global positioning system (GPS) data. In one or more embodiments, the real number data may include biometric data, such as face data, voice data, fingerprint data, palm data, iris data, and/or vascular data, of a user of the electronic device **101**.

[0077] In one or more embodiments, the electronic device **101** may include a camera (e.g., a camera module **180** in FIG. **1**). The electronic device **101** may obtain an image related to the place via the camera and generate real number data corresponding to the obtained image.

[0078] In one or more embodiments, the electronic device **101** may include at least one sensor (e.g., a sensor module **176** in FIG. **1**). The electronic device **101** may sense biometric data from the user's body via the at least one sensor. The electronic device **101** may obtain a sound related to the place via the at least one sensor.

[0079] In one or more embodiments, the electronic device **101** may include at least one communication circuit or communication interface (e.g., a communication module **190** in FIG. **1**). The electronic device **101** may receive a signal related to the place (e.g., a WiFi signal and/or a Bluetooth signal) via the at least one communication circuit, and obtain signal strength (e.g., a received signal strength indicator (RSSI)) based on the received signal. The electronic device **101** may obtain GPS data related to the place via the at least one communication circuit.

[0080] In one or more embodiments, the electronic device **101** may generate an encryption key (e.g., a secret key) and data (e.g., helper data) used for reproducing the encryption key based on a fuzzy extractor scheme. The electronic device **101** may generate the helper data and/or the encryption key based on the generated input data. In one or more embodiments, the encryption key may be a key used for encryption of content. In one or more embodiments, the helper data may be data used for reproducing the encryption key, and the helper data may be implemented in a form of, for example, a helper matrix.

[0081] In one or more embodiments, the encryption key may include a plurality of (e.g., 512) elements, where a set number of (e.g., 16) elements among the plurality of elements may be non-zero elements, and the remaining number of elements may be zero elements. For example, each of the 16 non-zero elements may have a magnitude of ¼ (i.e., a value of ±¼), and each of the remaining elements (e.g., zero elements) may have a value of 0. In this way, each of the 16 elements has the value of ±¼, so the magnitude of the generated encryption key may have a value of 1.

[0082] In one or more embodiments, the helper matrix may be a matrix used for relatively moving a value of a sphere (e.g., a hypersphere) on a surface of the sphere. The helper matrix may be used for transforming the input data (e.g., the real number data (e.g., the image, signal strength, sound, and/or GPS data related to the place)) into the

encryption key, and may also be referred to as "public helper data." In one or more embodiments, the helper matrix may be configured based on a single moving operation, or may be configured by a plurality of moving operations. The configuration of the helper matrix will be described below with reference to FIG. **6** or FIG. **7**.

[0083] In one or more embodiments, the electronic device **101** may generate encrypted content by encrypting the content based on the generated encryption key, and store (for example, upload) the encrypted content and the helper data used for reproducing the encryption key in a memory (e.g., database) of the server **108**.

[0084] In one or more embodiments, the electronic device **101** may perform a decryption operation on the encrypted content. The electronic device **101** may receive (for example, download) the encrypted content and the helper data used for reproducing the encryption key used for encrypting the content from the server **108**. The electronic device **101** may generate data related to a place (e.g., an image, signal strength, a sound, and/or GPS data related to the place), and apply the generated data related to the place to the received helper data to reproduce the encryption key. The electronic device **101** may decrypt the encrypted content based on the reproduced encryption key.

[0085] In one or more embodiments, the electronic device **101** may perform an error correcting operation on the reproduced encryption key. The electronic device **101** may approximate an element value of each of elements consisting of the reproduced encryption key to a set value or a zero (0) value. For example, if only 16 elements among 512 elements included in a codeword are non-zero elements, a reproduced codeword generated by a helper matrix and input data has a magnitude of 1, and each element may have an approximate value for ±¼ or 0 (for example, +0.25012, −0.0034).

[0086] In this case, the electronic device **101** may perform the error correcting operation by approximating a value of an element having a value approximated to 0.25 to ¼, approximating a value of an element having a value approximated to −0.25 to −¼, and approximating a value of an element having a value approximated to 0 to 0. Once the error correcting operation is performed, like the encryption key, each of 16 elements among 512 elements in the reproduced encryption key may have a value of ±¼, and each of the remaining elements may have a value of 0.

[0087] In one or more embodiments, the electronic device **101** may be implemented as, for example, but is not limited to, a biometric information scanner, a smart phone, a tablet PC, a mobile phone, a video phone, a camera, an infrared (IR) sensor device, a microphone device, a desktop PC, a laptop PC, a netbook computer, a workstation, a personal digital assistant (PDA), a portable multimedia player (PMP), an MP3 player, a medical device, and/or a wearable device.

[0088] In one or more embodiments, the server **108** may receive, from the electronic device **101**, the encrypted content and the data (e.g., the helper data) used for reproducing the encryption key used for encrypting the content, and may store the received encrypted content and helper data in a memory (e.g., a database).

[0089] FIG. **3** is a block diagram schematically illustrating configuration of a server according to one or more embodiments of the disclosure.

[0090] Referring to FIG. **3**, a server **108** (e.g., a server **108** in FIG. **1** or FIG. **2**) may include a communication circuit (**310**), a processor (**320**), and/or memory (**330**).

[0091] According to one or more embodiments, a communication circuit **310** may transmit and receive a signal and/or data to and from an electronic device (e.g., an electronic device **101** in FIG. **1** or **2**). The communication circuit **310** may receive, from the electronic device, encrypted content and data (e.g., helper data) used for reproducing an encryption key used for encrypting the content. The encrypted content may be generated by the electronic device, and the electronic device may generate the encrypted content by encrypting the content based on the encryption key. The encryption key may be generated based on data related to a place at which the electronic device is located, and an operation of the electronic device encrypting the content may be similar to or substantially the same as described in FIG. **2**, so a detailed description thereof will be omitted herein.

[0092] Meanwhile, in FIG. **3**, a case has been described as an example in which the server **108** includes three components, such as the communication circuit **310**, the processor **320**, and the memory **330**, but the server **108** may further include other components other than the components described in FIG. **3**, or the server **108** may be implemented in a form in which some of the components described in FIG. **3** are omitted.

[0093] FIG. **4** is a diagram for explaining a fuzzy extractor scheme according to one or more embodiments of the disclosure.

[0094] Referring to FIG. **4**, there may be various schemes for generating an encryption key based on input data (e.g., data related to a place), and a fuzzy extractor scheme may be a scheme for extracting the encryption key from the input data itself.

[0095] In the fuzzy extractor scheme, a helper matrix (p) may be generated based on data (x) related to a place, and the helper matrix (p) may be used for reproducing an encryption key if data related to a place similar to data related to a place which has been pre-registered (or pre-stored) is presented in the future. For example, as illustrated in FIG. **4**, it may be assumed that the helper matrix (p) is generated based on the first real number data **10** at the time of initial registration. If the second real number data **20** which is not identical to but similar to the first real number data **10** is presented at a time point at which a decryption operation is performed, an encryption key (sk) may be reproduced based on the second real number data **20** and the helper matrix (p) (this operation is illustrated as "Reproduce" in FIG. **4**). In one or more embodiments, the helper matrix (p) may be expressed as p=f (sk), where sk may represent a reproduced encryption key.

[0096] In the disclosure, an error correcting technology applicable to real number data may be used, and the error correcting technology applicable to the real number data may be described as follows.

[0097] According to one or more embodiments, an error correcting operation for input data (e.g., real number data) may operate on an n-dimensional sphere (e.g., a hypersphere) satisfying the following Equation 1.

$$S^n=\{x=(x_1,x_2,\ldots,x_n)1x_1^2+x_2^2+\ldots+x_n^2=1\} \quad \text{[Equation 1]}$$

[0098] In Equation 1, S^n may represent an n-dimensional sphere.

[0099] A distance between two vectors (e.g., two secret keys) in an n-dimensional sphere S^n may be calculated using a cosine function, and an operation on the two vectors may

be performed based on spherical coordinates via the cosine function. And the closest vector may be found based on orthogonal coordinates. In this case, the encryption key may be expressed as the following Equation 2.

$$C = U_{\textcircled{?}}^{\textcircled{?}} C_{\textcircled{?}} \quad \text{[Equation 2]}$$

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[0100] In Equation 2, C represents the encryption key, and C_i is $C_i=\{x_1,x_2, \ldots ,x_n)\in S^n|wi(x)=i$ and $x_j=x_k$ if $x_j,x_k\neq 0$ for all j,k}. For example, in a four-dimensional sphere S^4, C_1 may be $\{(\pm 1,0,0,0), (0,\pm 1,0,0)\ (0,0,\pm 1,0), (0,0,0,\pm 1)\}$, C_2 may be

$$\left\{\left(\frac{1}{\sqrt{\textcircled{?}}}, \frac{1}{\sqrt{\textcircled{?}}}, 0, 0\right), \left(\frac{1}{\sqrt{\textcircled{?}}}, 0, \frac{1}{\sqrt{\textcircled{?}}}, 0\right), \ldots, \left(0, 0, \frac{1}{\sqrt{\textcircled{?}}}, \frac{1}{\sqrt{\textcircled{?}}}\right)\right\},$$

? indicates text missing or illegible when filed

and C_3 may be

$$\left\{\left(\frac{1}{\sqrt{\textcircled{?}}}, \frac{1}{\sqrt{\textcircled{?}}}, \frac{1}{\sqrt{\textcircled{?}}}, 0\right), \left(\frac{1}{\sqrt{\textcircled{?}}}, 0, \frac{1}{\sqrt{\textcircled{?}}}, \frac{1}{\sqrt{\textcircled{?}}}\right), \ldots, \left(0, -\frac{1}{\sqrt{\textcircled{?}}}, -\frac{1}{\sqrt{\textcircled{?}}}, -\frac{1}{\sqrt{\textcircled{?}}}\right)\right\}.$$

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[0101] For convenience of explanation, it will be assumed below that the encryption key is C_{16} in S^{512}, but it may not be limited thereto. According to one or more embodiments, there may be no restrictions on a dimension of a sphere in which the encryption key is generated, the number of elements included in the encryption key, or the encryption key selected from the sphere of the corresponding dimension.

[0102] Referring back to Equation 2, a minimum distance between two vectors in Ci may be

$$1-\frac{1}{2^{\textcircled{?}}},$$

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and a minimum distance between two vectors in C_i and C_j may be

$$\frac{1}{\sqrt{2^{\textcircled{?}}}}$$

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(if i<j). So, a decryption operation may be performed via a process of finding the closest encryption key for each element included in C_i.

[0103] FIG. **5** is a diagram for explaining a fuzzy extractor scheme according to one or more embodiments of the disclosure.

[0104] Referring to FIG. **5**, an encryption key (C) may be generated. Specifically, among a plurality of elements (e.g., 512 elements), some elements (e.g., 16 elements) have preset values (e.g., non-zero values or values of ±¼), the remaining elements have values of 0, and one of sets having a preset size may be selected as the encryption key (C). The generated encryption key may be outputted by applying a hash function. According to one or more embodiments, in a fuzzy extractor scheme, a helper matrix (p) may be generated to cause input real number data **10** (e.g., first real number data (W) **10**) to move to the encryption key (C).

[0105] In such an sphere environment, if the same rotation processing is performed on the input real number data (e.g., the first real number data (W) **10**), a value (C') for second real number data (W') **20** may be the same as a value which is obtained by adding a difference value between the first real number data (W) **10** and the second real number data (W') **20** and the encryption key (C).

[0106] According to one or more embodiments, since only some of the plurality of elements included in the encryption key have a set value, not all surfaces of the sphere are available as the encryption key, so there may be coordinates which may be located, and a vector for the second real number data may be used as a secret key by finding adjacent corresponding coordinates.

[0107] As described above, since the real number data (i.e., the reproduced encryption key) moved by the helper matrix is not the same as the data related to the place (i.e., the encryption key), the helper matrix may be used as a kind of public data (e.g., a public key). In FIG. **5**, a case where the encryption key is reproduced by moving the input data (e.g., the real number data) only once has been described as an example, but the encryption key may also be reproduced by moving the input data (e.g., the real number data) multiple times.

[0108] FIG. **6** is a diagram for explaining a fuzzy extractor scheme according to one or more embodiments of the disclosure.

[0109] Referring to FIG. **6**, in a fuzzy extractor scheme, an encryption key may be randomly selected from a set satisfying a condition of Equation 1. In the fuzzy extractor scheme, a random orthogonal matrix satisfying $Q\in R^{uvn}$ may be selected. Here, the random orthogonal matrix may be a matrix used for moving input data (e.g., real number data) in a random direction.

[0110] In the fuzzy extractor scheme, a rotation matrix used for rotating and moving real number data may be calculated. According to one or more embodiments, when real number data (z) satisfying $z\in S^n$, is inputted, the first intermediate data (u=Qz) may be obtained by matrix multiplying the real number data (z) by a selected random orthogonal matrix (Q). The second intermediate data ($v=c-u^Tcu$) may be obtained by performing a unit orthogonalization process (e.g., Gram-Schmidt process) on the codeword (C) and the first intermediate data (u).

[0111] Afterwards, a rotation angle (Θ) between the codeword (C) and the first intermediate data (u) may be obtained. A rotation matrix ($R=I-uu^T-vv^T+[u\ v]R\Theta[u\ v]^T$) may be

obtained using the calculated rotation angle (Θ), the first intermediate data (u), and the second intermediate data (v). Finally, a helper matrix (H=RQ) may be generated using the obtained rotation matrix and random orthogonal matrix.

[0112] FIG. **7** is a diagram for explaining an operation of a key generator and a reproducer according to one or more embodiments of the disclosure.

[0113] Referring to FIG. **7**, a key generator **711** and a reproducer **713** are disclosed. The key generator **711** and the reproducer **713** may be a hardware component (e.g., an operation block within an ASIC) within a processor (e.g., a processor **120** in FIG. **1**) included in an electronic device (e.g., an electronic device **101** in FIG. **1** or FIG. **2**), or may be a software module.

[0114] According to one or more embodiments, the key generator **711** may generate keys related to encryption. In one or more embodiments, the keys related to encryption may include at least one of an encryption key, a helper matrix (or helper data), or an encrypted secret key. According to one or more embodiments, the key generator **711** may select one of vectors including a plurality of elements and having a set magnitude as an encryption key. For example, if 16 elements among 512 elements included in a secret key have a set value and the remaining elements have a value of 0, the encryption key may be generated by randomly selecting 16 elements having the set value among 512 elements.

[0115] According to one or more embodiments, the key generator **711** may generate a helper matrix (p) by reflecting real number data (W_0) to the generated encryption key. The helper matrix may be implemented in a form of moving the real number data once on a spherical surface, or may be implemented in a form of moving the real number data multiple times on the spherical surface. According to one or more embodiments, if the helper matrix is implemented in the form of moving the real number data once on the spherical surface, the helper matrix may be obtained by matrix multiplying the generated encryption key by the real number data. According to one or more embodiments, if the helper matrix is obtained in a form of moving the real number data twice on the spherical surface, a random orthogonal matrix for moving the real number data in a random direction may be selected, a rotation matrix for rotating and moving the real number data may be obtained, and the helper matrix may be generated using the real number data, the selected random orthogonal matrix, and the obtained rotation matrix.

[0116] According to one or more embodiments, the key generator **711** may be implemented with an instruction for performing the operation described above. According to one or more embodiments, the key generator **711** may be implemented with hardware (e.g., an ASIC) capable of performing the operation described above.

[0117] According to one or more embodiments, the reproducer **713** may generate a reproduced encryption key when real number data (W_1) is inputted. Specifically, the reproducer **713** may obtain a reproduced encryption key by multiplying the real number data (W_1) by the helper matrix. Then, the reproducer **713** may reproduce the same encryption key if the real number data (W_1) similar to real number data (W_0) used when generating the helper matrix is inputted by making each element included in the obtained reproduced encryption key have a set value or a value of 0.

[0118] According to one or more embodiments, if real number data with noise is inputted, the reproducer **713** may reproduce a unique encryption key within a range where an angle difference between the encryption key and the inputted real number data satisfies a condition of the following Equation 3.

$$\cos^{-1}\left(\max\left\{1-\frac{1}{2^{m-1}}\textcircled{?}\frac{1}{\sqrt{2}}\right\}\right)/2 \qquad \text{[Equation 3]}$$

? indicates text missing or illegible when filed

[0119] According to one or more embodiments, the reproducer **713** may be implemented as a set of instructions (e.g., a program) for performing the operation described above. According to one or more embodiments, the reproducer **713** may be implemented as hardware (e.g., an ASIC) capable of performing the operation described above.

[0120] FIG. **8** is a diagram for explaining data related to a place used for encrypting content according to one or more embodiments of the disclosure.

[0121] Referring to FIG. **8**, an electronic device (e.g., an electronic device **101** in FIG. **1** or FIG. **2**) generates input data (e.g., real number data). In one or more embodiments, the input data may include data related to a place at which the electronic device is located. The data related to the place at which the electronic device is located may include an image, signal strength, a sound, and/or GPS data. In one or more embodiments, it will be assumed that the data related to the place includes first information, second information, and/or third information. The first information may be information generated based on an image related to the place, the second information may be information generated based on signal strength (e.g., an RSSI) of a first signal (e.g., a WiFi signal) related to the place, and the third information may be information generated based on signal strength (e.g., an RSSI) of a second signal (e.g., a Bluetooth signal) related to the place. In one or more embodiments, the data related to the place will be described as an example in which the data related to the place includes the first information, the second information, and/or the third information, but the data related to the place may further include additional information in addition to the first information, the second information, and/or the third information.

[0122] In one or more embodiments, the electronic device may obtain an image **811** related to a place **810** at which the electronic device is located via a camera (e.g., a camera module **180** in FIG. **1**) and generate first information corresponding to the obtained image **811**. An operation of the electronic device generating the first information corresponding to the obtain image **811** may be described as follows with reference to FIG. **9**.

[0123] FIG. **9** is a diagram for explaining an operation of generating information related to a place corresponding to an image according to one or more embodiments of the disclosure.

[0124] Referring to FIG. **9**, an electronic device (e.g., an electronic device **101** in FIG. **1** or FIG. **2**) may obtain an image **811** (e.g., an image **811** in FIG. **8**) related to a place **810** at which the electronic device **101** is located via a camera (e.g., a camera module **180** in FIG. **1**).

[0125] The electronic device may extract feature information from the image **811** and obtain information (e.g., first information) related to a place based on the extracted feature information. In one or more embodiments, the feature infor-

mation may include feature points **812**, **813**, **814**, **815**, and **816** included in the image **811**. In one or more embodiments, a feature point may be a point which may represent a feature of the image **811**, such as a corner. The electronic device may generate the first information based on the extracted feature points **812**, **813**, **814**, **815**, and **816**, and this may be described as follows.

[0126] The electronic device may extract a total of five feature points **812**, **813**, **814**, **815**, and **816** from the image **811**, and set a specific feature point (for example, a first feature point **812**) among the total of five feature points **812**, **813**, **814**, **815**, and **816** as a reference feature point. The electronic device may set a value of the reference feature point **812** based on a location and a color of the reference feature point **812**. For example, a location value of the reference feature point **812** may be set to a value of (0,0), and a color value of the reference feature point **812** may be set to a real/rational number value of a red, green, blue (RGB) type. A location value of each of the remaining feature points **813**, **814**, **815**, and **816** may be set according to a relative location with respect to the reference feature point. In this case, the electronic device may generate the first information in a form of a vector including a real number, such as (0,0,R1,G1,B1, 0,3, R2,G2,B2, 0,5,R3,G3, B3, 0,7,R4,G4,B4, 0,9,R5,G5, B5) from the image **811**. Here, R* may represent a real/rational number value of a color corresponding to Red, G* may represent a real/rational number value of a color corresponding to Green, and B* may represent a real/rational number value of a color corresponding to Blue.

[0127] Referring back to FIG. **8**, the electronic device may receive a first signal **820** (e.g., a WiFi signal) related to the place **810** at which the electronic device is located via at least one communication circuit (e.g., a communication module **190** in FIG. **1**), and generate second information corresponding to signal strength (e.g., an RSSI) of the first signal. An operation of the electronic device generating second information corresponding to the received first signal may be described as follows with reference to FIG. **10**.

[0128] FIG. **10** is a diagram for explaining an operation of generating information related to a place corresponding to a first signal according to one or more embodiments of the disclosure.

[0129] Referring to FIG. **10**, an electronic device (e.g., an electronic device **101** in FIG. **1** or FIG. **2**) may receive a first signal (e.g., a WiFi signal) related to a place at which the electronic device is located via at least one communication circuit (e.g., a communication module **190** in FIG. **1**). The electronic device may receive a WiFi signal from each of a plurality of access points (APs) at a measurement location **1000**.

[0130] The electronic device may extract feature information from the WiFi signal received from each of the plurality of APs, and obtain information (e.g., second information) related to the place based on the extracted feature information. In one or more embodiments, the feature information may include an identifier (e.g., a service set identifier (SSID)) of an AP included in the received WiFi signal and signal strength (e.g., an RSSI) of the received WiFi signal. The electronic device may generate the second information based on the extracted feature information, and this may be described as follows.

[0131] The electronic device may extract an SSID and an RSSI of an AP from the WiFi signal received from each of the plurality of APs, and generate the information related to the place (e.g., the second information) based on the extracted SSID and RSSI. The electronic device may generate the second information in a form of a vector including the SSID and the RSSI of the WiFi signal received from the AP corresponding to the SSID in an order of the SSIDs (e.g., in ascending order). If the plurality of APs include a total of five APs **1011**, **1012**, **1013**, **1014**, and **1015**, the electronic device may generate the second information in a form of a vector including a real number, such as (SSID1,**22**, SSID2, **31**, SSID3, **45**, SSID4, **22**, SSID5, **31**).

[0132] Referring back to FIG. **8**, the electronic device may receive a second signal (e.g., a Bluetooth signal) related to the place **810** at which the electronic device is located via the at least one communication circuit, and may generate third information corresponding to signal strength (e.g., an RSSI) of the second signal. An operation of the electronic device generating the third information corresponding to the received second signal may be described as follows with reference to FIG. **11**.

[0133] FIG. **11** is a diagram for explaining an operation of generating information related to a place corresponding to a second signal according to one or more embodiments of the disclosure.

[0134] Referring to FIG. **11**, an electronic device (e.g., an electronic device **101** in FIG. **1** or FIG. **2**) may receive a second signal **830** (e.g., a Bluetooth signal) related to a place at which the electronic device is located via at least one communication circuit (e.g., a communication module **190** in FIG. **1**). The electronic device may receive a Bluetooth signal (e.g., an advertising signal) from each of a plurality of Bluetooth terminals (BTs) at a measurement location **1000**. A BT may periodically transmit an advertising signal via an advertising operation, and the electronic device may receive the advertising signal periodically transmitted from the BT via a scanning operation.

[0135] The electronic device may extract feature information from the advertising signal received from each of the plurality of BTs, and obtain information related to the place (e.g., third information) based on the extracted feature information. In one or more embodiments, the feature information may include an identifier (e.g., a universally unique identifier (UUID)) of the BT included in the received advertising signal and signal strength (e.g., an RSSI) of the received advertising signal. The electronic device may generate the third information based on the extracted feature information, and this may be described as follows.

[0136] The electronic device may extract the UUID and the RSSI of the BT from the advertising signal received from each of the plurality of BTs, and generate the information related to the place (e.g., the third information) based on the extracted UUID and RSSI. The electronic device may generate the third information in a form of a vector including the UUID and the RSSI of the advertising signal received from the BT corresponding to the UUID, in an order of the UUIDs (e.g., in ascending order). If the plurality of BTs include a total of five BTs **1111**, **1112**, **1113**, **1114**, and **1115**, the electronic device may generate the third information in a form of a vector including a real number, such as (UUID1, **22**, UUID2, **32**, UUID3, **45**, UUID4, **22**, UUID5, **32**).

[0137] Referring back to FIG. **8**, the electronic device which generates the information related to the place, including the first information, the second information, and/or the third information, may generate an encryption key used for

encrypting content by applying a first encryption scheme (e.g., a fuzzy extractor scheme) to the information related to the place. In FIG. **8**, it will be assumed that the electronic device generates all of the first information, the second information, and the third information as the information related to the place.

[0138] In one or more embodiments, the electronic device may generate first helper data and a first encryption key by applying a set first encryption scheme to the first information. In one or more embodiments, the first helper data may be data used for reproducing the first encryption key.

[0139] In one or more embodiments, the electronic device may generate second helper data and a second encryption key by applying the first encryption scheme to the second information. In one or more embodiments, the second helper data may be data used for reproducing the second encryption key. The electronic device may generate modified second helper data by applying a second encryption scheme (e.g., a rotation scheme) to the first encryption key and the second helper data. In one or more embodiments, the rotation scheme may be a scheme based on a set rotation matrix. The second helper data may be based only on the second information, but the modified second helper data may be based on the first encryption key based on the first information and the second information. So, the modified second helper data may be advantageous in terms of security compared to the second helper data.

[0140] In one or more embodiments, the electronic device may generate third helper data and a third encryption key by applying the first encryption scheme to the third information. The electronic device may generate modified third helper data by applying a second encryption scheme to the second encryption key and the third helper data. The third helper data may be based only on the third information, but the modified third helper data may be based on the second encryption key based on the second information and the third information. So, the modified third helper data may be advantageous in terms of security compared to the third helper data.

[0141] In one or more embodiments, the electronic device may encrypt the content using the third encryption key to generate encrypted content. The electronic device may transmit (for example, upload), to a server (e.g., a server **108** in FIG. **1**) via the at least one communication circuit, the encrypted content, and the first helper data, the modified second helper data, and the modified third helper data related to encrypting the content.

[0142] In FIG. **8**, a case in which the electronic device generates the modified second helper data and the modified third helper data has been described as an example, but the electronic device may transmit, to the server, the encrypted content, the first helper data, the second helper data, and the third helper data without generating the modified second helper data and the modified third helper data.

[0143] FIG. **12** is a diagram for explaining a scheme of encrypting content according to one or more embodiments of the disclosure.

[0144] Referring to FIG. **12**, an electronic device (e.g., an electronic device **101** in FIG. **1** or **2**) may generate input data (e.g., real number data). In one or more embodiments, the input data may include information related to a place at which the electronic device is located. The information related to the place at which the electronic device is located may include an image, signal strength, a sound, and/or GPS information. In one or more embodiments, it will be assumed that the information related to the place includes first information, second information, and/or third information. The first information may be information generated based on first data (e.g., an image) related to the place, the second information may be information generated based on second data (e.g., a first signal (e.g., a WiFi signal)) related to the place, and the third information may be information generated based on third data (e.g., a second signal (e.g., a Bluetooth signal)) related to the place. In one or more embodiments, the second information may be information generated based on signal strength (e.g., an RSSI) of the first signal, and the third information may be information generated based on signal strength (e.g., an RSSI) of the second signal. In one or more embodiments, the information related to the place will be described as an example in which the information related to the place includes the first information, the second information, and/or the third information, but the information related to the place may further include additional information in addition to the first information, the second information, and/or the third information. The first information, the second information, and/or the third information may be implemented similarly to or substantially the same as described with reference to FIGS. **8** to **11**, so detailed description thereof will be omitted herein.

[0145] The electronic device may generate first helper data and a first encryption key by applying a set first encryption scheme (e.g., a fuzzy extractor scheme) to the first information in operation **1210**.

[0146] The electronic device which generates the first helper data and the first encryption key may, in operation **1220**, generate second helper data and a second encryption key by applying the first encryption scheme (e.g., the fuzzy extractor scheme) to the second information.

[0147] The electronic device which generates the second helper data and the second encryption key may, in operation **1230**, generate encrypted second helper data by applying a second encryption scheme (e.g., a rotation scheme) to the first encryption key and the second helper data. In one or more embodiments, the rotation scheme may be a scheme based on a set rotation matrix. The second helper data may be based only on the second information, but the encrypted second helper data may be based on the first encryption key based on the first information and the second information. So, the encrypted second helper data may be advantageous in terms of security compared to the second helper data.

[0148] The electronic device which generates the encrypted second helper data may, in operation **1240**, apply the first encryption scheme (e.g., the fuzzy extractor scheme) to the third information to generate third helper data and a third encryption key.

[0149] The electronic device which generates the third helper data and the third encryption key may, in operation **1250**, generate encrypted third helper data by applying the second encryption scheme (e.g., the rotation scheme) to the second encryption key and the third helper data.

[0150] The electronic device which generates the encrypted third helper data may, in operation **1260**, generate encrypted content by encrypting the content using the third encryption key.

[0151] The electronic device which generates the encrypted content may transmit (for example, upload), to a server (e.g., a server **108** in FIG. **1**), via at least one communication circuit (e.g., a communication module **190**

in FIG. **1**), the encrypted content, and the first helper data, the encrypted second helper data, and the encrypted third helper data which are related to the content. The third helper data may be based only on the third information, but the encrypted third helper data may be based on the second encryption key based on the second information and the third information. So, the encrypted third helper data may be advantageous in terms of security compared to the third helper data.

[0152] In FIG. **12**, an example has been described in which the electronic device generates the encrypted second helper data and the encrypted third helper data, but the electronic device may transmit, to the server, the encrypted content, the first helper data, the second helper data, and the third helper data without generating the encrypted second helper data and the encrypted third helper data.

[0153] FIG. **13** is a diagram for explaining a scheme of decrypting content according to one or more embodiments of the disclosure.

[0154] Referring to FIG. **12**, an electronic device (e.g., an electronic device **101** in FIG. **1** or **2**) may generate input data (e.g., real number data). In one or more embodiments, the input data may include information related to a place at which the electronic device is located. The information related to the place at which the electronic device is located may include an image, signal strength, a sound, and/or GPS information. In one or more embodiments, it will be assumed that the information related to the place includes first information, second information, and/or third information. The first information may be information generated based on first data (e.g., an image) related to the place, the second information may be information generated based on second data (e.g., a first signal (e.g., a WiFi signal)) related to the place, and the third information may be information generated based on third data (e.g., a second signal (e.g., a Bluetooth signal)) related to the place. In one or more embodiments, the second information may be information generated based on signal strength (e.g., an RSSI) of the first signal, and the third information may be information generated based on signal strength (e.g., an RSSI) of the second signal. In one or more embodiments, the information related to the place will be described as an example in which the information related to the place includes the first information, the second information, and/or the third information, but the information related to the place may further include additional information in addition to the first information, the second information, and/or the third information. The first information, the second information, and/or the third information may be implemented similarly to or substantially the same as described with reference to FIGS. **8** to **11**, so detailed description thereof will be omitted herein.

[0155] The electronic device may receive (for example, download) encrypted content, first helper data related to content, encrypted second helper data, and encrypted third helper data from a server (e.g., a server **108** in FIG. **1**) via at least one communication circuit (e.g., a communication module **190** in FIG. **1**).

[0156] The electronic device which receives the encrypted content, the first helper data related to the content, the encrypted second helper data, and the encrypted third helper data may, in operation **1310**, reproduce a first encryption key by applying a set first decryption scheme (e.g., a fuzzy extractor scheme) to the first information and the first helper data. In one or more embodiments, the first decryption scheme may be a decryption scheme corresponding to a first encryption scheme.

[0157] The electronic device which reproduces the first encryption key may, in operation **1320**, generate second helper data by applying a second decryption scheme (e.g., a rotation scheme) to the reproduced first encryption key and the encrypted second helper data. In one or more embodiments, the second decryption scheme may be a decryption scheme corresponding to the second encryption scheme.

[0158] The electronic device which generates the second helper data may, in operation **1330**, reproduce the second encryption key by applying the first decryption scheme (e.g., the fuzzy extractor scheme) to the second information and the second helper data.

[0159] The electronic device which reproduces the second encryption key may, in operation **1340**, apply the second decryption scheme (e.g., the rotation scheme) to the reproduced second encryption key and the encrypted third helper data to generate third helper data.

[0160] The electronic device which generates the third helper data may, in operation **1350**, reproduce a third encryption key by applying the first decryption scheme (e.g., the fuzzy extractor scheme) to the third information and the third helper data.

[0161] The electronic device which reproduces the third encryption key may, in operation **1360**, decrypt the encrypted content using the third encryption key.

[0162] As described in FIG. **13**, in order to decrypt the encrypted content, the reproduced first encryption key, second encryption key, and third encryption key may need to be identical to the first encryption key, second encryption key, and third encryption key used for encrypting the content. If any one of the reproduced first encryption key, second encryption key, and third encryption key is different from the first encryption key, second encryption key, and third encryption key used for encrypting the content, the encrypted content may not be decrypted. The reproduced first encryption key, second encryption key, and third encryption key may be based on the first information, second information, and third information related to the place at which the electronic device is located, so the encrypted content may not be decrypted at a place other than the place at which the content is encrypted. So, if an encryption/decryption scheme for content proposed in one or more embodiments of the disclosure is used, security for the content may be improved based on a place.

[0163] If any one of the reproduced first encryption key, second encryption key, and third encryption key is different from the first encryption key, second encryption key, and third encryption key used for encrypting the content, the encrypted content may not be decrypted, and in this case, the electronic device may output a message indicating that decryption of the encrypted content has failed via a display (e.g., a display module **160** in FIG. **1**).

[0164] According to one or more embodiments of the disclosure, an electronic device (**101**) may include at least one communication circuit (**190**), a camera (**180**) or at least one sensor (**176**), and at least one processor (**120**) connected to the at least one communication circuit, the camera, or the at least one sensor.

[0165] According to one or more embodiments of the disclosure, the at least one processor may be configured to, based on first data obtained via the camera or the at least one

sensor, generate first information related to a place at which the electronic device is located.

[0166] According to one or more embodiments of the disclosure, the at least one processor may be configured to, based on second data obtained via the at least one communication circuit, generate second information related to the place.

[0167] According to one or more embodiments of the disclosure, the at least one processor may be configured to, based on the first information and the second information, generate an encryption key used for encrypting content and data used for reproducing the encryption key.

[0168] According to one or more embodiments of the disclosure, the at least one processor may be configured to encrypt the content based on the encryption key.

[0169] According to one or more embodiments of the disclosure, the at least one processor may be configured to transmit, to a server (**108**), via the at least one communication circuit, the encrypted content and the data used for reproducing the encryption key.

[0170] According to one or more embodiments of the disclosure, the at least one processor may be configured to apply a first encryption scheme to the first information to generate a first encryption key and data used for reproducing the first encryption key.

[0171] According to one or more embodiments of the disclosure, the at least one processor may be configured to apply the first encryption scheme to the second information to generate a second encryption key and data used for reproducing the second encryption key.

[0172] According to one or more embodiments of the disclosure, the at least one processor may be configured to generate data used for reproducing an encrypted second encryption key which is generated by applying a second encryption scheme to the first encryption key and the data used for reproducing the second encryption key.

[0173] According to one or more embodiments of the disclosure, the encryption key may include the second encryption key, and the data used for reproducing the encryption key may include the data used for reproducing the first encryption key and the data used for reproducing the encrypted second encryption key.

[0174] According to one or more embodiments of the disclosure, the at least one processor may be configured to, if the first data is an image obtained via the camera, extract feature information including feature points from the image.

[0175] According to one or more embodiments of the disclosure, the at least one processor may be configured to set any one of the feature points as a reference feature point.

[0176] According to one or more embodiments of the disclosure, the at least one processor may be configured to, based on a location and a color of the reference feature point, determine a location value and a color value of the reference feature point.

[0177] According to one or more embodiments of the disclosure, the at least one processor may be configured to, based on the location of the reference feature point, determine location values of remaining feature points except for the reference feature point among the feature points, and determine color values of the remaining feature points.

[0178] According to one or more embodiments of the disclosure, the at least one processor may be configured to generate the first information including the location values and the color values of the feature points.

[0179] According to one or more embodiments of the disclosure, the at least one processor may be configured to, if the second data is at least one signal obtained via the at least one communication circuit, identify an identifier of another electronic device transmitting the at least one signal.

[0180] According to one or more embodiments of the disclosure, the at least one processor may be configured to measure received signal strength of the at least one signal.

[0181] According to one or more embodiments of the disclosure, the at least one processor may be configured to generate the second information including the identifier of the other electronic device and the received signal strength.

[0182] According to one or more embodiments of the disclosure, the signal may be a wireless fidelity (Wi-Fi) signal, the identifier of the other electronic device may be a service set identifier (SSID), and the received signal strength may be a received signal strength indicator (RSSI).

[0183] According to one or more embodiments of the disclosure, the signal may be a Bluetooth signal, the identifier of the other electronic device may be a universally unique identifier (UUID), and the received signal strength may be a received signal strength indicator (RSSI).

[0184] According to one or more embodiments of the disclosure, an electronic device (**101**) may include at least one communication circuit (**190**), a camera (**180**) or at least one sensor (**176**), and at least one processor (**120**) connected to the at least one communication circuit, the camera, or the at least one sensor.

[0185] According to one or more embodiments of the disclosure, the at least one processor may be configured to, based on first data obtained via the camera or the at least one sensor, generate first information related to a place at which the electronic device is located.

[0186] According to one or more embodiments of the disclosure, the at least one processor may be configured to, based on second data obtained via the at least one communication circuit, generate second information related to the place.

[0187] According to one or more embodiments of the disclosure, the at least one processor may be configured to, based on data used for reproducing an encryption key used for encrypting content, the first information, and the second information, reproduce the encryption key.

[0188] According to one or more embodiments of the disclosure, the at least one processor may be configured to, based on the encryption key, decrypt the encrypted content.

[0189] According to one or more embodiments of the disclosure, the at least one processor may be configured to, receive, from a server (**108**), via the at least one communication circuit, the encrypted content and the data used for reproducing the encryption key.

[0190] According to one or more embodiments of the disclosure, the data used for reproducing the encryption key may include data used for reproducing a first encryption key and data used for reproducing an encrypted second encryption key.

[0191] According to one or more embodiments of the disclosure, the at least one processor may be configured to reproduce the first encryption key by applying a first decryption scheme to the first information and the data used for reproducing the first encryption key.

[0192] According to one or more embodiments of the disclosure, the at least one processor may be configured to reproduce data used for reproducing a second encryption

key by applying a second decryption scheme to the first encryption key and the data used for the encrypted second encryption key.

[0193] According to one or more embodiments of the disclosure, the at least one processor may be configured to reproduce the second encryption key by applying the first decryption scheme to the data used for reproducing the second encryption key and the second information.

[0194] According to one or more embodiments of the disclosure, the encryption key may include the second encryption key.

[0195] According to one or more embodiments of the disclosure, the data used for reproducing the first encryption key may be generated by applying a first encryption scheme corresponding to the first decryption scheme to the first information.

[0196] According to one or more embodiments of the disclosure, the data used for reproducing the encrypted second encryption key may be generated by applying a second encryption scheme corresponding to the second decryption scheme to the data used for reproducing the first encryption key and the data used for reproducing the second encryption key.

[0197] According to one or more embodiments of the disclosure, the data used for reproducing the first encryption key may be generated by applying the first encryption scheme to the first information.

[0198] According to one or more embodiments of the disclosure, the data used for reproducing the second encryption key may be generated by applying the first encryption scheme to the second information.

[0199] According to one or more embodiments of the disclosure, the at least one processor may be configured to, if the first data is an image obtained via the camera, extract feature information including feature points from the image.

[0200] According to one or more embodiments of the disclosure, the at least one processor may be configured to set any one of the feature points as a reference feature point.

[0201] According to one or more embodiments of the disclosure, the at least one processor may be configured to, based on a location and a color of the reference feature point, determine a location value and a color value of the reference feature point.

[0202] According to one or more embodiments of the disclosure, the at least one processor may be configured to, based on the location of the reference feature point, determine location values of remaining feature points except for the reference feature point among the feature points, and determine color values of the remaining feature points.

[0203] According to one or more embodiments of the disclosure, the at least one processor may be configured to generate the first information including the location values and the color values of the feature points.

[0204] According to one or more embodiments of the disclosure, the at least one processor may be configured to, if the second data is at least one signal obtained via the at least one communication circuit, identify an identifier of another electronic device transmitting the at least one signal.

[0205] According to one or more embodiments of the disclosure, the at least one processor may be configured to measure received signal strength of the at least one signal.

[0206] According to one or more embodiments of the disclosure, the at least one processor may be configured to generate the second information including the identifier of the other electronic device and the received signal strength.

[0207] According to one or more embodiments of the disclosure, the signal may be a wireless fidelity (Wi-Fi) signal, the identifier of the other electronic device may be a service set identifier (SSID), and the received signal strength may be a received signal strength indicator (RSSI).

[0208] According to one or more embodiments of the disclosure, the signal may be a Bluetooth signal, the identifier of the other electronic device may be a universally unique identifier (UUID), and the received signal strength may be a received signal strength indicator (RSSI).

[0209] FIG. **14** is a flowchart schematically illustrating an operating method of an electronic device according to one or more embodiments of the disclosure.

[0210] Referring to FIG. **14**, an electronic device (e.g., an electronic device **101** in FIG. **1** or FIG. **2**) (e.g., a processor **120** in FIG. **1**) may, in operation **1411**, generate first information related to a place at which the electronic device is located based on first data obtained via a camera (e.g., a camera module (**180**) in FIG. **1**) or at least one sensor (e.g., a sensor module **176** in FIG. **1**).

[0211] In one or more embodiments, the electronic device may extract feature information including feature points from the image if the first data is an image obtained via the camera, set any one of the feature points as a reference feature point, based on a location and a color of the reference feature point, determine a location value and a color value of the reference feature point, based on the location of the reference feature point, determine location values of remaining feature points except for the reference feature point among the feature points, and determine color values of the remaining feature points, and generate the first information including the location values and the color values of the feature points. A scheme of generating the first information based on the first data may be similar to or substantially the same as that described in FIG. **9**, so a detailed description thereof will be omitted herein.

[0212] The electronic device which generates the first information related to the place at which the electronic device is located may, in operation **1413**, generate second information related to the place at which the electronic device is located based on second data obtained via at least one communication circuit (e.g., a communication module **190** in FIG. **1**).

[0213] In one or more embodiments, if the second data is at least one signal obtained via the at least one communication circuit, the electronic device may identify an identifier of another electronic device transmitting the at least one signal, measure received signal strength of the at least one signal, and generate the second information including the identifier of the other electronic device and the received signal strength. For example, the signal may be a Wi-Fi signal, the identifier of the other electronic device may be an SSID, and the received signal strength may be an RSSI. For another example, the signal may be a Bluetooth signal, the identifier of the other electronic device is a UUID, and the received signal strength may be an RSSI. A scheme of generating the second information based on the second data may be similar to or substantially the same as that described in FIGS. **10** and **11**, so a detailed description thereof will be omitted herein.

[0214] The electronic device which generates the second information related to the place at which the electronic

device is located, may, in operation **1415**, generate an encryption key used for encrypting content based on the first information and the second information, and data used for reproducing the encryption key. Hereinafter, for convenience of explanation, the data used for reproducing the encryption key will be referred to as "reproduction-related data."

[0215] In one or more embodiments, the electronic device may apply a first encryption scheme (e.g., a fuzzy extractor scheme) to the first information to generate first reproduction-related data and a first encryption key, apply the first encryption scheme to the second information to generate second reproduction-related data and a second encryption key, and apply a second encryption scheme (e.g., a rotation scheme) to the first encryption key and the second reproduction-related data to generate encrypted second reproduction-related data. In one or more embodiments, the encryption key may include the second encryption key, and the reproduction-related data may include the first reproduction-related data and the encrypted second reproduction-related data.

[0216] The electronic device which generates the encryption key used for encrypting the content and the data used for reproducing the encryption key may encrypt the content based on the encryption key in operation **1417**.

[0217] The electronic device may transmit (for example, upload) the encrypted content and the reproduction-related data to a server (e.g., a server **108** in FIG. **1**) via the at least one communication circuit, thereby causing the encrypted content and the reproduction-related data to be stored on the server.

[0218] FIG. **15** is a flowchart schematically illustrating an operating method of an electronic device according to one or more embodiments of the disclosure.

[0219] Referring to FIG. **15**, an electronic device (e.g., an electronic device **101** in FIG. **1** or FIG. **2**) (e.g., a processor **120** in FIG. **1**) may, in operation **1511**, generate first information related to a place at which the electronic device is located based on first data obtained via a camera (e.g., a camera module (**180**) in FIG. **1**) or at least one sensor (e.g., a sensor module **176** in FIG. **1**).

[0220] In one or more embodiments, the electronic device may extract feature information including feature points from the image if the first data is an image obtained via the camera, set any one of the feature points as a reference feature point, based on a location and a color of the reference feature point, determine a location value and a color value of the reference feature point, based on the location of the reference feature point, determine location values of remaining feature points except for the reference feature point among the feature points, and determine color values of the remaining feature points, and generate the first information including the location values and the color values of the feature points. A scheme of generating the first information based on the first data may be similar to or substantially the same as that described in FIG. **9**, so a detailed description thereof will be omitted herein.

[0221] The electronic device which generates the first information related to the place at which the electronic device is located may, in operation **1513**, generate second information related to the place at which the electronic device is located based on second data obtained via at least one communication circuit (e.g., a communication module **190** in FIG. **1**).

[0222] In one or more embodiments, if the second data is at least one signal obtained via the at least one communication circuit, the electronic device may identify an identifier of another electronic device transmitting the at least one signal, measure received signal strength of the at least one signal, and generate the second information including the identifier of the other electronic device and the received signal strength. For example, the signal may be a Wi-Fi signal, the identifier of the other electronic device may be an SSID, and the received signal strength may be an RSSI. For another example, the signal may be a Bluetooth signal, the identifier of the other electronic device is a UUID, and the received signal strength may be an RSSI. A scheme of generating the second information based on the second data may be similar to or substantially the same as that described in FIGS. **10** and **11**, so a detailed description thereof will be omitted herein.

[0223] The electronic device, which generates the second information related to the place at which the electronic device is located, may reproduce an encryption key used for encrypting content based on data used for reproducing the encryption key, the first information, and the second information in operation **1515**. Hereinafter, for convenience of explanation, the data used for reproducing the encryption key will be referred to as "reproduction-related data," and the encryption key may include a second encryption key.

[0224] One or more embodiments herein may constitute an improvement to computer functionality (i.e. improving the functioning of the computer itself) by providing a novel method of encryption based on device location. This improves data security and solves a problem in the realm of computer networks.

[0225] In one or more embodiments, the data used for reproducing the encryption key may include data used for reproducing a first encryption key and data used for reproducing an encrypted second encryption key.

[0226] In one or more embodiments, the electronic device may reproduce the first encryption key by applying a first decryption scheme to the first information and the data used for reproducing the first encryption key. The electronic device may reproduce data used for reproducing a second encryption key by applying a second decryption scheme to the first encryption key and the data used for the encrypted second encryption key. The electronic device may reproduce the second encryption key by applying the first decryption scheme to the data used for reproducing the second encryption key and the second information.

[0227] In one or more embodiments, the data used for reproducing the first encryption key may be generated by applying a first encryption scheme corresponding to the first decryption scheme to the first information. In one or more embodiments, the data used for reproducing the encrypted second encryption key may be generated by applying a second encryption scheme corresponding to the second decryption scheme to the data used for reproducing the first encryption key and the data used for reproducing the second encryption key. In one or more embodiments, the data used for reproducing the first encryption key may be generated by applying the first encryption scheme to the first information. In one or more embodiments, the data used for reproducing the second encryption key may be generated by applying the first encryption scheme to the second information.

[0228] The electronic device which reproduces the encryption key may decrypt the encrypted content based on the encryption key in operation **1517**.

[0229] According to one or more embodiments of the disclosure, a method may be provided.

[0230] According to one or more embodiments of the disclosure, the method may include, based on first data obtained via a camera (**180**) or at least one sensor (**176**), generating first information related to a place at which an electronic device (**101**) is located.

[0231] According to one or more embodiments of the disclosure, the method may include, based on second data obtained via at least one communication circuit (**190**), generating second information related to the place.

[0232] According to one or more embodiments of the disclosure, the method may include, based on the first information and the second information, generating an encryption key used for encrypting content and data used for reproducing the encryption key.

[0233] According to one or more embodiments of the disclosure, the method may include encrypting the content based on the encryption key.

[0234] According to one or more embodiments of the disclosure, the method may include transmitting, to a server (**108**), the encrypted content and the data used for reproducing the encryption key.

[0235] According to one or more embodiments of the disclosure, generating the encryption key and the data used for reproducing the encryption key may include applying a first encryption scheme to the first information to generate a first encryption key and data used for reproducing the first encryption key.

[0236] According to one or more embodiments of the disclosure, generating the encryption key and the data used for reproducing the encryption key may include applying the first encryption scheme to the second information to generate a second encryption key and data used for reproducing the second encryption key.

[0237] According to one or more embodiments of the disclosure, generating the encryption key and the data used for reproducing the encryption key may include generating data used for reproducing an encrypted second encryption key which is generated by applying a second encryption scheme to the first encryption key and the data used for reproducing the second encryption key.

[0238] According to one or more embodiments of the disclosure, the encryption key includes the second encryption key, and the data used for reproducing the encryption key includes the data used for reproducing the first encryption key and the data used for reproducing the encrypted second encryption key.

[0239] According to one or more embodiments of the disclosure, generating the first information may include, if the first data is an image obtained via the camera, extracting feature information including feature points from the image.

[0240] According to one or more embodiments of the disclosure, generating the first information may include setting any one of the feature points as a reference feature point.

[0241] According to one or more embodiments of the disclosure, generating the first information may include, based on a location and a color of the reference feature point, determining a location value and a color value of the reference feature point.

[0242] According to one or more embodiments of the disclosure, generating the first information may include, based on the location of the reference feature point, determining location values of remaining feature points except for the reference feature point among the feature points, and determine color values of the remaining feature points.

[0243] According to one or more embodiments of the disclosure, generating the first information may include generating the first information including the location values and the color values of the feature points.

[0244] According to one or more embodiments of the disclosure, generating the first information may include, if the second data is at least one signal obtained via the at least one communication circuit, identifying an identifier of another electronic device transmitting the at least one signal.

[0245] According to one or more embodiments of the disclosure, generating the first information may include measuring received signal strength of the at least one signal.

[0246] According to one or more embodiments of the disclosure, generating the first information may include generating the second information including the identifier of the other electronic device and the received signal strength.

[0247] According to one or more embodiments of the disclosure, the signal may be a wireless fidelity (Wi-Fi) signal, the identifier of the other electronic device may be a service set identifier (SSID), and the received signal strength may be a received signal strength indicator (RSSI).

[0248] According to one or more embodiments of the disclosure, the signal may be a Bluetooth signal, the identifier of the other electronic device may be a universally unique identifier (UUID), and the received signal strength may be a received signal strength indicator (RSSI).

[0249] According to one or more embodiments of the disclosure, a method may be provided.

[0250] According to one or more embodiments of the disclosure, the method may include, based on first data obtained via a camera (**180**) or at least one sensor (**176**), generating first information related to a place at which an electronic device (**101**) is located.

[0251] According to one or more embodiments of the disclosure, the method may include, based on second data obtained via at least one communication circuit (**190**), generating second information related to the place.

[0252] According to one or more embodiments of the disclosure, the method may include, based on data used for reproducing an encryption key used for encrypting content, the first information, and the second information, reproducing the encryption key.

[0253] According to one or more embodiments of the disclosure, the method may include, based on the encryption key, decrypting the encrypted content.

[0254] According to one or more embodiments of the disclosure, the method may include receiving, from a server (**108**), the encrypted content and the data used for reproducing the encryption key.

[0255] According to one or more embodiments of the disclosure, the data used for reproducing the encryption key may include data used for reproducing a first encryption key and data used for reproducing an encrypted second encryption key.

[0256] According to one or more embodiments of the disclosure, reproducing the encryption key may include reproducing the first encryption key by applying a first

decryption scheme to the first information and the data used for reproducing the first encryption key.

[0257] According to one or more embodiments of the disclosure, reproducing the encryption key may include reproducing data used for reproducing a second encryption key by applying a second decryption scheme to the first encryption key and the data used for the encrypted second encryption key.

[0258] According to one or more embodiments of the disclosure, reproducing the encryption key may include reproducing the second encryption key by applying the first decryption scheme to the data used for reproducing the second encryption key and the second information.

[0259] According to one or more embodiments of the disclosure, the encryption key may include the second encryption key.

[0260] According to one or more embodiments of the disclosure, the data used for reproducing the first encryption key may be generated by applying a first encryption scheme corresponding to the first decryption scheme to the first information.

[0261] According to one or more embodiments of the disclosure, the data used for reproducing the encrypted second encryption key may be generated by applying a second encryption scheme corresponding to the second decryption scheme to the data used for reproducing the first encryption key and the data used for reproducing the second encryption key.

[0262] According to one or more embodiments of the disclosure, the data used for reproducing the first encryption key may be generated by applying the first encryption scheme to the first information.

[0263] According to one or more embodiments of the disclosure, the data used for reproducing the second encryption key may be generated by applying the first encryption scheme to the second information.

[0264] According to one or more embodiments of the disclosure, generating the first information may include, if the first data is an image obtained via the camera, extracting feature information including feature points from the image.

[0265] According to one or more embodiments of the disclosure, generating the first information may include, setting any one of the feature points as a reference feature point.

[0266] According to one or more embodiments of the disclosure, generating the first information may include, based on a location and a color of the reference feature point, determining a location value and a color value of the reference feature point.

[0267] According to one or more embodiments of the disclosure, generating the first information may include, based on the location of the reference feature point, determining location values of remaining feature points except for the reference feature point among the feature points, and determine color values of the remaining feature points.

[0268] According to one or more embodiments of the disclosure, generating the first information may include, generating the first information including the location values and the color values of the feature points.

[0269] According to one or more embodiments of the disclosure, generating the second information may include, if the second data is at least one signal obtained via the at least one communication circuit, identifying an identifier of another electronic device transmitting the at least one signal.

[0270] According to one or more embodiments of the disclosure, generating the second information may include, measuring received signal strength of the at least one signal.

[0271] According to one or more embodiments of the disclosure, generating the second information may include generating the second information including the identifier of the other electronic device and the received signal strength.

[0272] According to one or more embodiments of the disclosure, the signal may be a wireless fidelity (Wi-Fi) signal, the identifier of the other electronic device may be a service set identifier (SSID), and the received signal strength may be a received signal strength indicator (RSSI).

[0273] According to one or more embodiments of the disclosure, the signal may be a Bluetooth signal, the identifier of the other electronic device may be a universally unique identifier (UUID), and the received signal strength may be a received signal strength indicator (RSSI).

[0274] According to one or more embodiments of the disclosure, a storage medium storing at least one computer-readable instruction may be provided.

[0275] According to one or more embodiments of the disclosure, the at least one instruction, when executed by at least one processor (**120**) of an electronic device (**101**), may cause the electronic device to perform at least one operation.

[0276] According to one or more embodiments of the disclosure, the at least one operation may include, based on first data obtained via a camera (**180**) or at least one sensor (**176**), generating first information related to a place at which an electronic device (**101**) is located.

[0277] According to one or more embodiments of the disclosure, the at least one operation may include, based on second data obtained via at least one communication circuit (**190**), generating second information related to the place.

[0278] According to one or more embodiments of the disclosure, the at least one operation may include, based on the first information and the second information, generating an encryption key used for encrypting content and data used for reproducing the encryption key.

[0279] According to one or more embodiments of the disclosure, the at least one operation may include encrypting the content based on the encryption key.

[0280] According to one or more embodiments of the disclosure, a storage medium storing at least one computer-readable instruction may be provided.

[0281] According to one or more embodiments of the disclosure, the at least one instruction, when executed by at least one processor (**120**) of an electronic device (**101**), may cause the electronic device to perform at least one operation.

[0282] According to one or more embodiments of the disclosure, the at least one operation may include, based on first data obtained via a camera (**180**) or at least one sensor (**176**), generating first information related to a place at which an electronic device (**101**) is located.

[0283] According to one or more embodiments of the disclosure, the at least one operation may include, based on second data obtained via at least one communication circuit (**190**), generating second information related to the place.

[0284] According to one or more embodiments of the disclosure, the at least one operation may include, based on data used for reproducing an encryption key used for encrypting content, the first information, and the second information, reproducing the encryption key.

[0285] According to one or more embodiments of the disclosure, the at least one operation may include, based on the encryption key, decrypting the encrypted content.

What is claimed is:

1. An electronic device, comprising:

at least one communication interface;

a camera or at least one sensor;

at least one processor connected to the at least one communication interface, and the camera or the at least one sensor; and

memory storing instructions that, when executed by the at least one processor, cause the at least one processor to:

based on first data obtained via the camera or the at least one sensor, generate first information related to a location of the electronic device;

based on second data obtained via the at least one communication interface, generate second information related to the location;

based on the first information and the second information, generate an encryption key used for encrypting content, and data used for reproducing the encryption key; and

encrypt the content based on the encryption key.

2. The electronic device of claim **1**, wherein the instructions further cause the at least one processor to:

transmit the encrypted content and the data used for reproducing the encryption key to a server via the at least one communication interface.

3. The electronic device of claim **1**, wherein the instructions further cause the at least one processor to:

apply a first encryption scheme to the first information to generate a first encryption key and data used for reproducing the first encryption key;

apply the first encryption scheme to the second information to generate a second encryption key and data used for reproducing the second encryption key; and

generate data used for reproducing an encrypted second encryption key which is generated by applying a second encryption scheme to the first encryption key and the data used for reproducing the second encryption key,

wherein the encryption key comprises the second encryption key, and the data used for reproducing the encryption key comprises the data used for reproducing the first encryption key and the data used for reproducing the encrypted second encryption key.

4. The electronic device of claim **1**, wherein the instructions further cause the at least one processor to:

based on the first data being an image obtained via the camera, extract feature information comprising feature points from the image;

set one of the feature points as a reference feature point;

based on a location and a color of the reference feature point, determine a location value and a color value of the reference feature point;

based on the location of the reference feature point, determine location values of remaining feature points other than the reference feature point among the feature points, and determine color values of the remaining feature points; and

generate the first information comprising the location values and the color values of the feature points.

5. The electronic device of claim **1**, wherein the instructions further cause the at least one processor to:

based on the second data being at least one signal obtained via the at least one communication interface, identify an identifier of another electronic device transmitting the at least one signal;

measure received signal strength of the at least one signal; and

generate the second information comprising the identifier of the other electronic device and the received signal strength.

6. The electronic device of claim **5**, wherein the at least one signal is a wireless fidelity (Wi-Fi) signal, the identifier of the other electronic device is a service set identifier (SSID), and the received signal strength is a received signal strength indicator (RSSI).

7. The electronic device of claim **5**, wherein the at least one signal is a Bluetooth signal, the identifier of the other electronic device is a universally unique identifier (UUID), and the received signal strength is a received signal strength indicator (RSSI).

8. An electronic device, comprising:

at least one communication interface;

a camera or at least one sensor;

at least one processor connected to the at least one communication interface, and the camera or the at least one sensor; and

memory storing instructions that, when executed by the at least one processor, cause the at least one processor to:

based on first data obtained via the camera or the at least one sensor, generate first information related to a location of the electronic device;

based on second data obtained via the at least one communication interface, generate second information related to the location;

based on data used for reproducing an encryption key used for encrypting content, the first information, and the second information, reproduce the encryption key; and

based on the encryption key, decrypt the encrypted content.

9. The electronic device of claim **8**, wherein the instructions further cause the at least one processor to:

receive the encrypted content and the data used for reproducing the encryption key from a server via the at least one communication interface.

10. The electronic device of claim **8**,

wherein the data used for reproducing the encryption key comprises data used for reproducing a first encryption key and data used for reproducing an encrypted second encryption key, and

wherein the instructions further cause the at least one processor to:

reproduce the first encryption key by applying a first decryption scheme to the first information and the data used for reproducing the first encryption key;

reproduce data used for reproducing a second encryption key by applying a second decryption scheme to the first encryption key and the data used for the encrypted second encryption key; and

reproduce the second encryption key by applying the first decryption scheme to the data used for reproducing the second encryption key and the second information, and wherein the encryption key comprises the second encryption key.

11. The electronic device of claim 10,
wherein the data used for reproducing the first encryption key is generated by applying a first encryption scheme corresponding to the first decryption scheme to the first information,
wherein the data used for reproducing the encrypted second encryption key is generated by applying a second encryption scheme corresponding to the second decryption scheme to the data used for reproducing the first encryption key and the data used for reproducing the second encryption key,
wherein the data used for reproducing the first encryption key is generated by applying the first encryption scheme to the first information, and
wherein the data used for reproducing the second encryption key is generated by applying the first encryption scheme to the second information.

12. The electronic device of claim 8, wherein the instructions further cause the at least one processor to:
based on the first data being an image obtained via the camera, extract feature information comprising feature points from the image; and
set any one of the feature points as a reference feature point;
based on a location and a color of the reference feature point, determine a location value and a color value of the reference feature point;
based on the location of the reference feature point, determine location values of remaining feature points other than the reference feature point among the feature points, and determine color values of the remaining feature points; and
generate the first information comprising the location values and the color values of the feature points.

13. The electronic device of claim 8, wherein the instructions further cause the at least one processor to:
based on the second data being at least one signal obtained via the at least one communication interface, identify an identifier of another electronic device transmitting the at least one signal;
measure received signal strength of the at least one signal; and
generate the second information comprising the identifier of the other electronic device and the received signal strength.

14. The electronic device of claim 13, wherein the at least one signal is a wireless fidelity (Wi-Fi) signal, the identifier of the other electronic device is a service set identifier (SSID), and the received signal strength is a received signal strength indicator (RSSI).

15. The electronic device of claim 13, wherein the at least one signal is a Bluetooth signal, the identifier of the other electronic device is a universally unique identifier (UUID), and the received signal strength is a received signal strength indicator (RSSI).

16. A method, comprising:
based on first data obtained via a camera or at least one sensor, generating first information related to a location of an electronic device;
based on second data obtained via at least one communication interface, generating second information related to the location;
based on the first information and the second information, generating an encryption key used for encrypting content and data used for reproducing the encryption key; and
encrypting the content based on the encryption key.

17. The method of claim 16, further comprising:
transmitting the encrypted content and the data used for reproducing the encryption key to a server.

18. The method of claim 16, wherein generating the encryption key and the data used for reproducing the encryption key comprises:
applying a first encryption scheme to the first information to generate a first encryption key and data used for reproducing the first encryption key;
applying the first encryption scheme to the second information to generate a second encryption key and data used for reproducing the second encryption key; and
generating data used for reproducing an encrypted second encryption key which is generated by applying a second encryption scheme to the first encryption key and the data used for reproducing the second encryption key,
wherein the encryption key comprises the second encryption key, and the data used for reproducing the encryption key comprises the data used for reproducing the first encryption key and the data used for reproducing the encrypted second encryption key.

19. The method of claim 16, wherein generating the first information comprises:
based on the first data being an image obtained via the camera, extracting feature information comprising feature points from the image;
setting any one of the feature points as a reference feature point;
based on a location and a color of the reference feature point, determining a location value and a color value of the reference feature point;
based on the location of the reference feature point, determining location values of remaining feature points other than the reference feature point among the feature points, and determining color values of the remaining feature points; and
generating the first information comprising the location values and the color values of the feature points.

20. The method of claim 16, wherein generating the first information comprises:
based on the second data being at least one signal obtained via the at least one communication interface, identifying an identifier of another electronic device transmitting the at least one signal;
measuring received signal strength of the at least one signal; and
generating the second information comprising the identifier of the other electronic device and the received signal strength.

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