US011979511B2

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Ishimaru et al.

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(45) **Date of Patent: May 7, 2024**

(54) **TERMINAL DEVICE, TERMINAL DEVICE CONTROL METHOD, AND MEMORY MEDIUM**

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(72) Inventors: **Mikio Ishimaru**, Tokyo (JP); **Kenta Endo**, Tokyo (JP)

(73) Assignee: **Sony Group Corporation**, Tokyo (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 452 days.

(21) Appl. No.: **17/268,774**

(22) PCT Filed: **Aug. 2, 2019**

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PCT Pub. Date: **Mar. 12, 2020**

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(30) **Foreign Application Priority Data**

Sep. 7, 2018 (JP) 2018-168353

(51) **Int. Cl.**
G06F 3/16 (2006.01)
G06F 21/32 (2013.01)
(Continued)

(52) **U.S. Cl.**
CPC ***H04M 1/271*** (2013.01); ***G06F 3/16*** (2013.01); ***G06F 21/32*** (2013.01); ***G06V 40/165*** (2022.01);
(Continued)

(58) **Field of Classification Search**
CPC H04M 1/271; H04M 1/724631; G06V 40/165; G06V 40/172; G06V 40/174; G06F 3/13; G06F 21/32
See application file for complete search history.

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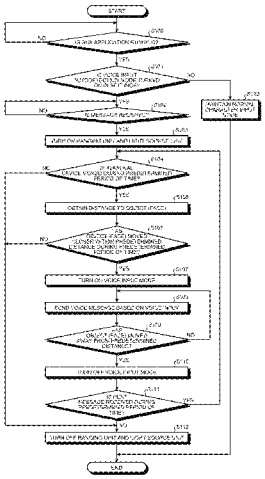
Assistant Examiner — Farideh Madani
(74) *Attorney, Agent, or Firm* — Sheridan Ross PC

(57) **ABSTRACT**

A terminal device according to an embodiment includes: a microphone; a communication unit that performs communication via a network; a first sensor that obtains depth information; a first face detecting unit that detects a face and the distance to the face based on the depth information; and a processor. When a communication program, which is meant for making the processor perform transmission and reception of messages including voice messages and which has a sound input mode for enabling collection of sounds using the microphone and transmission of voice messages based on the collected sounds, is executed, and when a message is received by the communication unit under the control of the communication program being executed; the processor performs first-type face detection using the first
(Continued)



face detecting unit and controls turning ON and turning OFF the sound input mode according to the result of the first-type face detection.

20 Claims, 21 Drawing Sheets

(51) **Int. Cl.**
G06V 40/16 (2022.01)
H04M 1/27 (2006.01)
H04M 1/72463 (2021.01)

(52) **U.S. Cl.**
CPC ***G06V 40/172*** (2022.01); ***G06V 40/176*** (2022.01); ***H04M 1/724631*** (2022.02)

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FIG.1

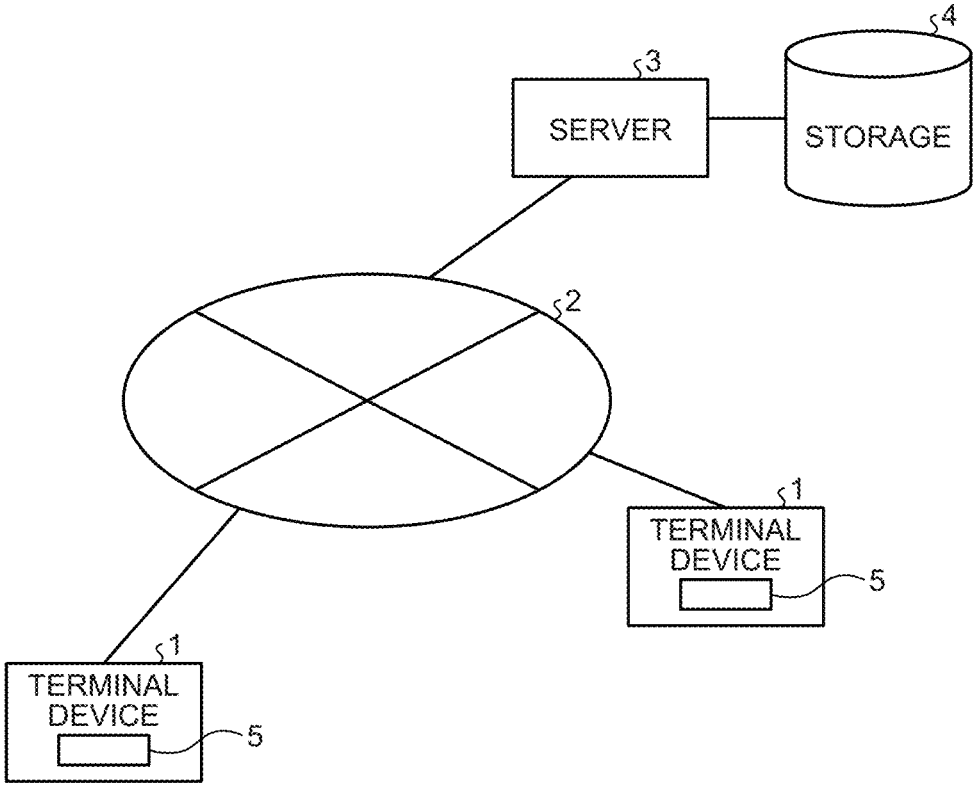


FIG.2

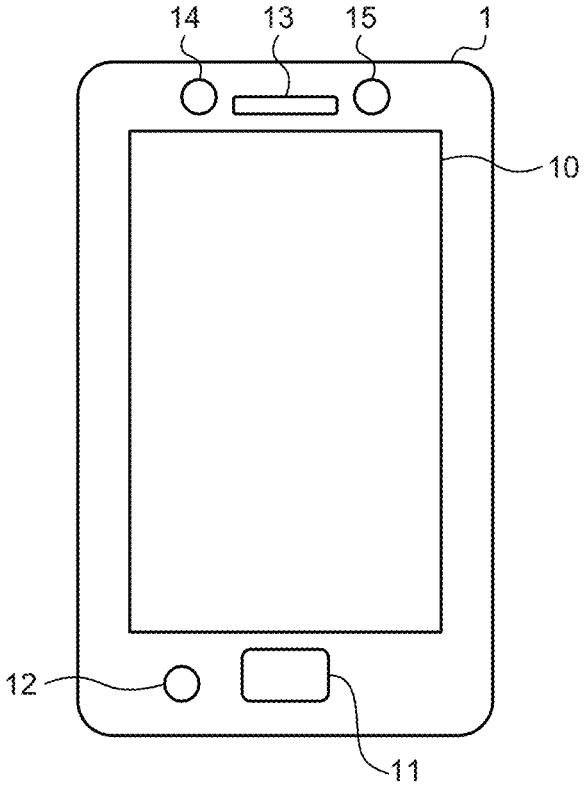


FIG.3

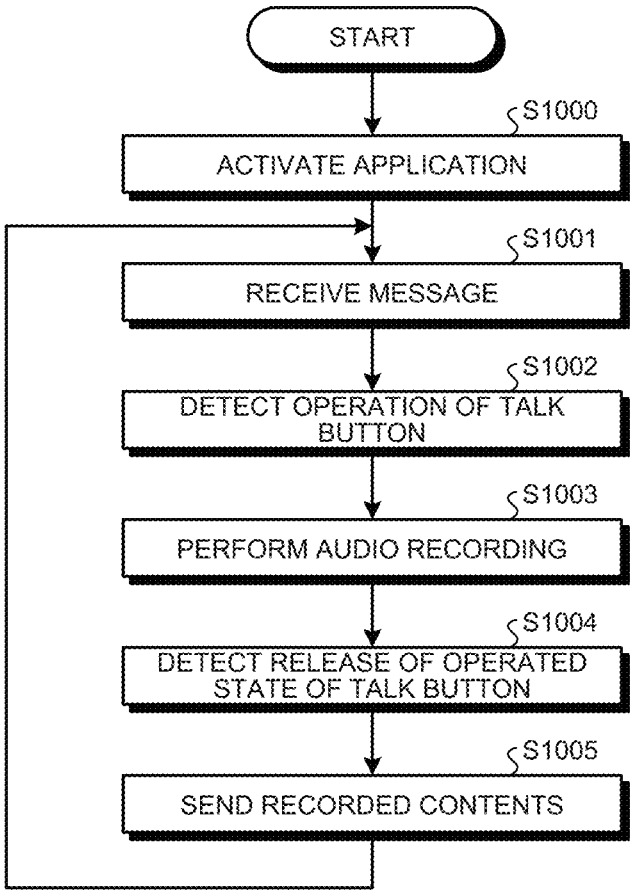

START
S1000
ACTIVATE APPLICATION
S1001
RECEIVE MESSAGE
S1002
DETECT OPERATION OF TALK BUTTON
S1003
PERFORM AUDIO RECORDING
S1004
DETECT RELEASE OF OPERATED STATE OF TALK BUTTON
S1005
SEND RECORDED CONTENTS

FIG.4A

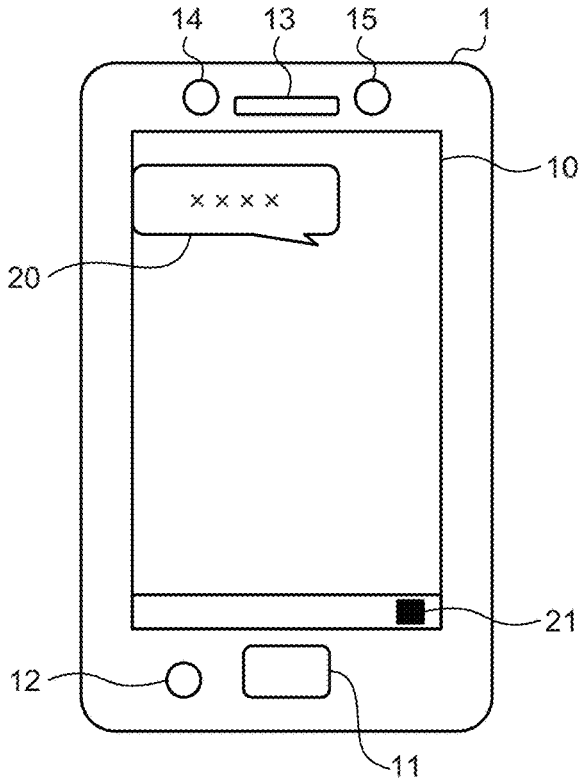


FIG.4B

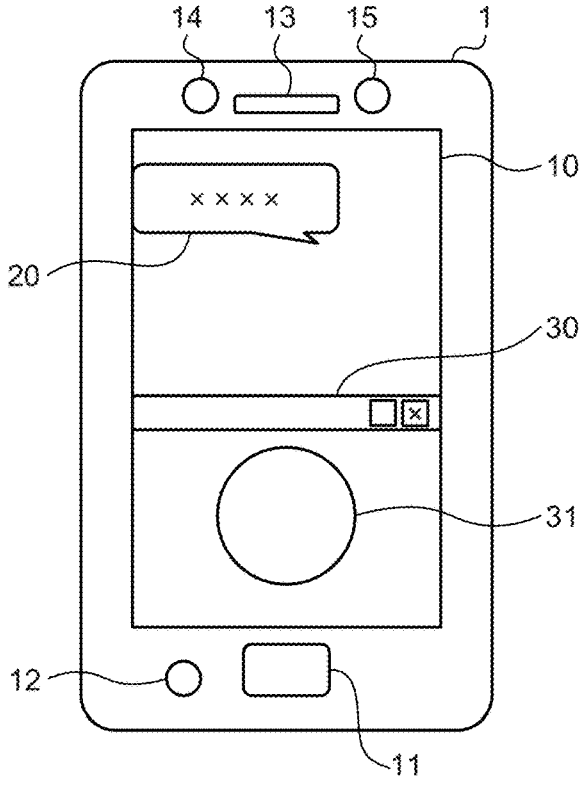


FIG.5

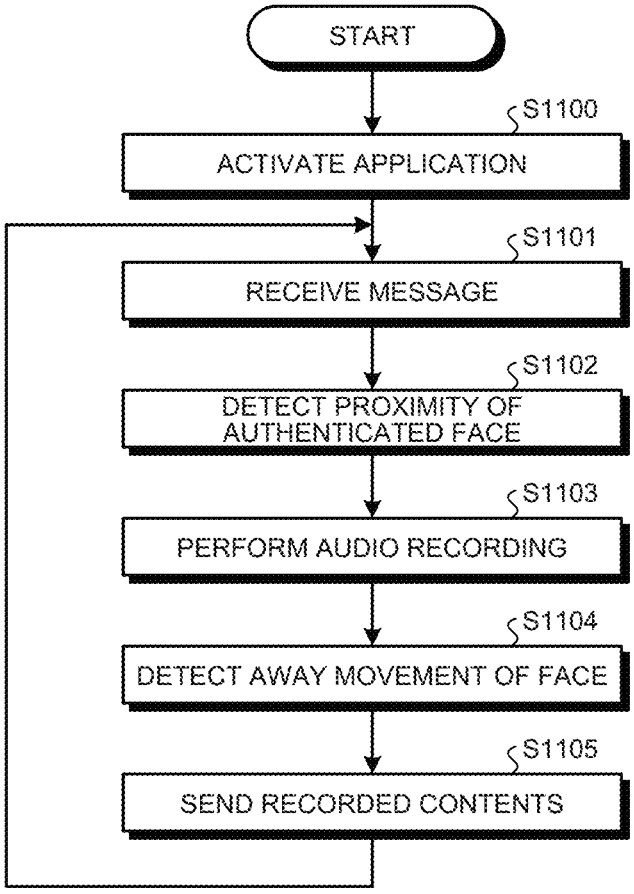

START
S1100
ACTIVATE APPLICATION
S1101
RECEIVE MESSAGE
S1102
DETECT PROXIMITY OF AUTHENTICATED FACE
S1103
PERFORM AUDIO RECORDING
S1104
DETECT AWAY MOVEMENT OF FACE
S1105
SEND RECORDED CONTENTS

FIG.6

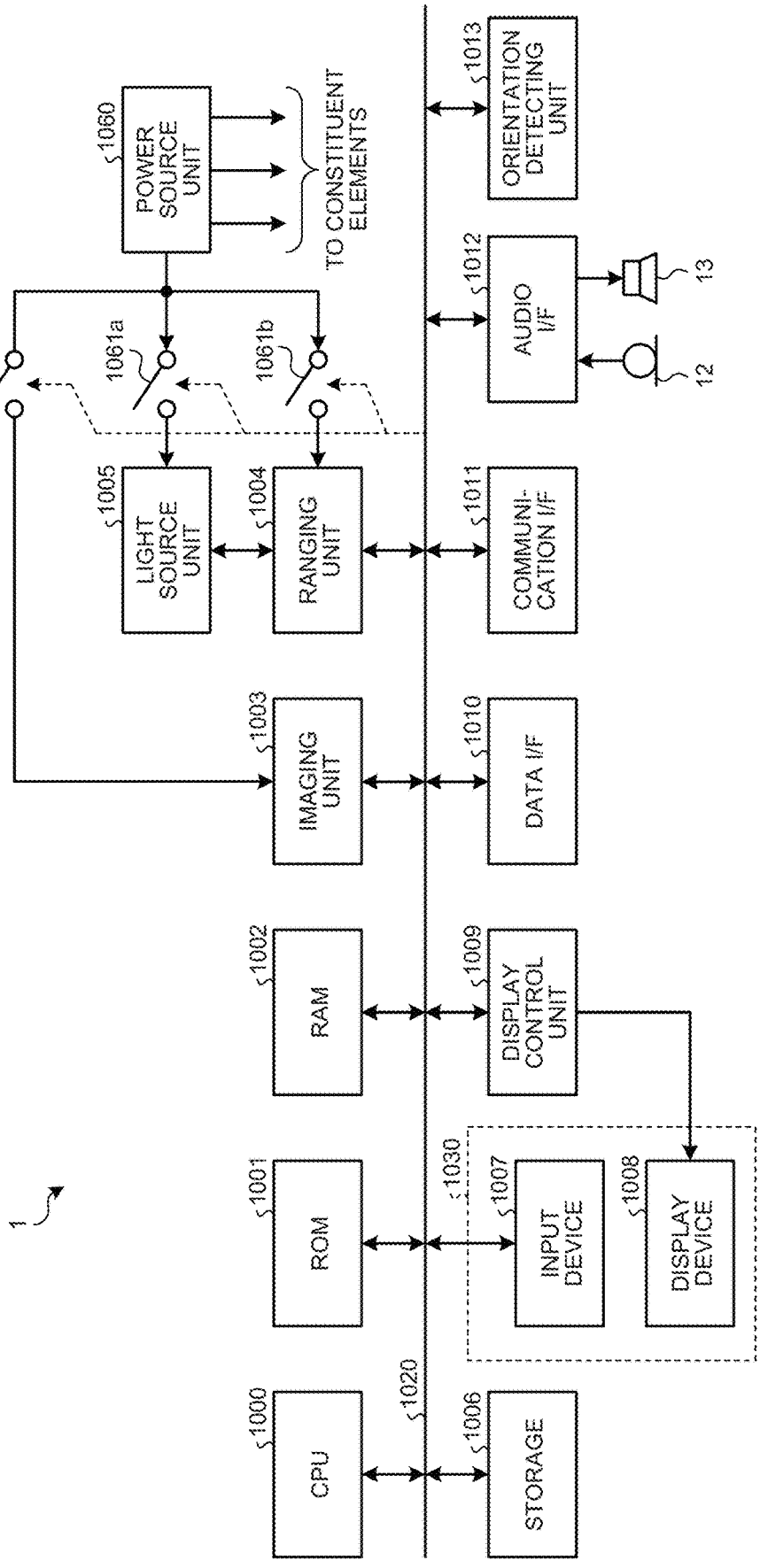

1
CPU
1000
ROM
1001
RAM
1002
IMAGING UNIT
1003
RANGING UNIT
1004
LIGHT SOURCE UNIT
1005
STORAGE
1006
DISPLAY CONTROL UNIT
1009
DATA I/F
1010
COMMUNI-CATION I/F
1011
AUDIO I/F
1012
ORIENTATION DETECTING UNIT
1013
1020
1030
INPUT DEVICE
1007
DISPLAY DEVICE
1008
POWER SOURCE UNIT
1060
TO CONSTITUENT ELEMENTS
1062
1061a
1061b
12
13

FIG.7

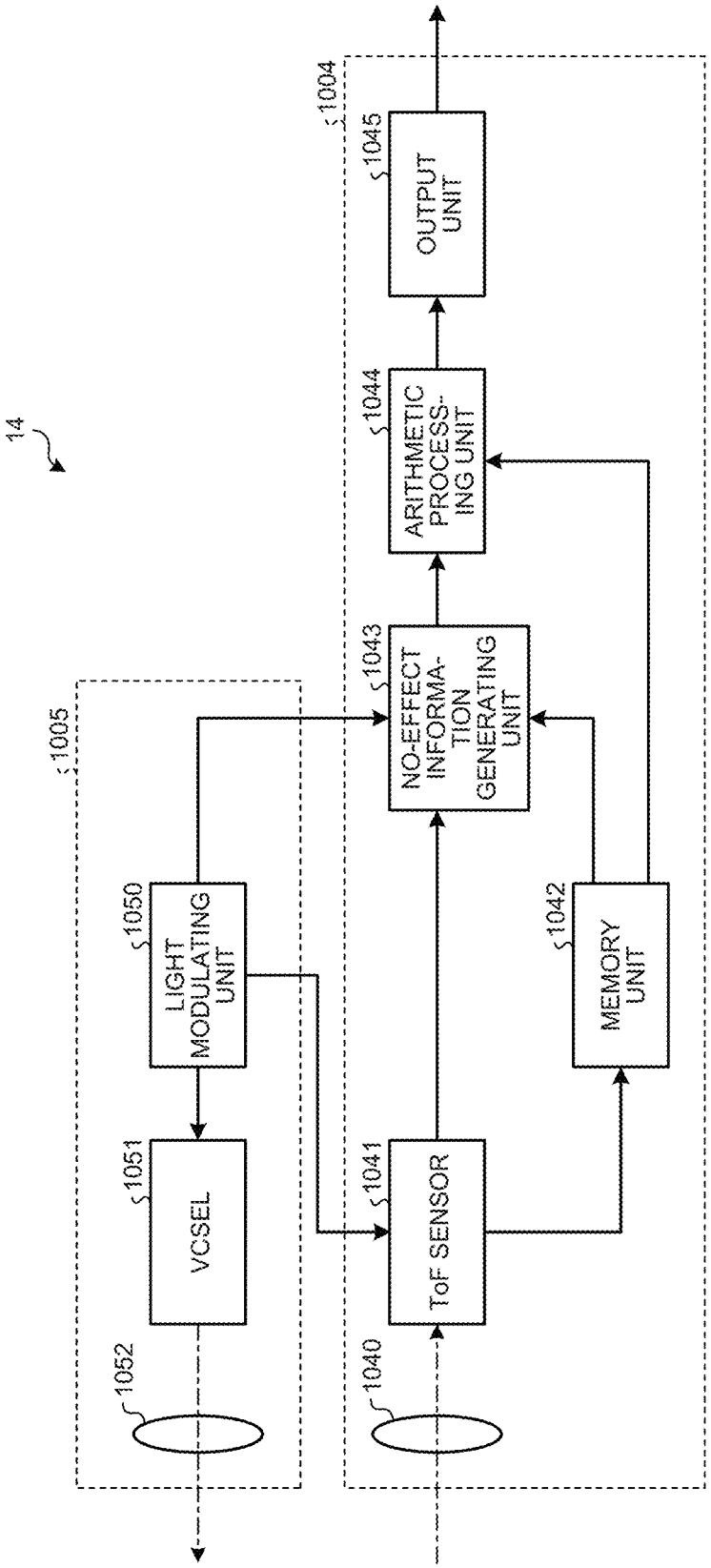

14
1004
1045
OUTPUT UNIT
1044
ARITHMETIC PROCESS-ING UNIT
1043
NO-EFFECT INFORMA-TION GENERATING UNIT
1042
MEMORY UNIT
1041
ToF SENSOR
1040
1005
1050
LIGHT MODULATING UNIT
1051
VCSEL
1052

FIG.8

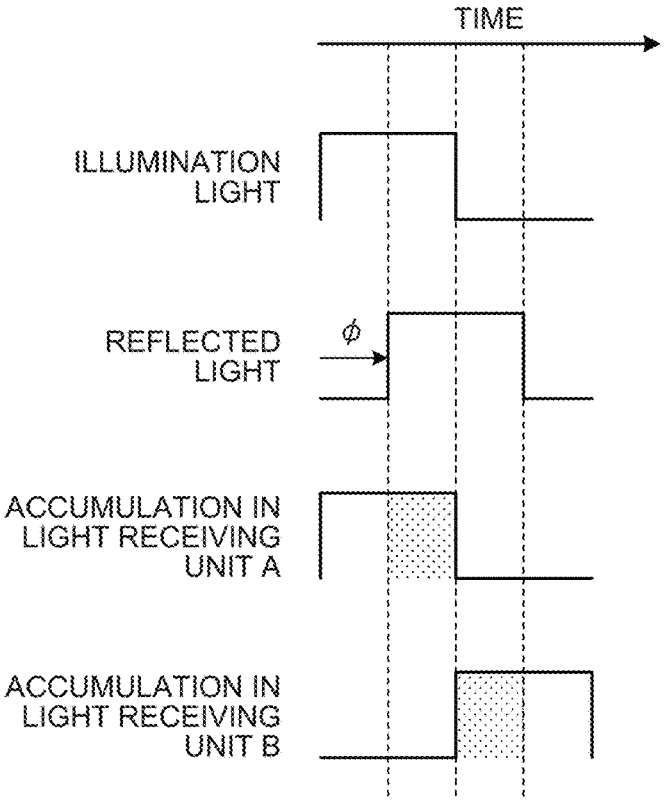
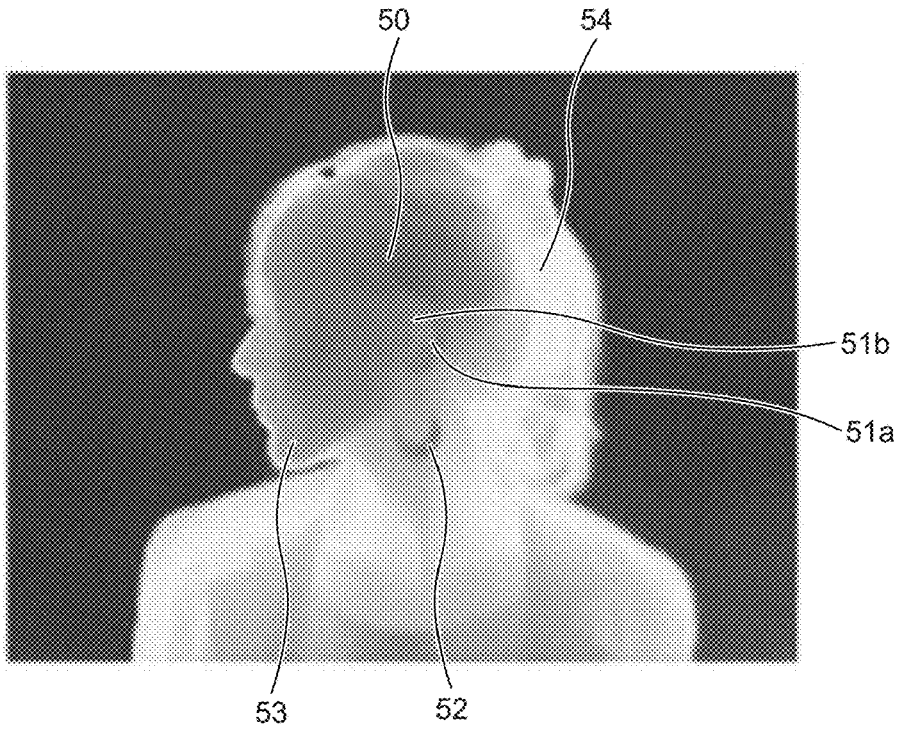

TIME
ILLUMINATION LIGHT
REFLECTED LIGHT
ϕ
ACCUMULATION IN LIGHT RECEIVING UNIT A
ACCUMULATION IN LIGHT RECEIVING UNIT B

FIG.9


50
54
51b
51a
53
52

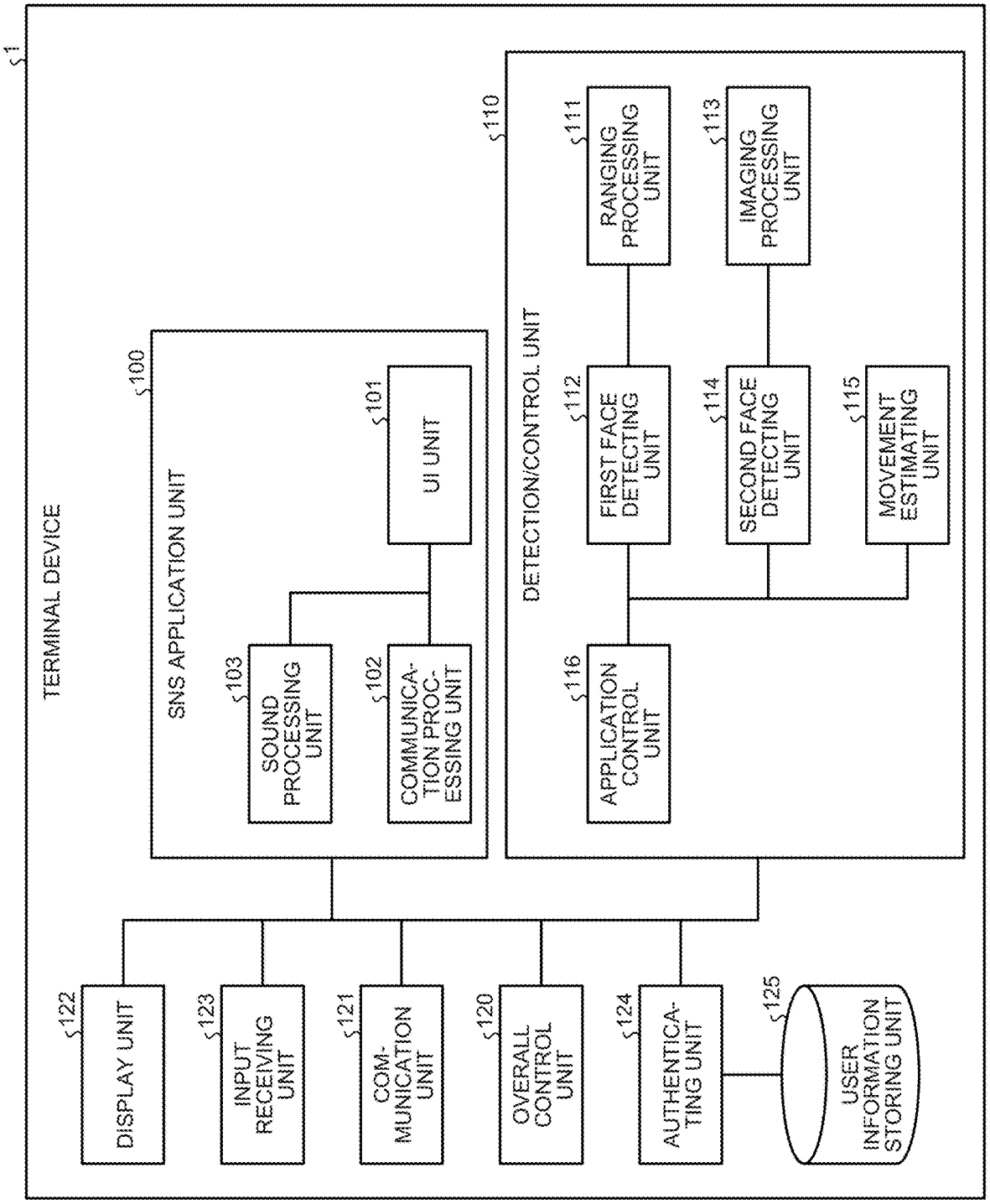

1
TERMINAL DEVICE
100
SNS APPLICATION UNIT
101
UI UNIT
102
COMMUNICATION PROCESSING UNIT
103
SOUND PROCESSING UNIT
110
DETECTION/CONTROL UNIT
111
RANGING PROCESSING UNIT
112
FIRST FACE DETECTING UNIT
113
IMAGING PROCESSING UNIT
114
SECOND FACE DETECTING UNIT
115
MOVEMENT ESTIMATING UNIT
116
APPLICATION CONTROL UNIT
120
OVERALL CONTROL UNIT
121
COMMUNICATION UNIT
122
DISPLAY UNIT
123
INPUT RECEIVING UNIT
124
AUTHENTICATING UNIT
125
USER INFORMATION STORING UNIT

FIG.10

FIG.11

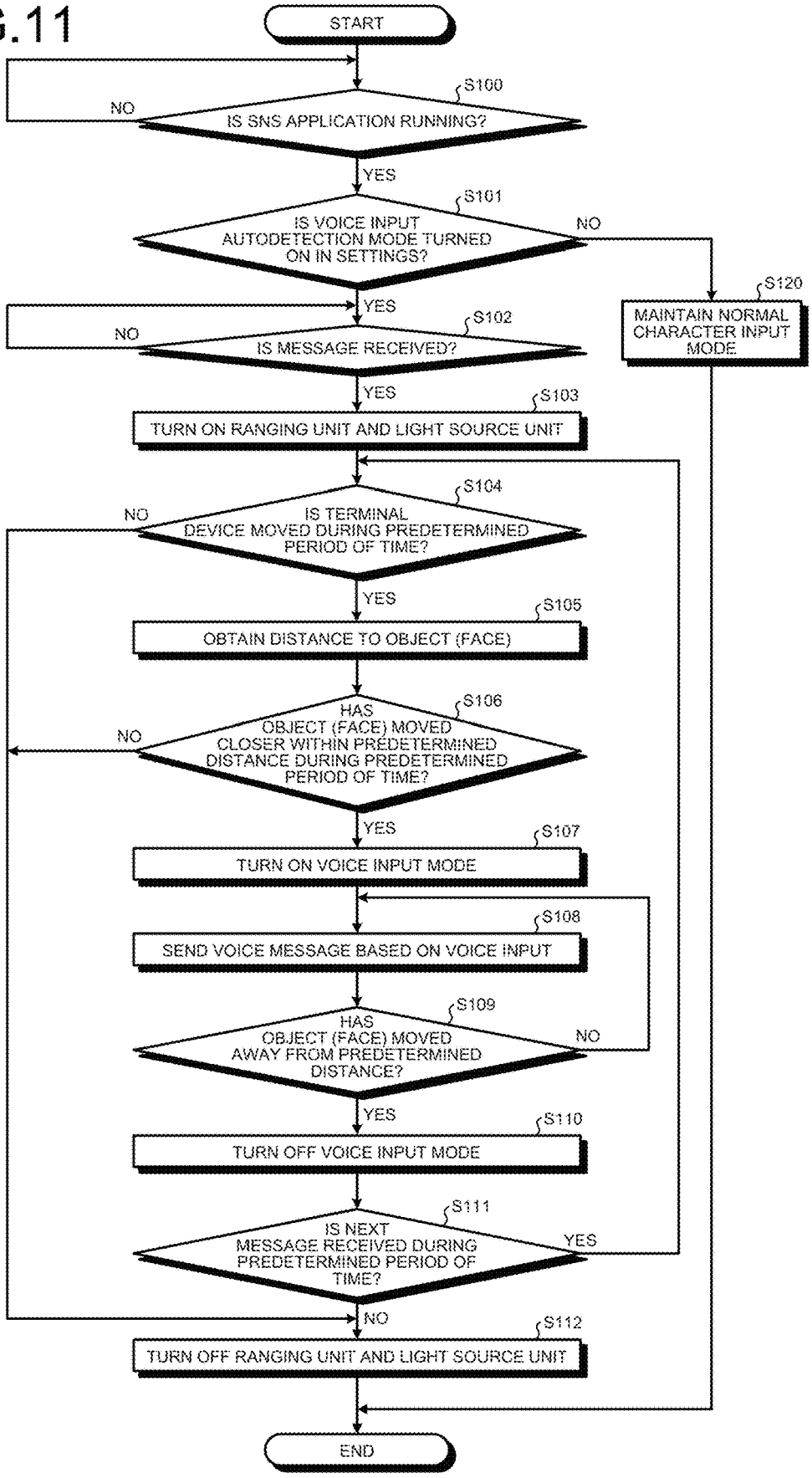

START
S100
IS SNS APPLICATION RUNNING?
NO
YES
S101
IS VOICE INPUT AUTODETECTION MODE TURNED ON IN SETTINGS?
NO
S120
MAINTAIN NORMAL CHARACTER INPUT MODE
YES
S102
IS MESSAGE RECEIVED?
NO
YES
S103
TURN ON RANGING UNIT AND LIGHT SOURCE UNIT
S104
IS TERMINAL DEVICE MOVED DURING PREDETERMINED PERIOD OF TIME?
NO
YES
S105
OBTAIN DISTANCE TO OBJECT (FACE)
S106
HAS OBJECT (FACE) MOVED CLOSER WITHIN PREDETERMINED DISTANCE DURING PREDETERMINED PERIOD OF TIME?
NO
YES
S107
TURN ON VOICE INPUT MODE
S108
SEND VOICE MESSAGE BASED ON VOICE INPUT
S109
HAS OBJECT (FACE) MOVED AWAY FROM PREDETERMINED DISTANCE?
NO
YES
S110
TURN OFF VOICE INPUT MODE
S111
IS NEXT MESSAGE RECEIVED DURING PREDETERMINED PERIOD OF TIME?
YES
NO
S112
TURN OFF RANGING UNIT AND LIGHT SOURCE UNIT
END

FIG.12

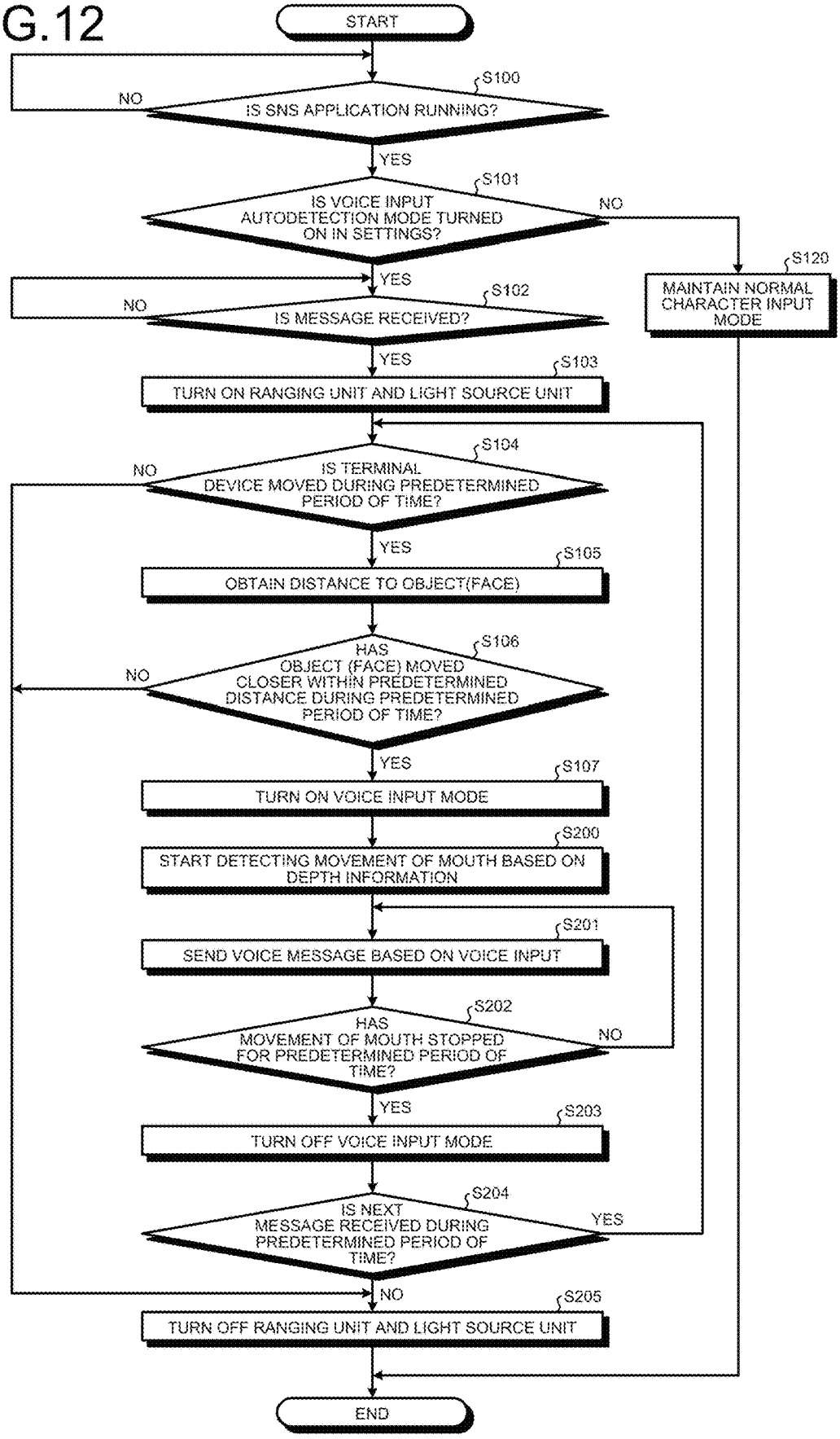

START
S100
IS SNS APPLICATION RUNNING?
NO
YES
S101
IS VOICE INPUT AUTODETECTION MODE TURNED ON IN SETTINGS?
NO
S120
MAINTAIN NORMAL CHARACTER INPUT MODE
YES
S102
IS MESSAGE RECEIVED?
NO
YES
S103
TURN ON RANGING UNIT AND LIGHT SOURCE UNIT
S104
IS TERMINAL DEVICE MOVED DURING PREDETERMINED PERIOD OF TIME?
NO
YES
S105
OBTAIN DISTANCE TO OBJECT(FACE)
S106
HAS OBJECT (FACE) MOVED CLOSER WITHIN PREDETERMINED DISTANCE DURING PREDETERMINED PERIOD OF TIME?
NO
YES
S107
TURN ON VOICE INPUT MODE
S200
START DETECTING MOVEMENT OF MOUTH BASED ON DEPTH INFORMATION
S201
SEND VOICE MESSAGE BASED ON VOICE INPUT
S202
HAS MOVEMENT OF MOUTH STOPPED FOR PREDETERMINED PERIOD OF TIME?
NO
YES
S203
TURN OFF VOICE INPUT MODE
S204
IS NEXT MESSAGE RECEIVED DURING PREDETERMINED PERIOD OF TIME?
YES
NO
S205
TURN OFF RANGING UNIT AND LIGHT SOURCE UNIT
END

FIG.13

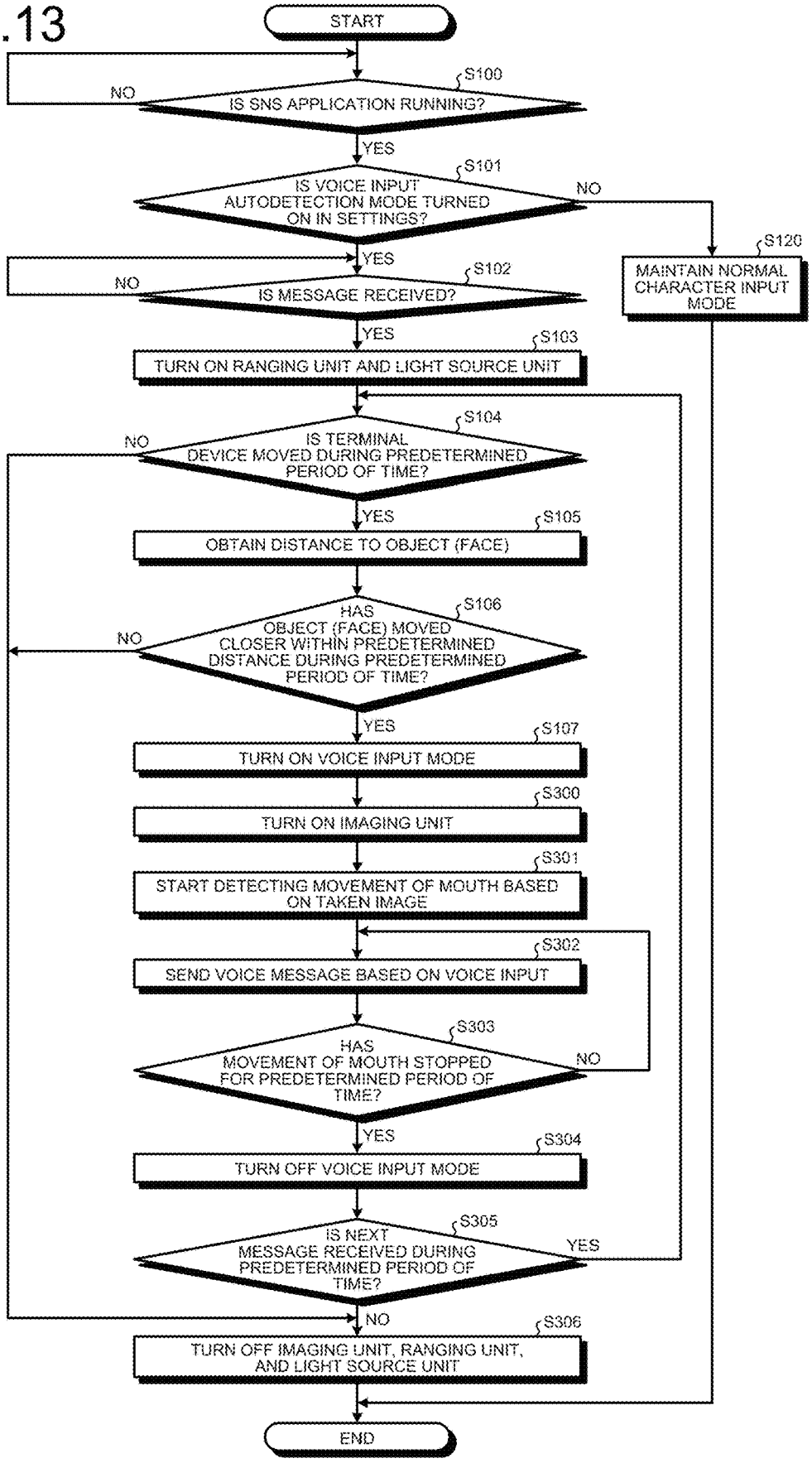

START
S100
IS SNS APPLICATION RUNNING?
NO
YES
S101
IS VOICE INPUT AUTODETECTION MODE TURNED ON IN SETTINGS?
NO
YES
S120
MAINTAIN NORMAL CHARACTER INPUT MODE
S102
IS MESSAGE RECEIVED?
NO
YES
S103
TURN ON RANGING UNIT AND LIGHT SOURCE UNIT
S104
IS TERMINAL DEVICE MOVED DURING PREDETERMINED PERIOD OF TIME?
NO
YES
S105
OBTAIN DISTANCE TO OBJECT (FACE)
S106
HAS OBJECT (FACE) MOVED CLOSER WITHIN PREDETERMINED DISTANCE DURING PREDETERMINED PERIOD OF TIME?
NO
YES
S107
TURN ON VOICE INPUT MODE
S300
TURN ON IMAGING UNIT
S301
START DETECTING MOVEMENT OF MOUTH BASED ON TAKEN IMAGE
S302
SEND VOICE MESSAGE BASED ON VOICE INPUT
S303
HAS MOVEMENT OF MOUTH STOPPED FOR PREDETERMINED PERIOD OF TIME?
NO
YES
S304
TURN OFF VOICE INPUT MODE
S305
IS NEXT MESSAGE RECEIVED DURING PREDETERMINED PERIOD OF TIME?
YES
NO
S306
TURN OFF IMAGING UNIT, RANGING UNIT, AND LIGHT SOURCE UNIT
END

FIG.14

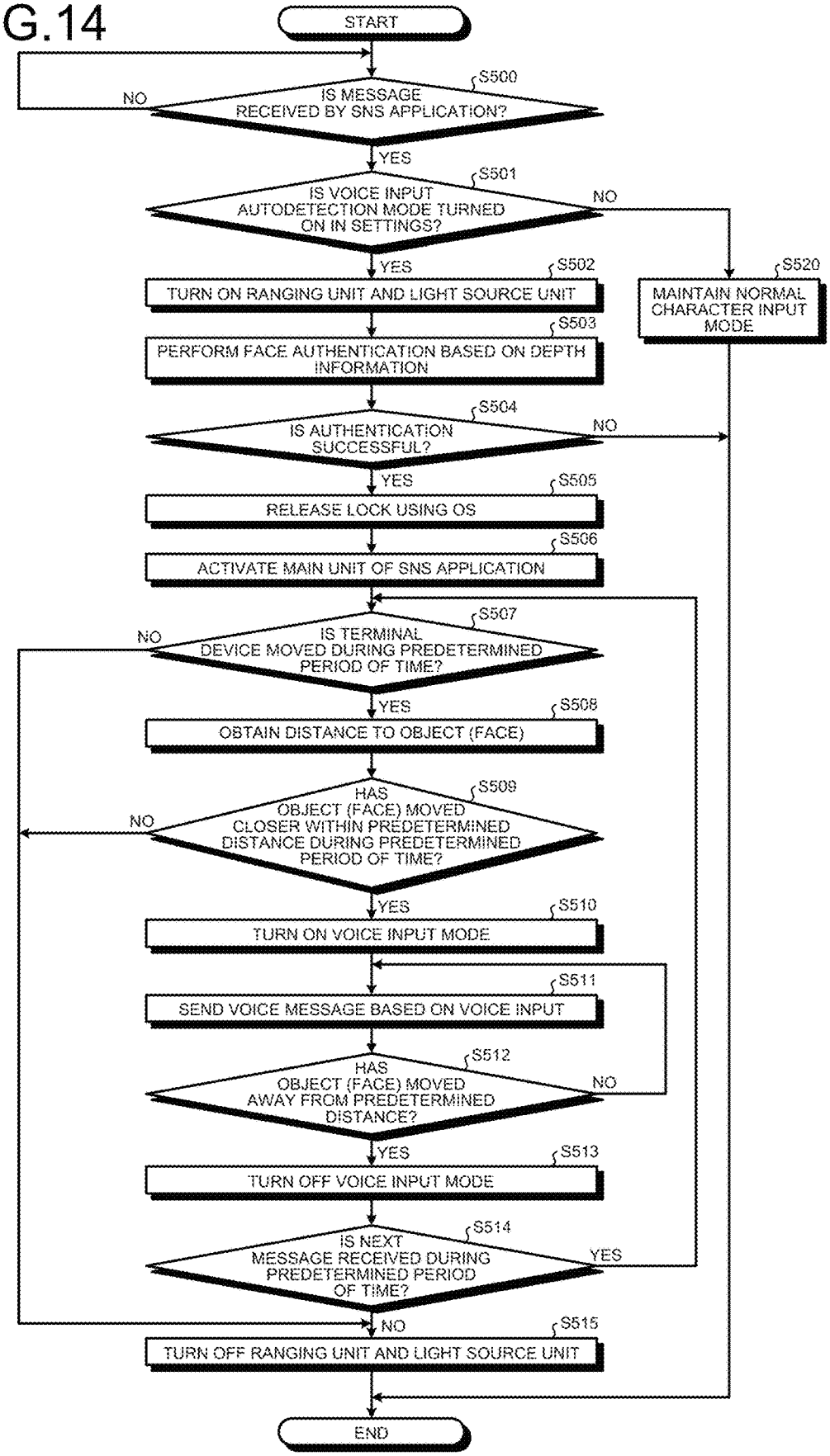

START
S500
IS MESSAGE RECEIVED BY SNS APPLICATION?
NO
YES
S501
IS VOICE INPUT AUTODETECTION MODE TURNED ON IN SETTINGS?
NO
YES
S502
TURN ON RANGING UNIT AND LIGHT SOURCE UNIT
S503
PERFORM FACE AUTHENTICATION BASED ON DEPTH INFORMATION
S504
IS AUTHENTICATION SUCCESSFUL?
NO
YES
S505
RELEASE LOCK USING OS
S506
ACTIVATE MAIN UNIT OF SNS APPLICATION
S507
IS TERMINAL DEVICE MOVED DURING PREDETERMINED PERIOD OF TIME?
NO
YES
S508
OBTAIN DISTANCE TO OBJECT (FACE)
S509
HAS OBJECT (FACE) MOVED CLOSER WITHIN PREDETERMINED DISTANCE DURING PREDETERMINED PERIOD OF TIME?
NO
YES
S510
TURN ON VOICE INPUT MODE
S511
SEND VOICE MESSAGE BASED ON VOICE INPUT
S512
HAS OBJECT (FACE) MOVED AWAY FROM PREDETERMINED DISTANCE?
NO
YES
S513
TURN OFF VOICE INPUT MODE
S514
IS NEXT MESSAGE RECEIVED DURING PREDETERMINED PERIOD OF TIME?
YES
NO
S515
TURN OFF RANGING UNIT AND LIGHT SOURCE UNIT
S520
MAINTAIN NORMAL CHARACTER INPUT MODE
END

FIG.15A

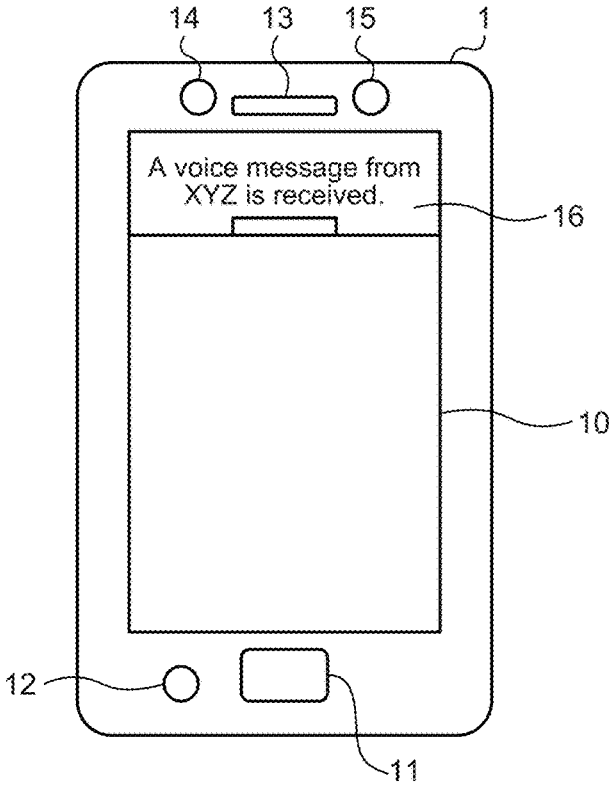


FIG.15B

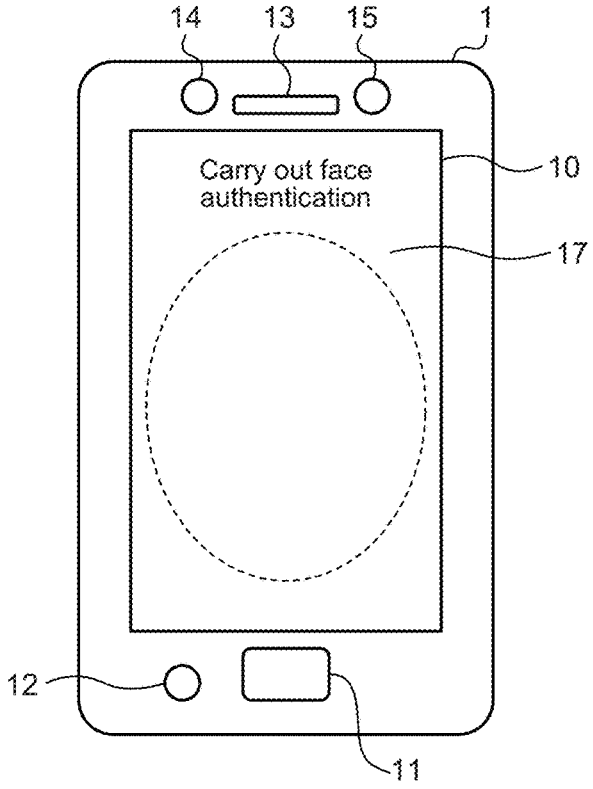


FIG.16

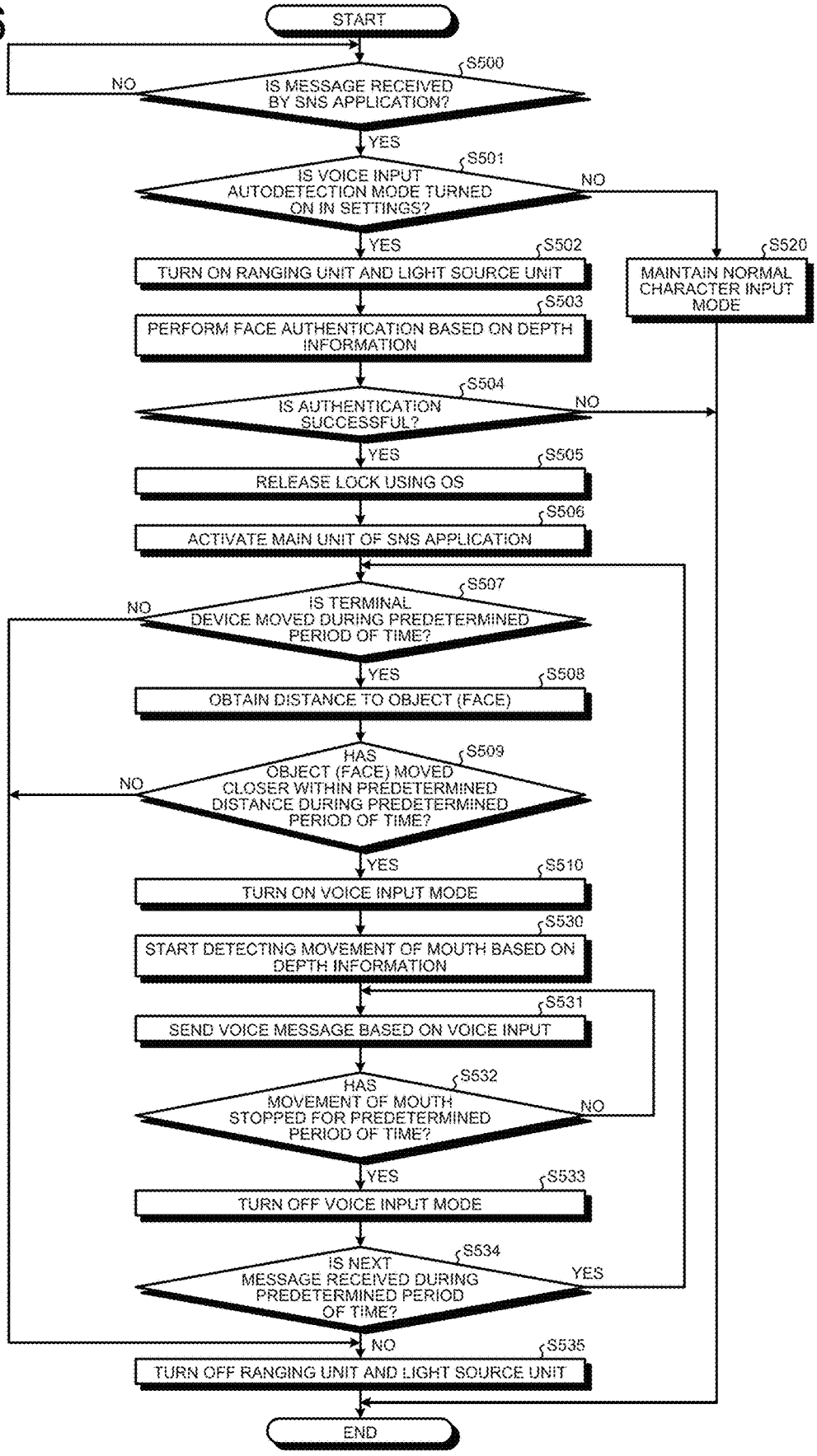

START
S500
IS MESSAGE RECEIVED BY SNS APPLICATION?
NO
YES
S501
IS VOICE INPUT AUTODETECTION MODE TURNED ON IN SETTINGS?
NO
YES
S502
TURN ON RANGING UNIT AND LIGHT SOURCE UNIT
S503
PERFORM FACE AUTHENTICATION BASED ON DEPTH INFORMATION
S504
IS AUTHENTICATION SUCCESSFUL?
NO
YES
S505
RELEASE LOCK USING OS
S506
ACTIVATE MAIN UNIT OF SNS APPLICATION
S520
MAINTAIN NORMAL CHARACTER INPUT MODE
S507
IS TERMINAL DEVICE MOVED DURING PREDETERMINED PERIOD OF TIME?
NO
YES
S508
OBTAIN DISTANCE TO OBJECT (FACE)
S509
HAS OBJECT (FACE) MOVED CLOSER WITHIN PREDETERMINED DISTANCE DURING PREDETERMINED PERIOD OF TIME?
NO
YES
S510
TURN ON VOICE INPUT MODE
S530
START DETECTING MOVEMENT OF MOUTH BASED ON DEPTH INFORMATION
S531
SEND VOICE MESSAGE BASED ON VOICE INPUT
S532
HAS MOVEMENT OF MOUTH STOPPED FOR PREDETERMINED PERIOD OF TIME?
NO
YES
S533
TURN OFF VOICE INPUT MODE
S534
IS NEXT MESSAGE RECEIVED DURING PREDETERMINED PERIOD OF TIME?
YES
NO
S535
TURN OFF RANGING UNIT AND LIGHT SOURCE UNIT
END

FIG.17

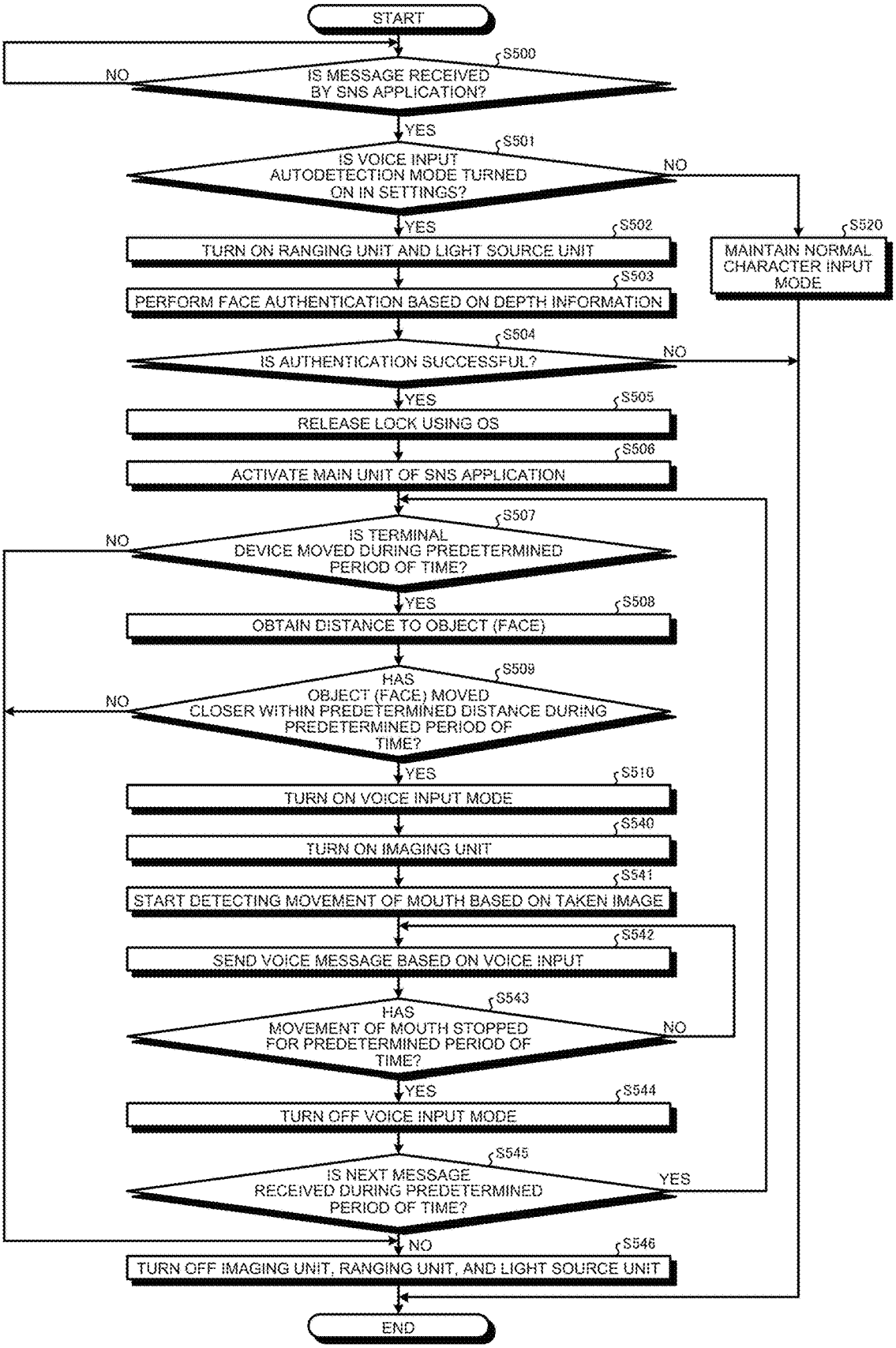
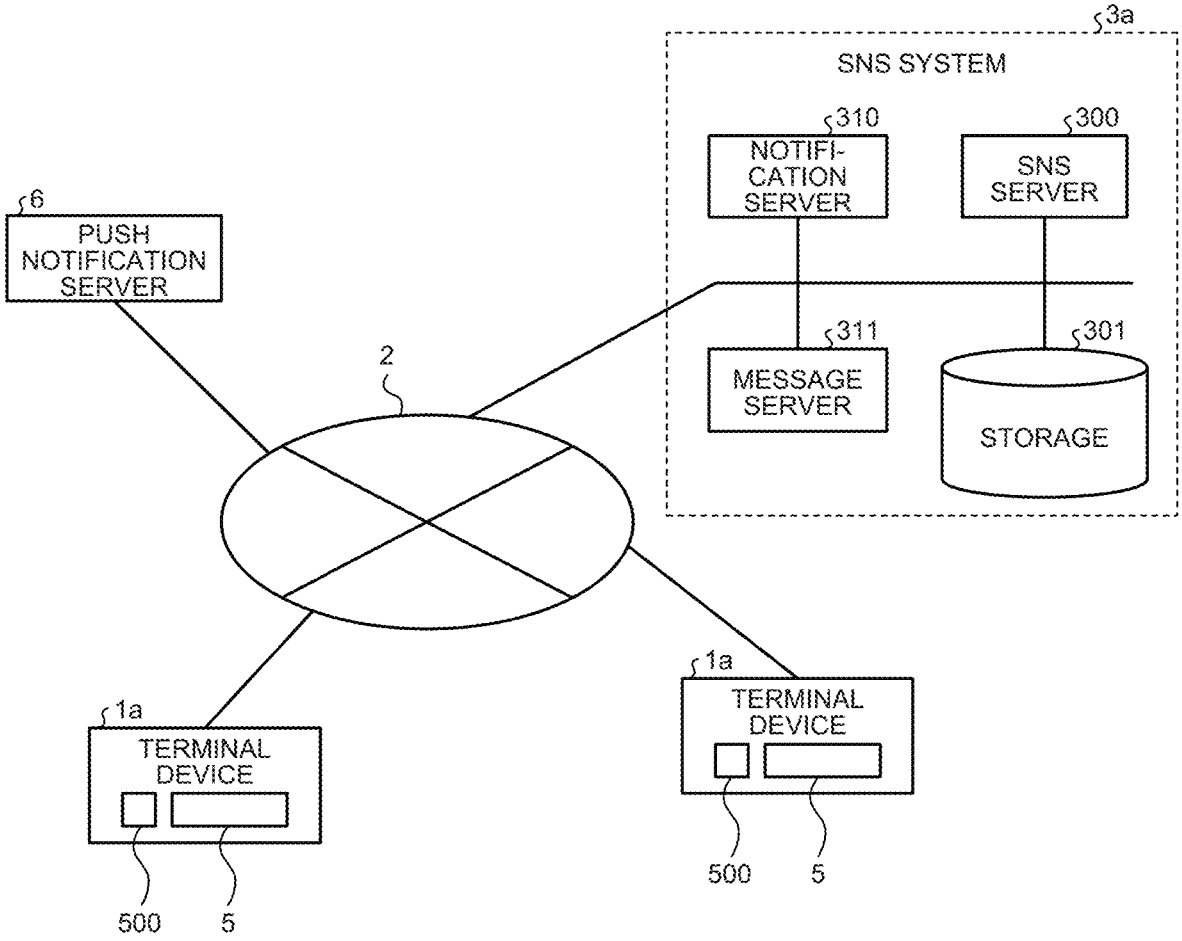

START
S500
IS MESSAGE RECEIVED BY SNS APPLICATION?
NO
YES
S501
IS VOICE INPUT AUTODETECTION MODE TURNED ON IN SETTINGS?
NO
YES
S520
MAINTAIN NORMAL CHARACTER INPUT MODE
S502
TURN ON RANGING UNIT AND LIGHT SOURCE UNIT
S503
PERFORM FACE AUTHENTICATION BASED ON DEPTH INFORMATION
S504
IS AUTHENTICATION SUCCESSFUL?
NO
YES
S505
RELEASE LOCK USING OS
S506
ACTIVATE MAIN UNIT OF SNS APPLICATION
S507
IS TERMINAL DEVICE MOVED DURING PREDETERMINED PERIOD OF TIME?
NO
YES
S508
OBTAIN DISTANCE TO OBJECT (FACE)
S509
HAS OBJECT (FACE) MOVED CLOSER WITHIN PREDETERMINED DISTANCE DURING PREDETERMINED PERIOD OF TIME?
NO
YES
S510
TURN ON VOICE INPUT MODE
S540
TURN ON IMAGING UNIT
S541
START DETECTING MOVEMENT OF MOUTH BASED ON TAKEN IMAGE
S542
SEND VOICE MESSAGE BASED ON VOICE INPUT
S543
HAS MOVEMENT OF MOUTH STOPPED FOR PREDETERMINED PERIOD OF TIME?
NO
YES
S544
TURN OFF VOICE INPUT MODE
S545
IS NEXT MESSAGE RECEIVED DURING PREDETERMINED PERIOD OF TIME?
YES
NO
S546
TURN OFF IMAGING UNIT, RANGING UNIT, AND LIGHT SOURCE UNIT
END

FIG.18


3a
SNS SYSTEM
310
NOTIFI-
CATION
SERVER
300
SNS
SERVER
6
PUSH
NOTIFICATION
SERVER
311
MESSAGE
SERVER
301
STORAGE
2
1a
TERMINAL
DEVICE
1a
TERMINAL
DEVICE
500
5
500
5

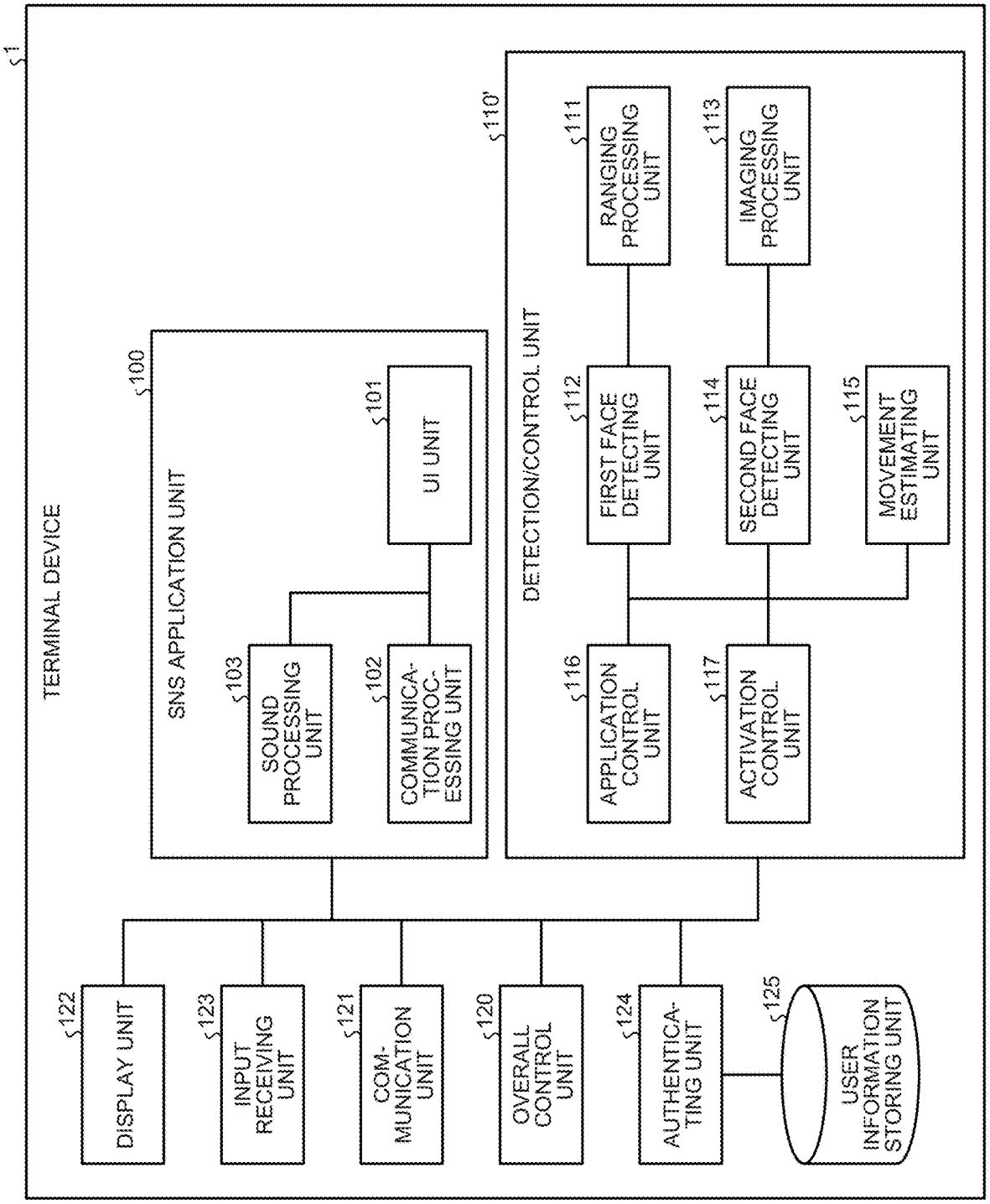

1
TERMINAL DEVICE
100
SNS APPLICATION UNIT
101
UI UNIT
102
COMMUNICATION PROCESSING UNIT
103
SOUND PROCESSING UNIT
110'
DETECTION/CONTROL UNIT
111
RANGING PROCESSING UNIT
112
FIRST FACE DETECTING UNIT
113
IMAGING PROCESSING UNIT
114
SECOND FACE DETECTING UNIT
115
MOVEMENT ESTIMATING UNIT
116
APPLICATION CONTROL UNIT
117
ACTIVATION CONTROL UNIT
120
OVERALL CONTROL UNIT
121
COMMUNICATION UNIT
122
DISPLAY UNIT
123
INPUT RECEIVING UNIT
124
AUTHENTICATING UNIT
125
USER INFORMATION STORING UNIT

FIG.19

FIG.20

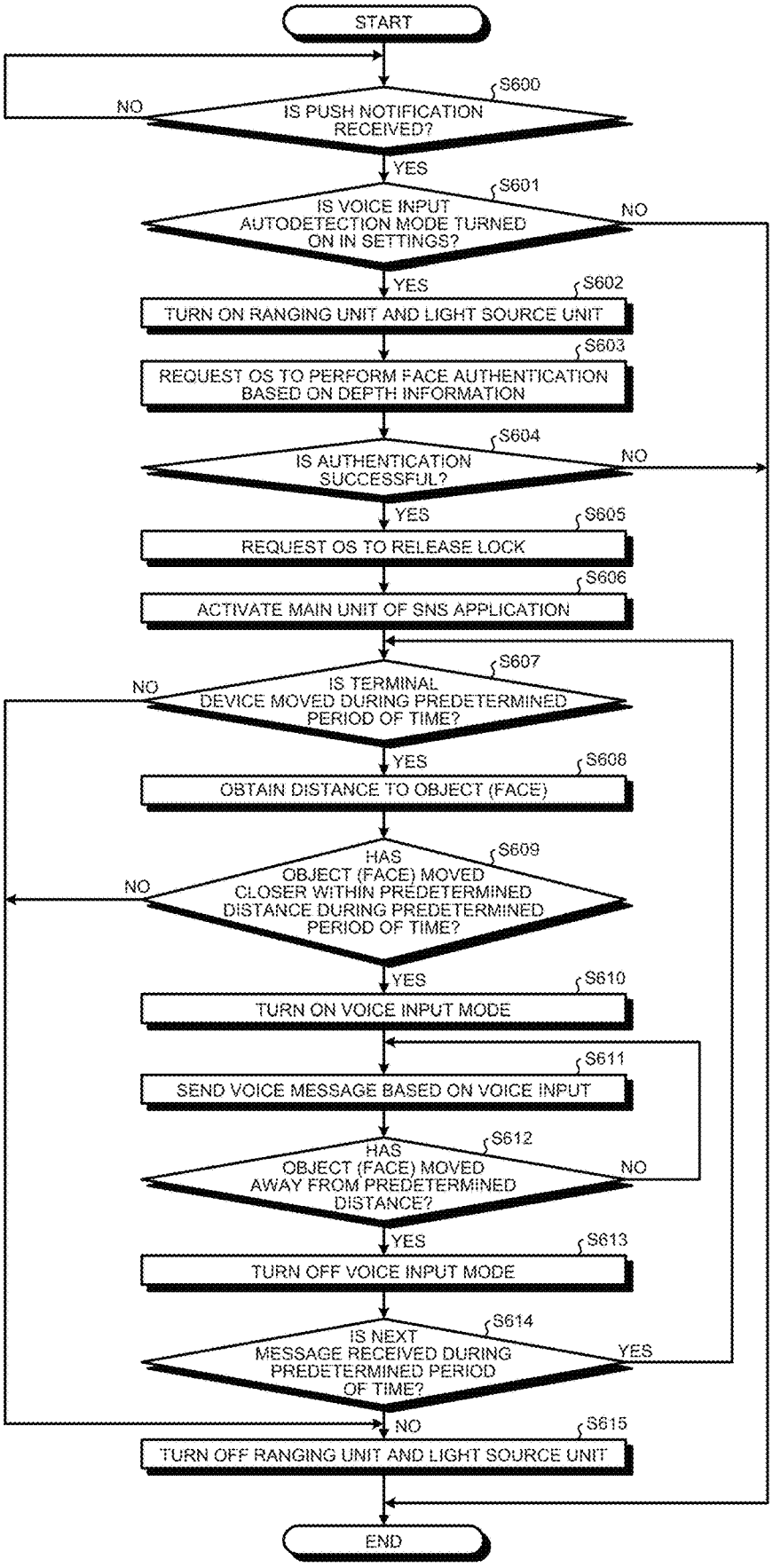

START
S600
IS PUSH NOTIFICATION RECEIVED?
NO
YES
S601
IS VOICE INPUT AUTODETECTION MODE TURNED ON IN SETTINGS?
NO
YES
S602
TURN ON RANGING UNIT AND LIGHT SOURCE UNIT
S603
REQUEST OS TO PERFORM FACE AUTHENTICATION BASED ON DEPTH INFORMATION
S604
IS AUTHENTICATION SUCCESSFUL?
NO
YES
S605
REQUEST OS TO RELEASE LOCK
S606
ACTIVATE MAIN UNIT OF SNS APPLICATION
S607
IS TERMINAL DEVICE MOVED DURING PREDETERMINED PERIOD OF TIME?
NO
YES
S608
OBTAIN DISTANCE TO OBJECT (FACE)
S609
HAS OBJECT (FACE) MOVED CLOSER WITHIN PREDETERMINED DISTANCE DURING PREDETERMINED PERIOD OF TIME?
NO
YES
S610
TURN ON VOICE INPUT MODE
S611
SEND VOICE MESSAGE BASED ON VOICE INPUT
S612
HAS OBJECT (FACE) MOVED AWAY FROM PREDETERMINED DISTANCE?
NO
YES
S613
TURN OFF VOICE INPUT MODE
S614
IS NEXT MESSAGE RECEIVED DURING PREDETERMINED PERIOD OF TIME?
YES
NO
S615
TURN OFF RANGING UNIT AND LIGHT SOURCE UNIT
END

FIG.21

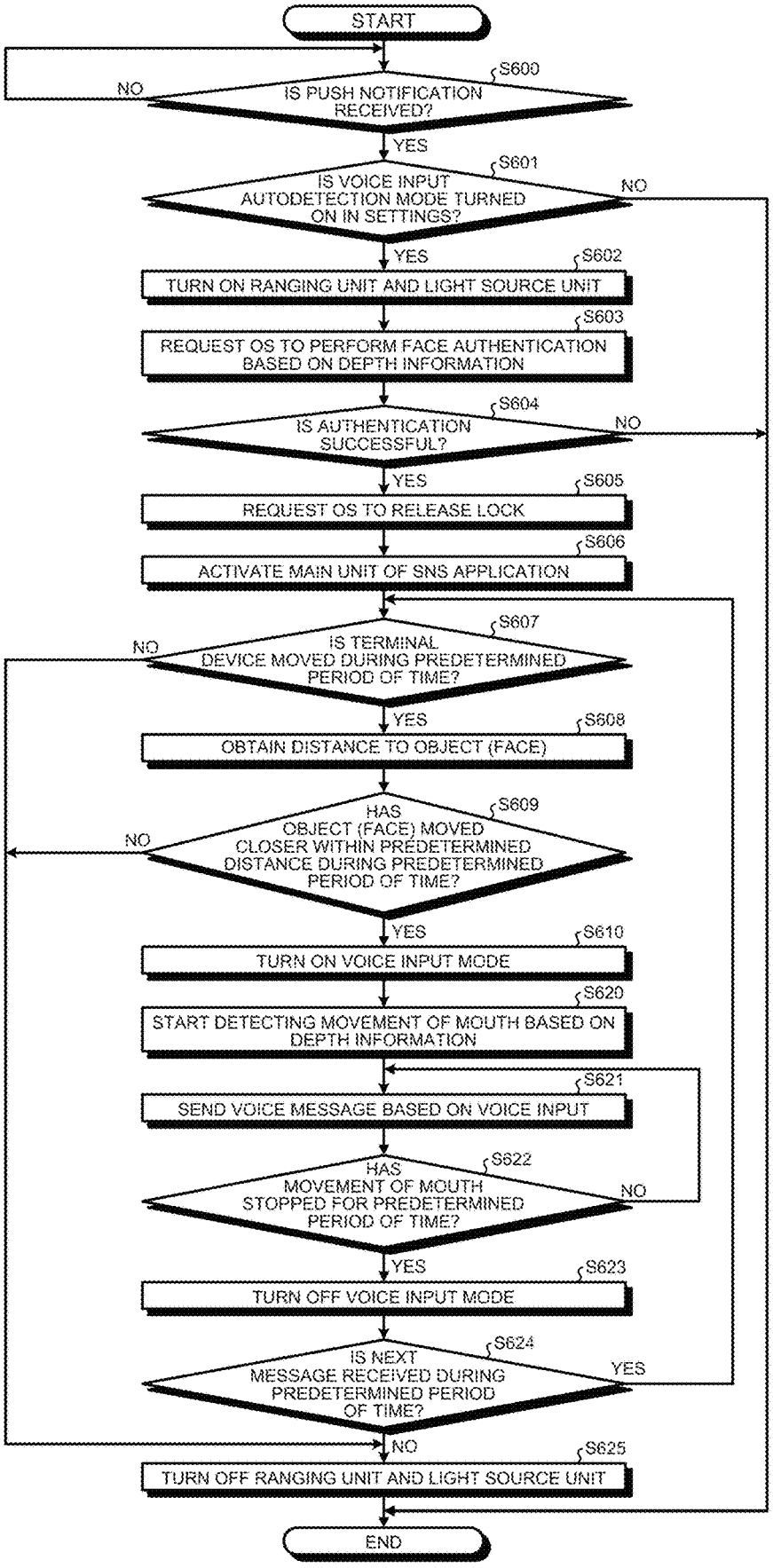
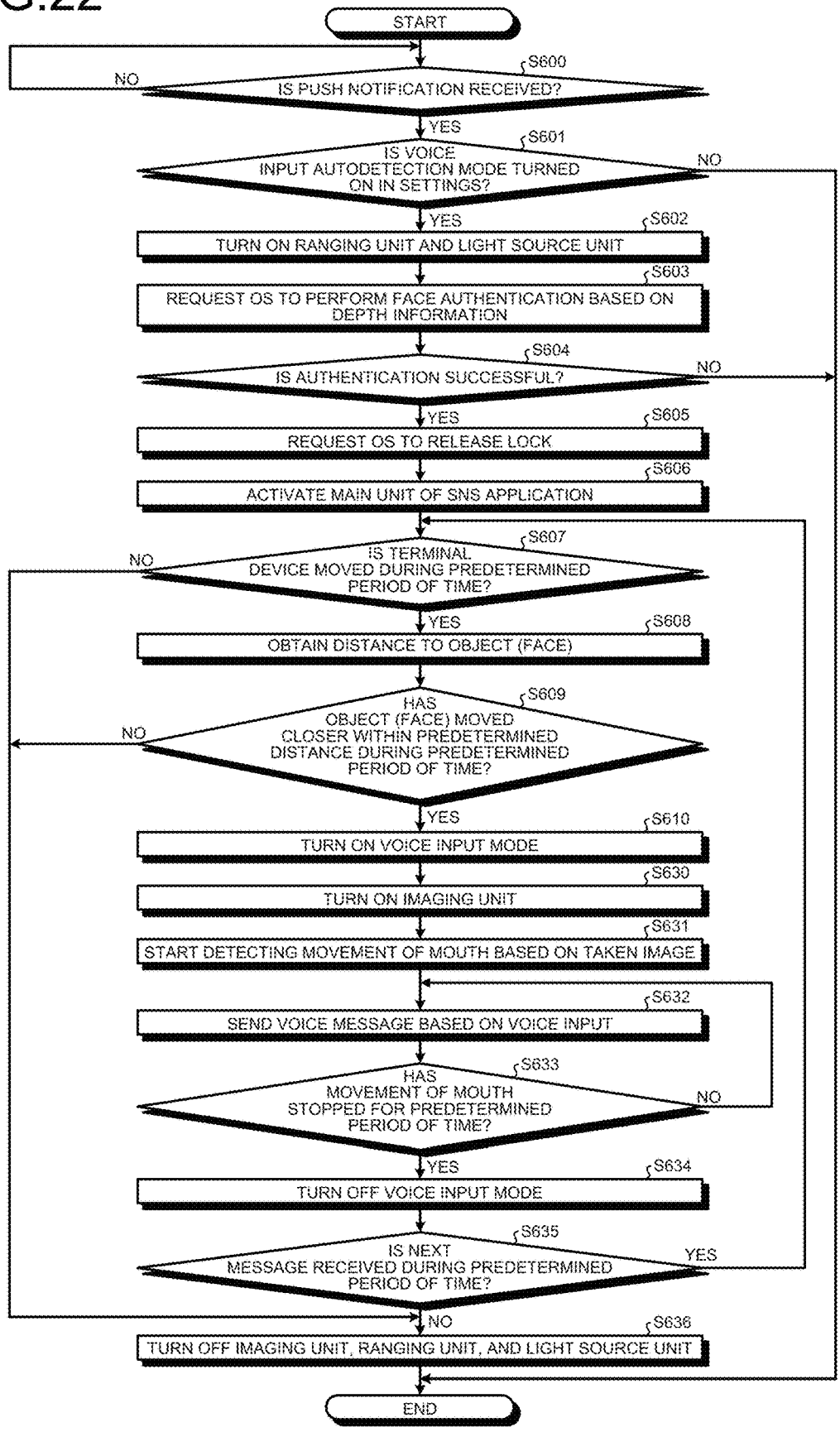

START
S600
IS PUSH NOTIFICATION RECEIVED?
NO
YES
S601
IS VOICE INPUT AUTODETECTION MODE TURNED ON IN SETTINGS?
NO
YES
S602
TURN ON RANGING UNIT AND LIGHT SOURCE UNIT
S603
REQUEST OS TO PERFORM FACE AUTHENTICATION BASED ON DEPTH INFORMATION
S604
IS AUTHENTICATION SUCCESSFUL?
NO
YES
S605
REQUEST OS TO RELEASE LOCK
S606
ACTIVATE MAIN UNIT OF SNS APPLICATION
S607
IS TERMINAL DEVICE MOVED DURING PREDETERMINED PERIOD OF TIME?
NO
YES
S608
OBTAIN DISTANCE TO OBJECT (FACE)
S609
HAS OBJECT (FACE) MOVED CLOSER WITHIN PREDETERMINED DISTANCE DURING PREDETERMINED PERIOD OF TIME?
NO
YES
S610
TURN ON VOICE INPUT MODE
S620
START DETECTING MOVEMENT OF MOUTH BASED ON DEPTH INFORMATION
S621
SEND VOICE MESSAGE BASED ON VOICE INPUT
S622
HAS MOVEMENT OF MOUTH STOPPED FOR PREDETERMINED PERIOD OF TIME?
NO
YES
S623
TURN OFF VOICE INPUT MODE
S624
IS NEXT MESSAGE RECEIVED DURING PREDETERMINED PERIOD OF TIME?
YES
NO
S625
TURN OFF RANGING UNIT AND LIGHT SOURCE UNIT
END

FIG.22


START
S600
IS PUSH NOTIFICATION RECEIVED?
NO
YES
S601
IS VOICE INPUT AUTODETECTION MODE TURNED ON IN SETTINGS?
NO
YES
S602
TURN ON RANGING UNIT AND LIGHT SOURCE UNIT
S603
REQUEST OS TO PERFORM FACE AUTHENTICATION BASED ON DEPTH INFORMATION
S604
IS AUTHENTICATION SUCCESSFUL?
NO
YES
S605
REQUEST OS TO RELEASE LOCK
S606
ACTIVATE MAIN UNIT OF SNS APPLICATION
S607
IS TERMINAL DEVICE MOVED DURING PREDETERMINED PERIOD OF TIME?
NO
YES
S608
OBTAIN DISTANCE TO OBJECT (FACE)
S609
HAS OBJECT (FACE) MOVED CLOSER WITHIN PREDETERMINED DISTANCE DURING PREDETERMINED PERIOD OF TIME?
NO
YES
S610
TURN ON VOICE INPUT MODE
S630
TURN ON IMAGING UNIT
S631
START DETECTING MOVEMENT OF MOUTH BASED ON TAKEN IMAGE
S632
SEND VOICE MESSAGE BASED ON VOICE INPUT
S633
HAS MOVEMENT OF MOUTH STOPPED FOR PREDETERMINED PERIOD OF TIME?
NO
YES
S634
TURN OFF VOICE INPUT MODE
S635
IS NEXT MESSAGE RECEIVED DURING PREDETERMINED PERIOD OF TIME?
YES
NO
S636
TURN OFF IMAGING UNIT, RANGING UNIT, AND LIGHT SOURCE UNIT
END

TERMINAL DEVICE, TERMINAL DEVICE CONTROL METHOD, AND MEMORY MEDIUM

CROSS REFERENCE TO RELATED APPLICATIONS

This application is a national stage application under 35 U.S.C. 371 and claims the benefit of PCT Application No. PCT/JP2019/030497 having an international filing date of 2 Aug. 2019, which designated the United States, which PCT application claimed the benefit of Japanese Patent Application No. 2018-168353 filed 7 Sep. 2018, the entire disclosures of each of which are incorporated herein by reference.

FIELD

The application concerned is related to a terminal device, a terminal device control method, and a memory medium.

BACKGROUND

Devices that are capable of performing wireless communication and that are configured to be easily portable (called mobile devices), such as multifunctional cellular phone terminals (smartphones) and tablet computers, are in widespread use. Generally, such mobile devices are equipped to perform communication of voice messages using the telephone function or using the Internet-based voice communication. In the following explanation, such functions of performing communication of voice messages are collectively referred to as the voice communication function. In the case of using the voice communication function in a mobile device, a touch-sensitive panel needs to be tapped for one or more times. Hence, for example, if a person is holding some other things in hands, a situation may often arise when the tapping operation is felt cumbersome.

For that reason, regarding smartphones, various operation methods have been proposed to activate predetermined functions in a contactless manner without performing the tapping operation. For example, in Patent Literature 1 is disclosed a configuration in which a plurality of sensors is used in combination and the device is operated in response to the actions and the utterances of the user. Moreover, in Patent Literature 2 is disclosed a configuration in which the operation mode of a mobile device is decided according to the orientation of the mobile device.

CITATION LIST

Patent Literature

Patent Literature 1: Japanese Patent Application Laid-open No. 2017-215970

Patent Literature 2: Japanese Translation of PCT International Application Publication No. 2012-508530

SUMMARY

Technical Problem

However, in the conventional contactless operation methods, attention is not given to security. For example, when there is an incoming call based on the voice communication function in the mobile device of a user, there is a risk that the incoming call gets answered in response to a predetermined action performed by some other person present near the concerned user.

It is an objective of the application concerned to provide a terminal device, a terminal device control method, and a memory medium that enable contactless activation of the voice communication function only by a specific user.

Solution to Problem

For solving the problem described above, a terminal device according to one aspect of the present disclosure has a microphone; a communication unit that performs communication via a network; a first sensor that obtains depth information; a first face detecting unit that performs first-type face detection for detecting a face and distance to the face based on the depth information; and a processor, wherein when a communication program, which is meant for making the processor perform transmission and reception of messages including voice messages and which has a sound input mode for enabling collection of sounds using the microphone and transmission of voice messages based on the collected sounds, is executed, and when a message is received by the communication unit under control of the communication program being executed, the processor performs the first-type face detection using the first face detecting unit and controls turning ON and turning OFF the sound input mode according to result of the first-type face detection.

BRIEF DESCRIPTION OF DRAWINGS

FIG. **1** is a diagram that schematically illustrates an exemplary information processing system applicable in the application concerned.

FIG. **2** is a diagram illustrating an exemplary external appearance of a terminal device applicable in embodiments.

FIG. **3** is an exemplary flowchart for schematically explaining a sequence of operations performed for voice message transmission according to the existing technology.

FIG. **4**A is a diagram illustrating an example of the display on the display unit of a terminal device in which a message is received.

FIG. **4**B is a diagram of a screen displayed in the display unit for enabling voice message transmission.

FIG. **5** is an exemplary flowchart for schematically explaining a sequence of operations performed for voice message transmission according to a first embodiment.

FIG. **6** is an exemplary block diagram illustrating a hardware configuration of the terminal device applicable to the first embodiment.

FIG. **7** is a diagram illustrating a more detailed configuration example of a first sensor.

FIG. **8** is a diagram for explaining the principle of distance measurement implemented in the first sensor.

FIG. **9** is a diagram illustrating an example of depth information output by the first sensor according to the first embodiment.

FIG. **10** is an exemplary functional block diagram for explaining the functions of the terminal device according to the first embodiment.

FIG. **11** is an exemplary flowchart for explaining a voice message transmission operation performed in the terminal device according to the first embodiment.

FIG. **12** is an exemplary flowchart for explaining a voice message transmission operation performed in the terminal device according to a first modification example of the first embodiment.

FIG. **13** is an exemplary flowchart for explaining a voice message transmission operation performed in the terminal device according to a second modification example of the first embodiment.

FIG. **14** is an exemplary flowchart for explaining a voice message transmission operation performed in the terminal device according to a second embodiment.

FIG. **15**A is a diagram illustrating an example of a banner image that is displayed in the display unit in the display lock state.

FIG. **15**B is a diagram illustrating an example of a display lock release screen to be used for releasing the display lock according to face authentication.

FIG. **16** is an exemplary flowchart for explaining a voice message transmission operation performed in the terminal device according to a first modification example of the second embodiment.

FIG. **17** is an exemplary flowchart for explaining a voice message transmission operation performed in the terminal device according to a second modification example of the second embodiment.

FIG. **18** is a diagram that schematically illustrates an example of an information processing system that is applicable to a third embodiment and that is used in the case of implementing a push notification.

FIG. **19** is an exemplary functional block diagram for explaining the functions of a terminal device according to the third embodiment.

FIG. **20** is an exemplary flowchart for explaining a voice message transmission operation performed in the terminal device according to the third embodiment.

FIG. **21** is an exemplary flowchart for explaining a voice message transmission operation performed in the terminal device according to a first modification example of the third embodiment.

FIG. **22** is an exemplary flowchart for explaining a voice message transmission operation performed in the terminal device according to a second modification example of the third embodiment.

DESCRIPTION OF EMBODIMENTS

Preferred embodiments of the application concerned are described below in detail with reference to the accompanying drawings. In the embodiments described below, identical constituent elements are referred to by the same reference numerals, and their explanation is not given repeatedly.

First Embodiment

(Information processing system applicable in embodiments) FIG. **1** is a diagram that schematically illustrates an exemplary information processing system applicable in the application concerned. With reference to FIG. **1**, a plurality of terminal devices **1** is connected to a server **3** via a network **2** such as the Internet. Moreover, to the server **3**, a storage **4** is also connected that represents a high-capacity memory medium configured with a hard disk drive or a flash memory.

Each terminal device **1** is installed with application software **5** (hereinafter, referred to as an SNS application **5**) that enables the use of, for example, an SNS (Social Networking Service) provided by the server **3**. The SNS provided by the server **3** is, for example, a service enabling transmission and reception of messages, including voice messages, among the terminal devices **1** via the network **2**. For example, the user of the terminal device **1** receives the SNS application **5**, which is stored in the storage **4**, from the server **3**; installs it in the terminal device **1**; and registers account information in the server **3**. With that, the user becomes able to use the SNS, which is provided by the server **3**, from the SNS application **5**.

The storage **4** can be used to store programs meant for implementing the functions (described later) of the embodiments and their modification examples according to the application concerned. For example, the user can access the server **3** using the terminal device **1**; obtain the programs from the storage **4** via the server **3**; and install the programs in the terminal device **1**.

The terminal device **1** is an information processing device configured to be small in size, light in weight, and easily portable. Examples of the terminal device **1** include a multifunctional cellular phone (smartphone) and a tablet computer. The following explanation is given under the assumption that the terminal device **1** is a smartphone.

FIG. **2** is a diagram illustrating an exemplary external appearance of the terminal device **1** applicable in embodiments. With reference to FIG. **2**, the terminal device **1** includes a display unit **10**, a home button **11**, a microphone **12**, a speaker **13**, a first sensor **14**, and a second sensor **15**. The display unit **10** is a touch-sensitive panel in which, for example, a display device and an input device are configured in an integrated manner. Examples of the display device include an LCD (Liquid Crystal Display) and an organic EL (Electro-Luminescence) display. The input device outputs control signals according to the position at which it is touched.

The home button **11** is, for example, a button for receiving user operations meant for controlling the overall operations of the terminal device **1**. For example, when the display on the display unit **10** is locked thereby restricting the user operations with respect to the display unit **10**, the home button **11** can be operated to release the display lock. The microphone **12** collects, for example, the voice of the user and converts it into voice signals. The speaker **13** converts voice signals into a voice output.

As the first sensor **14**, for example, a ranging element is used. In the application concerned, as the first sensor **14**, a ToF (Time of Flight) sensor is used that performs ranging based on the difference between an illumination light, which is obtained by irradiation of a laser light, and the reflected light, which is obtained as reflection of the laser light from the ranging target. For example, the user holds the terminal device **1** in such a way that the side on which the first sensor **14** is installed is directed toward his or her face, and the distance (depth) to the parts of the face is measured by the first sensor **14**. Then, based on the depth information about the parts of the face as obtained by the first sensor **14** and based on preregistered depth information of the face, the terminal device **1** can perform face authentication of the user.

As the second sensor **15**, for example, an image sensor is used that performs imaging and obtains images.

In the information processing system, the user of each terminal device **1** can activate the SNS application **5** in the corresponding terminal device **1**, and communicate messages including voice messages with the terminal devices **1** of the other users.

(Voice Message Communication According to Existing Technology)

Prior to the explanation of a first embodiment, the communication performed according to the existing technology is explained in a schematic manner. The following explanation is given with the focus on the example of transmission and reception of voice messages between two terminal

devices **1**. Herein, the two terminal devices **1** are referred to as a terminal device **1**(A) and a terminal device **1**(B); and the users of the terminal devices **1**(A) and **1**(B) are referred to as users A and B, respectively.

FIG. **3** is an exemplary flowchart for schematically explaining a sequence of operations performed for voice message transmission according to the existing technology. For example, the user A activates the SNS application **5** in the terminal device **1**(A) (Step S**1000**). The user B, who has activated the SNS application **5** in the terminal device **1**(B) in an identical manner, sends a message having, for example, text data to the terminal device **1**(A). That message is received in the terminal device **1**(A) (Step S**1001**).

FIG. **4**A is a diagram illustrating an example of the display on the display unit **10** of the terminal device **1**(A) in which the message is received. In the display of the display unit **10**, for example, the elapse of time is indicated from the top toward the bottom of the screen, and a message **20** that is received is displayed at the upper end of the screen. In the example illustrated in FIG. **4**A, a button **21** meant for voice message transmission is displayed at the lower end.

If the user A wishes to reply to the message, which is received at Step S**1001**, using a voice message; he or she operates (taps) the button **21**. In response to the operation of the button **21**, the terminal device **1**(A) switches the screen of the display unit **10** to a screen meant for voice message transmission. FIG. **4**B is a diagram of a screen displayed in the display unit **10** for enabling voice message transmission. In the screen of the display unit **10**, a talk area **30** having a talk button **31** gets displayed.

When an operation (for example, tapping) of the talk button **31** is detected (Step S**1002**), the terminal device **1**(A) starts audio recording of the sounds collected by the microphone **12** (Step S**1003**). The audio recording is continuously performed while the talk button **31** is in the operated state. When it is detected that the talk button **31** is released from the operated state (Step S**1004**), the terminal device **1**(A) ends the audio recording and sends the recorded contents to the terminal device **1**(B) (Step S**1005**).

In this way, in the transmission of a voice message according to the existing technology, the talk button **31** is operated and, while the talk button **31** is in the operated state, the voice to be transmitted gets recorded. Thus, the user A who wishes to send a voice message happens to hold the terminal device **1** in one hand and operate the talk button **31** using the other hand. Hence, for example, when the user A is holding some other thing in one hand, the operation of the terminal device **1** becomes extremely cumbersome.

In the explanation given above, the audio recording is performed while the talk button **31** is in the operated state; and a voice message is sent that is recorded till the point of time of releasing the talk button **31** from the operated state. However, that is not the only possible example. Alternatively, it is also possible to think of a method in which a voice message is sent while the talk button **31** is still in the operated state. However, in that method too, the fact remains that the terminal device **1** is held in one hand and the talk button **31** is operated using the other hand.

(Voice Message Transmission According to First Embodiment)

Given below is the schematic explanation about the voice message transmission performed according to the first embodiment. FIG. **5** is an exemplary flowchart for schematically explaining a sequence of operations performed for voice message transmission according to the first embodiment. In the following explanation, it is assumed that, for example, the user A makes the terminal device **1**(A) obtain an image of his or her face using the first sensor **14** and perform face authentication. The information about the authenticated face is stored in the terminal device **1**(A).

For example, the user A activates the SNS application **5** in the terminal device **1**(A) (Step S**1100**). The user B, who has activated the SNS application **5** in the terminal device **1**(B) in an identical manner, sends a message having, for example, text data to the terminal device **1**(A). The message is received in the terminal device **1**(A) (Step S**1101**).

Upon receiving the message, the terminal device **1**(A) turns the first sensor **14** toward his or her face and moves it closer to the face. Based on the face detection result obtained by the first sensor **14**, the terminal device **1**(A) determines whether or not the detected face is an already-authenticated face. If the detected face is determined to be an already-authenticated face (Step S**1102**), the terminal device **1**(A) starts audio recording of the voice collected by the microphone **12** (Step S**1103**). The audio recording is continuously performed until it is determined based on the detection result of the first sensor **14** that the face has moved away. When it is detected based on the detection result of the first sensor **14** that the face has moved away from the terminal device **1**(A) by a predetermined distance or more (Step S**1104**), the terminal device **1**(A) ends the audio recording and sends the recorded contents to the terminal device **1**(B) (Step S**1105**).

In this way, in the first embodiment, only by moving the face close to the terminal device **1**(A), a voice message can be set without having to perform any button operation in the terminal device **1**(A). Thus, in response to a message from the user B, the user A becomes able to easily send a voice message using only one hand.

In the explanation given above, audio recording is performed while the face is kept close to the terminal device **1**(A); and the recorded voice message is sent once the face is moved away from the terminal device **1**(A) by a predetermined distance or more. However, that is not the only possible case. Alternatively, it is also possible to think of a method in which a voice message is sent while the face is kept close to the terminal device **1**(A). In that case too, the fact remains that a voice message can be easily sent as a response using only one hand.

(More Detailed Explanation of First Embodiment)

Given below is the more detailed explanation of the first embodiment.

(Specific Configuration of Terminal Device According to First Embodiment)

Firstly, regarding the terminal device **1** according to the first embodiment, the specific explanation is given below. FIG. **6** is an exemplary block diagram illustrating a hardware configuration of the terminal device **1** applicable to the first embodiment. With reference to FIG. **6**, the terminal device **1** includes a CPU (Central Processing Unit) **1000**, a ROM (Read Only Memory) **1001**, a RAM (Random Access Memory) **1002**, an imaging unit **1003**, a ranging unit **1004**, a storage **1006**, an input device **1007**, a display control unit **1009**, a data I/F (interface) **1010**, a communication I/F **1011**, an audio I/F **1012**, and an orientation detecting unit **1013** that are connected to each other by a bus **1020**. Moreover, the terminal device **1** includes a power source unit **1060** that supplies power to the constituent elements of the terminal device **1**.

To the ranging unit **1004**, a light source unit **1005** is connected. The power supply unit **1060** supplies power to the ranging unit **1004** and the light source unit **1005** via switches **1061***a* and **1061***b*, respectively. Moreover, the power supply unit **1060** supplies power to the imaging unit **1003** via a switch **1062**. The switches **1061***a*, **1061***b*, and

1062 switch between the ON state and the OFF state under the control of, for example, the CPU 1000.

The storage 1006 is a nonvolatile memory medium such as a flash memory or a hard disk drive. The CPU 1000 follows instructions written in the programs that are stored in the storage 1006 or the ROM 1001, and controls the overall operations of the terminal device 1 while using the RAM 1002 as the work memory.

The input device 1007 outputs control signals according to user operations. The display control unit 1009 generates display signals, which are displayable by a display device 1008, based on display control signals sent by the CPU 1000. The input device 1007 and the display device 1008 are configured in an integrated manner and function as a touch-sensitive panel 1030.

The data I/F 1010 is an interface for enabling the terminal device 1 to perform data communication with external devices. For example, USB (Universal Serial Bus) or Bluetooth (registered trademark) can be used as the data I/F 1010. The communication I/F 1011 performs communication with the network 2. To the audio I/F 1012 are connected the microphone 12 and the speaker 13. The audio I/F 1012 performs AD (Analog to Digital) conversion of the analog sound signals that are based on the sounds collected by the microphone 12, and output digital sound data. Moreover, the audio I/F 1012 performs DA (Digital to Analog) conversion of sound data received via the bus 1020 into analog sound signals, and sends it to the speaker 13.

The orientation detecting unit 1013 detects the orientation of the terminal device 1. For example, as the orientation detecting unit 1013, it is possible to implement a 9-axis sensor including a gyro sensor (an angular velocity sensor), an acceleration sensor, and a geomagnetic sensor that individually perform detection along the three axes, namely, the x axis, the y axis, and the z axis.

The imaging unit 1003 corresponds to the second sensor 15 and includes: an image sensor that outputs image signals corresponding to the light with which it is irradiated; an optical system that guides the light from the photographic subject to the light receiving surface of the image sensor; and a processing unit that performs predetermined signal processing and predetermined image processing with respect to the image signals output from the image sensor. As the image sensor, it is possible to use a solid-state image sensing device (CIS: CMOS Image Sensor) in which a CMOS (Complementary Metal Oxide Semiconductor) is used.

The solid-state imaging device can be configured by forming an image sensor unit, in which pixels are arranged in an array-like manner, and a processing unit on a single semiconductor chip. Moreover, the solid-state imaging device can have a two-layer structure configured by bonding a layer in which an image sensor is formed and a layer in which a processing unit is formed. However, that is not the only possible case. Alternatively, the solid-state imaging device can have a three-layer structure configured by further bonding a layer in which a memory is formed to the layers in which an image sensor unit and a processing unit are formed.

The ranging unit 1004 and the light source unit 1005 constitute a ToF sensor representing the first sensor 14. Although explained later in detail, the light source unit 1005 includes a light source of, for example, infrared light (IR). The ranging unit 1004 includes a light receiving element that receives the reflected light of the infrared light emitted from the light source unit 1005 onto the target, and includes a signal processing unit that generates point group information in which each point holds depth information based on the output of the light receiving element (distance information along the optical axis direction).

FIG. 7 is a diagram illustrating a more detailed configuration example of the first sensor 14. In the first sensor 14, the light source unit 1005 includes a light modulating unit 1050, a VCSEL (Vertical Cavity-Surface Emitting Laser) 1051, and a projector lens 1052. The ranging unit 1004 includes a light receiving lens 1040, a ToF sensor 1041, a memory unit 1042, a no-effect information generating unit 1043, an arithmetic processing unit 1044, and an output unit 1045.

The light modulating unit 1050 sends the light output from the VCSEL 1051, such as modulation signals to be used in performing modulation at high-frequency waves of about 10 MHz, to the VCSEL 1051. Moreover, the light modulating unit 1050 sends timing signals, which indicate the timings of modulation of the light of the VCSEL 1051, to the ToF sensor 1041 and the no-effect information generating unit 1043.

According to the modulation signals sent by the light modulating unit 1050, the VCSEL 1051 emits light while performing high-speed modulation of the light of the invisible area such as the infrared light; and emits the resultant light onto the target object for distance measurement by the first sensor 14. In the first embodiment, the light source that emits light toward the target object is explained as the VCSEL 1051. However, alternatively, it is possible to use some other light source such as a laser diode.

The projector lens 1052 is configured using a narrow-angle lens for adjusting the distribution of light, so that the light emitted from the VCSEL 1051 has the desired irradiation angle.

The light receiving lens 1040 is configured using a wide-angle lens that covers the light receiving range of the light received by the first sensor 14 for the purpose of distance measurement. The light receiving lens 1040 forms an image of the light, which is collected within the angle of field of the light receiving range, onto the sensor surface of the ToF sensor 1041.

The ToF sensor 1041 is configured using light receiving elements (pixels) having sensitivity in the wavelength area of the light that is emitted from the VCSEL 1051; and receives the light, with which the light receiving lens 1040 has formed an image, using a plurality of light receiving elements arranged in an array-like manner on the sensor surface. For example, the ToF sensor 1041 includes the light receiving elements in about 180×240 number of arrays. The ToF sensor 1041 is disposed near the VCSEL 1051 and receives the light coming from the light receiving range including the irradiation range within which the light is emitted from the VCSEL 1051. Then, the ToF sensor 1041 outputs RAW signals having the amount of light received by each light receiving element as the measured value.

The memory unit 1042 is used to store point group information that is built using the RAW signals output from the ToF sensor 1041. For example, the memory unit 1042 can be used to store the latest point group information obtained when a change occurs in the light receiving range, or can be used to store, as background information, the point group information in the state in which no target object is present in the light receiving range.

The no-effect information generating unit 1043 eliminates, according to the timing signals received from the light modulating unit 1050, the effect of the ambient light from the RAW signals received from the ToF sensor 1041. As a result, the no-effect information generating unit 1043 gen-

erates point group information having only the reflected light component corresponding to the light emitted from the VCSEL **1051** as the measured value (hereinafter, called no-effect information); and sends the no-effect information to the arithmetic processing unit **1044**. Moreover, the no-effect information generating unit **1043** reads the background information stored in the memory unit **1042**; obtains the difference between the background information and the point group information built using the RAW signals received from the ToF sensor **1041**; and generates no-effect information confined to the target object in the light receiving range.

Regarding the arithmetic processing unit **1044**, every time the no-effect information is received from the no-effect information generating unit **1043**, the arithmetic processing unit **1044** performs the calculation for obtaining the distance to the target object from each point in the no-effect information; and sends depth signals, which represent the distances, to the output unit **1045**. Moreover, as may be necessary, the arithmetic processing unit **1044** can read the latest point group information stored in the memory unit **1042**, and obtain the distances to the target object using that point group information.

The output unit **1045** generates depth information, in which the distances to the photographic subject are lined up according to the arrangement of the light receiving elements, based on the depth signals received from the arithmetic processing unit **1044**; and outputs the depth information to the bus **1020**.

Meanwhile, in the explanation given above, a VCSEL is used as the light source element in the light source unit **1005**. However, that is not the only possible case. Alternatively, for example, an LED (Light Emitting Diode) can be used as the light source element used in the light source unit **1005**.

Explained below with reference to FIG. **8** is the principle of distance measurement implemented in the first sensor **14**. For example, the VCSEL **1051** emits illumination light toward the target object, and the ToF sensor **1041** receives the reflected light, which is obtained due to the reflection of the illumination light from the target object, with a delay of a time period ϕ from the emission timing of the illumination light according to the distance to the target object. At that time, in the ToF sensor **1041**, the reflected light is received by a light receiving unit A, which receives light at the same time interval as the time interval at which the VCSEL **1051** emits the illumination light, and by a light receiving unit B, which receives light at that same time interval but starting from the end of light reception by the light receiving unit A. Thus, an electric charge gets accumulated in the light receiving units A and B.

Based on the ratio of the electrical charge accumulated in the light receiving unit A and the electrical charge accumulated in the light receiving unit B, the time period ϕ taken till the reception of the reflected light can be obtained; and the distance to the target object can be calculated according to the speed of light. Such a ToF method for calculating the distance to the target object based on the ratio of the electrical charge is called an indirect ToF.

In contrast, the ToF method for calculating the distance to the target object based on the time difference between the illumination light and the reflected light is called a direct ToF. In the application concerned, either one of the indirect ToF and the direct ToF can be implemented.

FIG. **9** is a diagram illustrating an example of the depth information output by the first sensor **14** according to the first embodiment. In the example illustrated in FIG. **9**, the depth information is expressed in the form of gradation by performing interpolation among the points. In FIG. **9**, excluding the background, the portion having a darker shade (black shade) indicates a shorter distance, and the portion having a lighter shade (white shade) indicates a longer distance.

More particularly, regarding the face that is oriented sideways as illustrated in FIG. **9**, it can be understood that a temporal region **50**, an outer edge **51***a* of the auricle of ear, and an earing **52** have the darkest shade and are at the shortest distance. Moreover, it can be understood that a jaw **53** has a lighter shade than the temporal region **50** and is farther than the temporal region **50**. Furthermore, it can be understood that hair **54** on the back of the head has the lightest shade and is farthest from among the other areas of the face. Moreover, it can be understood that, in the auricle of ear, the outer edge **51***a* and an inner portion **51***b* have different levels of darkness, and the inner portion **51***b* is farther than the outer edge **51***a*.

In this way, based on the ranging result obtained by the first sensor **14**, it becomes possible to obtain the concavo-convex shape of the target object.

FIG. **10** is an exemplary functional block diagram for explaining the functions of the terminal device **1** according to the first embodiment. With reference to FIG. **10**, the terminal device **1** includes an SNS application unit **100**, a detection/control unit **110**, an overall control unit **120**, a communication unit **121**, a display unit **122**, an input receiving unit **123**, an authenticating unit **124**, and a user information storing unit **125**.

Of those functions, the SNS application unit **100** corresponds to the SNS application **5** provided by the server **3**, and is configured in the terminal device **1** as a result of installing an installation program, which is obtained from the server **3**, in the terminal device **1**. The detection/control unit **110** performs operations according to the first embodiment, and is configured in the terminal device **1** as a result of installing an installation program, which is obtained from the server **3** or another server, in the terminal device **1**. However, that is not the only possible case. Alternatively, the installation program for configuring the detection/control unit **110** can be included in the installation program for configuring the SNS application unit **100**.

On the other hand, the overall control unit **120**, the communication unit **121**, the display unit **122**, the input receiving unit **123**, and the authenticating unit **124** are installed in advance in the terminal device **1**. The user information storing unit **125** is configured using, for example, a predetermined area of the storage **1006**.

The overall control unit **120** represents, for example, the OS (Operating System) that controls the overall operations of the terminal device **1**. The communication unit **121** controls the communication performed via the network **2**. The display unit **122** generates display control signals meant for performing display in the display device **1008**. The input receiving unit **123** receives user operations with respect to the input device **1007**.

The authenticating unit **124** authenticates the user of the terminal device **1** based on the user information stored in the user information storing unit **125**. The user information used by the authenticating unit **124** in performing user authentication contains: a user ID; a password; a PIN (Personal Identification Number) code; face information based on the depth information detected by a first face detecting unit **112** (described later); and a taken image detected by a second face detecting unit **114** (described later).

The SNS application unit **100** includes a UI (User Interface) unit **101**, a communication processing unit **102**, and a

sound processing unit **103**. The UI unit **101** provides a user interface enabling the user to scan the terminal device **1**; and is used to define the configuration of the display screens to be displayed in the display device **1008** by the display unit **122** and to define user operations performed with respect to the input device **1007** and received by the input receiving unit **123**. The communication processing unit **102** performs processing related to the communication in the concerned SNS. The sound processing unit **103** performs processing related to the transmission and reception of voice messages in the concerned SNS.

The detection/control unit **110** includes a ranging processing unit **111**, the first face detecting unit **112**, an imaging processing unit **113**, the second face detecting unit **114**, a movement estimating unit **115**, and an application control unit **116**.

The ranging processing unit **111** performs ranging using the first sensor **14**, that is, using the ranging unit **1004** and the light source unit **1005**; and obtains depth information. The first face detecting unit **112** detects the face based on the depth information obtained by the ranging processing unit **111**. Moreover, the first face detecting unit **112** can compare a plurality of sets of depth information obtained in chronological order, and accordingly detect the movement of the face.

The imaging processing unit **113** performs imaging using the imaging unit **1003** and obtains a taken image. The second face detecting unit **114** detects the face based on the taken image obtained by the imaging processing unit **113**. Moreover, the second face detecting unit **114** can compare a plurality of taken images obtained in a chronological order, and accordingly detect the movement of the face.

The movement estimating unit **115** estimates the movement of the terminal device **1** based on the output of the orientation detecting unit **1013**. For example, when the user holds the terminal device **1** in hand and moves it, the movement estimating unit **115** can detect the movement according to the movement estimation result based on the output of the orientation detecting unit **1013**.

The application control unit **116** controls the operations of the SNS application unit **100** and obtains the state of the SNS application unit **100**. For example, based on the result of face detection performed by the first face detecting unit **112** and the second face detecting unit **114**, the application control unit **116** controls the operations of the SNS application unit **100**.

The programs that are written for implementing the operations of the SNS application unit **100** and the detection/control unit **110** in the terminal device **1** are stored in a downloadable manner in a computer (for example, the server **3**) that is connected to the network **2** such as the Internet. Alternatively, the programs can be distributed via the network **2** such as the Internet. Still alternatively, the programs can be recorded as installable files or executable files in a computer-readable recording medium such as a CD (Compact Disk), a flexible disk (FD), or a DVD (Digital Versatile Disk).

Of those programs, the program written for configuring the SNS application unit **100** (i.e., the SNS application **5**) has a modular configuration including the UI unit **101**, the communication processing unit **102**, and the sound processing unit **103**. The program written for configuring the detection/control unit **110** (i.e., a control program) has a modular configuration including the ranging processing unit **111**, the first face detecting unit **112**, the imaging processing unit **113**, the second face detecting unit **114**, and the application control unit **116**. As far as the actual hardware is concerned, the CPU **1000** reads the programs from a recording medium, such as the ROM **1001** or the storage **1006**, and executes the programs; so that the abovementioned constituent elements get loaded and generated in the main memory device such as the RAM **1002**.

Meanwhile, from among the functions included in the detection/control unit **110**, regarding the functions that are same as the preinstalled functions in the terminal device **1**, the preinstalled functions in the terminal device **1** can be used. For example, when the terminal device **1** has the preinstalled function of performing face authentication based on the depth information, that face authentication function can be used in the ranging processing unit **111** and the first face detecting unit **112**.

(Details of Operations According to First Embodiment)

Given below is the more detailed explanation about the operations performed in the terminal device **1** according to the first embodiment. FIG. **11** is an exemplary flowchart for explaining a voice message transmission operation performed in the terminal device **1** according to the first embodiment. At the start of the operations illustrated in the flowchart in FIG. **11**, it is assumed that the switches **1061***a* and **1061***b* are in the OFF state. Hence, no power is supplied to the ranging unit **1004** and the light source unit **1005**, and their functions are disabled. In an identical manner, it is assumed that the switch **1062** is in the OFF state. Hence, no power is supplied to the imaging unit **1003**, and its functions are disabled.

At Step S**100**, the application control unit **116** obtains the state of the SNS application unit **100**, and determines whether or not the SNS application **5** is running. If the application control unit **116** determines that the SNS application **5** is not running (No at Step S**100**), then the system control returns to Step S**100**. On the other hand, if the application control unit **116** determines that the SNS application **5** is running (Yes at Step S**100**), then the system control proceeds to Step S**101**.

At Step S**101**, the application control unit **116** determines whether or not the voice input autodetection mode is turned ON in the settings. The voice input autodetection mode is an item set, for example, using a setting screen presented by the overall control unit **120**. When the voice input autodetection mode is turned ON, the autodetection function of the detection/control unit **110** with respect to a voice input gets enabled. If the application control unit **116** determines that the voice input autodetection mode is not turned ON in the settings (No at Step S**101**), then the system control proceeds to Step S**120**.

At Step S**120**, the application control unit **116** instructs the SNS application unit **100** to maintain the operation mode for inputting messages to the normal character input mode. After the operation at Step S**120** is performed, the application control unit **116** ends the sequence of operations illustrated in the flowchart in FIG. **11**.

Meanwhile, at Step S**101**, if the application control unit **116** determines that the voice input autodetection mode is turned ON in the settings (Yes at Step S**101**), then the system control proceeds to Step S**102**. At Step S**102**, the application control unit **116** determines whether or not the SNS application unit **100** has received a message that is sent from another terminal device **1** using the corresponding SNS application **5**. In that case, the message can be a text message written by inputting characters, or a voice message given by inputting the voice.

If the application control unit **116** determines that the SNS application unit **100** has not received a message (No at Step S**102**), then the system control returns to Step S**102**. On the

other hand, if the application control unit **116** determines that the SNS application unit **100** has received a message (Yes at Step S**102**), then the system control proceeds to Step S**103**.

At Step S**103**, the application control unit **116** turns ON the ranging unit **1004** and the light source unit **1005**. More particularly, the application control unit **116** instructs, for example, the overall control unit **120** to control the switches **1061***a* and **1061***b* in the ON state. As a result of switching ON the switches **1061***a* and **1061***b*, power gets supplied to the ranging unit **1004** and the light source unit **1005**, and their functions are enabled. Once the functions of the ranging unit **1004** and the light source unit **1005** are enabled, the ranging processing unit **111** starts the ranging operation based on the depth information output from the ranging unit **1004**.

Subsequently, at Step S**104**, the application control unit **116** determines whether or not the terminal device **1** has been moved during a predetermined period of time since the point of time of reception of the message at Step S**102**. The application control unit **116** can determine about the movement of the terminal device **1** based on, for example, the output of the movement estimating unit **115**.

Herein, although the explanation is given about the case in which it is determined at Step S**104** about whether or not the terminal device **1** has been moved, that is not the only possible case. For example, at Step S**104**, the face can be detected based on the depth information obtained by the ranging processing unit **111**, and it can be determined whether or not the detected face has moved closer to the terminal device **1**. That implies obtaining the variation in the relative position between the terminal device **1** and the face representing the ranging target.

If the application control unit **116** determines at Step S**104** that the terminal device **1** has not been moved during the predetermined period of time (No at Step S**104**), then the system control proceeds to Step S**112**. On the other hand, if the application control unit **116** determines at Step S**104** that the terminal device **1** has been moved during the predetermined period of time (Yes at Step S**104**), then the system control proceeds to Step S**105**.

At Step S**105**, the application control unit **116** obtains the distance to the object (face) based on the face detection result obtained by the first face detecting unit **112**. Subsequently, at Step S**106**, based on the distance obtained at Step S**105**, the application control unit **116** determines whether or not the object (face) has moved closer within a predetermined distance during a predetermined period of time.

If the application control unit **116** determines at Step S**106** that the object (face) has not moved closer within the predetermined distance during the predetermined period of time (No at Step S**106**), then the system control proceeds to Step S**112**. That is, in this case, it is possible to think that the user has no intention to perform a voice input and send a voice message. Hence, the subsequent operations related to voice message transmission are cancelled.

On the other hand, if the application control unit **116** determines at Step S**106** that the object (face) has moved closer within the predetermined distance during the predetermined period of time (Yes at Step S**106**), then the system control proceeds to Step S**107**.

Meanwhile, in FIG. **11**, although it is illustrated that the operations at Steps S**105** and S**106** are over in only one iteration; in practice, the operations at Steps S**105** and S**106** are performed in a loop until the condition at Step S**106** is satisfied.

At Step S**107**, the application control unit **116** instructs the SNS application unit **100** to set the operation mode to the voice input mode (i.e., to turn ON the voice input mode). In response to the instruction, the SNS application unit **100** sets the operation mode to the voice input mode, and starts voice input processing using the sound processing unit **103** based on the sounds collected by the microphone **12**.

Then, at Step S**108**, in the SNS application unit **100**, the communication processing unit **102** sends the voice data, which is obtained as a result of processing performed by the sound processing unit **103**, as a voice message to the sender of the message received at Step S**102**.

Subsequently, at Step S**109**, based on the face detection result obtained by the first face detecting unit **112**, the application control unit **116** determines whether or not the object (face) has moved away from the predetermined distance from the terminal device **1**. If the application control unit **116** determines that the object (face) has not moved away from the predetermined distance (No at Step S**109**), then the system control returns to Step S**108**.

On the other hand, at Step S**109**, if the application control unit **116** determines that the object (face) has moved away from the predetermined distance (Yes at Step S**109**), then the system control proceeds to Step S**110**. That is, in this case, it is possible to think that the user intends to discontinue or end the transmission of the voice message. At Step S**110**, the application control unit **116** instructs the SNS application unit **100** to end (turn OFF) the voice input mode. In response to that instruction, the SNS application unit **100** ends the voice input processing performed by the sound processing unit **103**, and ends the voice message transmission performed by the communication processing unit **102**.

Subsequently, at Step S**111**, the application control unit **116** determines whether or not the next message is received within a predetermined period of time since ending the voice input mode at Step S**110**. If the application control unit **116** determines that the next message is received (Yes at Step S**111**), then the system control returns to Step S**104**. On the other hand, if the application control unit **116** determines that the next message is not received within the predetermined period of time (No at Step S**111**), then the system control proceeds to Step S**112**.

At Step S**112**, the application control unit **116** turns OFF the ranging unit **1004** and the light source unit **1005**. More particularly, the application control unit **116** instructs, for example, the overall control unit **120** to control the switches **1061***a* and **1061***b* in the OFF state. As a result of switching OFF the switches **1061***a* and **1061***b*, the power supply from the power supply unit **1060** to the ranging unit **1004** and the light source unit **1005** is stopped, and their functions are disabled.

When the operation at Step S**112** is finished, the sequence of operations illustrated in the flowchart in FIG. **11** is ended.

In this way, in the first embodiment, the SNS application unit **100** controls the operation of turning ON and turning OFF the voice input mode based on the distance between the terminal device **1** and the face. That eliminates the need for the user to perform an operation such as tapping the touch-sensitive panel **1030** of the terminal device **1** in order to turn ON or turn OFF the voice input mode, and can send a voice message, for example, just by holding the terminal device **1** in one hand and moving it closer to the face. That is, the user becomes able to send a voice message in a contactless manner except for holding the terminal device **1**.

Moreover, in the first embodiment, the SNS application unit **100** controls the operation of turning ON and turning OFF the voice input mode based on the output of the ToF

sensor **1041** for which infrared light is used as the light source. Hence, even in a dark environment such as in the night time, the control for turning ON and turning OFF the voice input mode can be performed. For example, in the case of performing that control using an image sensor such as a CIS, it is required to have the outside light of some brightness. Hence, such an image sensor is not suitable for use in a dark environment.

Furthermore, in the first embodiment, the distance to the face is measured at the time when a voice input is performed for sending a voice message. Hence, the sensitivity of the microphone **12** (the gain with respect to the output of the microphone **12**) can be adjusted based on the distance to the face. That enables transmission of the voice message with an appropriate sound level.

First Modification Example of First Embodiment

Given below is the explanation of a first modification example of the first embodiment. In the first embodiment, the SNS application unit **100** controls the voice input mode based on the distance of the face from the terminal device **1**. In contrast, in the first modification example of the first embodiment, the SNS application unit **100** controls the voice input mode by detecting the movement of the mouth based on the depth information.

In the first modification example of the first embodiment, the configuration of the terminal device **1** as explained with reference to FIGS. **6** to **10** according to the first embodiment can be implemented without modification.

FIG. **12** is an exemplary flowchart for explaining a voice message transmission operation performed in the terminal device **1** according to the first modification example of the first embodiment. In FIG. **12**, the operations identical to the operations illustrated in the flowchart in FIG. **11** are referred to by the same step numbers, and their explanation is given in short. At the start of the operations illustrated in the flowchart in FIG. **12**, it is assumed that the switches **1061***a* and **1061***b* are in the OFF state. In an identical manner, it is assumed that the switch **1062** is in the OFF state. Hence, no power is supplied to the imaging unit **1003**, and its functions are disabled.

In the flowchart illustrated in FIG. **12**, the operations from Step S**100** to Step S**107** are identical to the operations performed from Step S**100** to Step S**107** illustrated in the flowchart in FIG. **11**. That is, at Step S**100**, the application control unit **116** determines whether or not the SNS application **5** is running. If the application control unit **116** determines that the SNS application **5** is not running (No at Step S**100**), then the system control returns to Step S**100**. On the other hand, if the application control unit **116** determines that the SNS application **5** is running (Yes at Step S**100**), then the system control proceeds to Step S**101**.

At Step S**101**, the application control unit **116** determines whether or not the voice input autodetection mode is turned ON in the settings. If the application control unit **116** determines that the voice input autodetection mode is not turned ON in the settings (No at Step S**101**), then the system control proceeds to Step S**120**. At Step S**120**, the application control unit **116** instructs the SNS application unit **100** to maintain the operation mode for inputting messages to the normal character input mode. That marks the end of the sequence of operations illustrated in the flowchart in FIG. **12**.

Meanwhile, at Step S**101**, if the application control unit **116** determines that the voice input autodetection mode is turned ON in the settings (Yes at Step S**101**), then the system control proceeds to Step S**102**. At Step S**102**, the application control unit **116** determines whether or not the SNS application unit **100** has received a message that is sent from another terminal device **1** using the corresponding SNS application **5**. If the application control unit **116** determines that the SNS application unit **100** has not received a message (No at Step S**102**), then the system control returns to Step S**102**.

On the other hand, if the application control unit **116** determines that the SNS application unit **100** has received a message (Yes at Step S**102**), then the system control proceeds to Step S**103**. At Step S**103**, the application control unit **116** turns ON the ranging unit **1004** and the light source unit **1005**.

Subsequently, at Step S**104**, the application control unit **116** detects the movement of the terminal device **1** using a gyro and determines whether or not the terminal device **1** has been moved during a predetermined period of time since the point of time of reception of the message at Step S**102**. If the application control unit **116** determines that the terminal device **1** has not been moved (No at Step S**104**), then the system control proceeds to Step S**205**.

On the other hand, if the application control unit **116** determines at Step S**104** that the terminal device **1** has been moved during the predetermined period of time (Yes at Step S**104**), then the system control proceeds to Step S**105**. At Step S**105**, the application control unit **116** obtains the distance to the object (face) based on the face detection result obtained by the first face detecting unit **112**.

Subsequently, at Step S**106**, based on the distance obtained at Step S**105**, the application control unit **116** determines whether or not the object (face) has moved closer within a predetermined distance during a predetermined period of time. In an identical manner to the explanation given with reference to FIG. **11**; in practice, the operations at Steps S**105** and S**106** are performed in a loop until the condition at Step S**106** is satisfied.

At Step S**106**, if the application control unit **116** determines that the object (face) has not moved closer within the predetermined distance during the predetermined period of time (No at Step S**106**), then the system control proceeds to Step S**205**, and the subsequent operations related to voice message transmission are canceled.

On the other hand, if the application control unit **116** determines at Step S**106** that the object (face) has moved closer within the predetermined distance during the predetermined period of time (Yes at Step S**106**), then the system control proceeds to Step S**107**. At Step S**107**, the application control unit **116** instructs the SNS application unit **100** to turn ON the voice input mode.

Subsequently, at Step S**200**, the application control unit **116** instructs the first face detecting unit **112** to start detecting the movement of the mouth in the face using the face detection result that is based on the depth information. In response to the instruction, the first face detecting unit **112** compares a plurality of sets of depth information obtained in, for example, chronological order and detects the movement of the mouth.

Subsequently, at Step S**201**, in the SNS application unit **100**, the communication processing unit **102** sends the voice data, which has been processed by the sound processing unit **103**, as a voice message to the sender of the message received at Step S**102**.

Then, at Step S**202**, based on the result of mouth movement detection started by the first face detecting unit **112** at Step S**200**, the application control unit **116** determines whether or not the movement of the mouth has stopped for

a predetermined period of time. At Step S202, if the application control unit 116 determines that the movement of the mouth has not stopped for the predetermined period of time (No at Step S202), then the system control returns to Step S201. On the other hand, if the application control unit 116 determines that the movement of the mouth has stopped for the predetermined period of time (Yes at Step S202), then the system control proceeds to Step S203.

Meanwhile, in FIG. 12, although it is illustrated that the operations at Steps S201 and S202 are over in only one iteration; in practice, the operations at Steps S201 and S202 are performed in a loop until the condition at Step S202 is satisfied.

The operations performed from Step S203 onward are identical to the operations performed from Step S110 onward illustrated in the flowchart in FIG. 11 according to the first embodiment. That is, at Step S203, the application control unit 116 instructs the SNS application unit 100 to end (turn OFF) the voice input mode. In response to the instruction, the SNS application unit 100 ends the voice input processing performed using the sound processing unit 103, and ends the voice message transmission operation performed using the communication processing unit 102.

Subsequently, at Step S204, the application control unit 116 determines whether or not the next message is received within a predetermined period of time since ending the voice input mode at Step S203. If the application control unit 116 determines that the next message is received (Yes at Step S203), then the system control returns to Step S104.

On the other hand, if the application control unit 116 determines that the next message is not received within the predetermined period of time (No at Step S204), then the system control proceeds to Step S205. At Step S205, the application control unit 116 turns OFF the ranging unit 1004 and the light source unit 1005. When the operation at Step S205 is finished, the sequence of operations illustrated in the flowchart in FIG. 11 is ended.

In this way, in the first modification example of the first embodiment, the control for turning OFF the voice input mode is performed according to the result of detecting the movement of the mouth based on the depth information. Hence, voice message transmission can be controlled with higher accuracy.

Moreover, in the first modification example of the first embodiment, in an identical manner to the first embodiment, the user need not perform an operation such as tapping the touch-sensitive panel 1030 of the terminal device 1 in order to turn ON or turn OFF the voice input mode, and can send a voice message, for example, just by holding the terminal device 1 in one hand and moving it closer to the face.

Furthermore, in the first modification example of the first embodiment, in an identical manner to the first embodiment, the SNS application unit 100 controls the operation of turning ON and turning OFF the voice input mode based on the output of the ToF sensor 1041 for which infrared light is used as the light source. Hence, even in a dark environment such as in the night time, the control for turning ON and turning OFF the voice input mode can be performed.

Second Modification Example of First Embodiment

Given below is the explanation of a second modification example of the first embodiment. In the first modification example of the first embodiment, the SNS application unit 100 controls the voice input mode by detecting the movement of the mouth based on the depth information. In contrast, in the second modification example of the first embodiment, the SNS application unit 100 controls the voice input mode by detecting the movement of the mouth based on a taken image.

In the first modification example of the first embodiment, the configuration of the terminal device 1 as explained with reference to FIGS. 6 to 10 according to the first embodiment can be implemented without modification.

FIG. 13 is an exemplary flowchart for explaining a voice message transmission operation performed in the terminal device 1 according to the second modification example of the first embodiment. In FIG. 13, the operations identical to the operations illustrated in the flowchart in FIG. 11 are referred to by the same step numbers, and their explanation is given in short. At the start of the operations illustrated in the flowchart in FIG. 13, it is assumed that the switches 1061*a* and 1061*b* are in the OFF state. In an identical manner, it is assumed that the switch 1062 is in the OFF state. Hence, no power is supplied to the imaging unit 1003, and its functions are disabled.

In the flowchart illustrated in FIG. 13, the operations from Step S100 to Step S107 are identical to the operations performed from Step S100 to Step S107 illustrated in the flowchart in FIG. 11. That is, at Step S100, the application control unit 116 determines whether or not the SNS application 5 is running. If the application control unit 116 determines that the SNS application 5 is not running (No at Step S100), then the system control returns to Step S100. On the other hand, if the application control unit 116 determines that the SNS application 5 is running (Yes at Step S100), then the system control proceeds to Step S101.

At Step S101, the application control unit 116 determines whether or not the voice input autodetection mode is turned ON in the settings. If the application control unit 116 determines that the voice input autodetection mode is not turned ON in the settings (No at Step S101), then the system control proceeds to Step S120. At Step S120, the application control unit 116 instructs the SNS application unit 100 to maintain the operation mode for inputting messages to the normal character input mode. That marks the end of the sequence of operations illustrated in the flowchart in FIG. 13.

Meanwhile, at Step S101, if the application control unit 116 determines that the voice input autodetection mode is turned ON in the settings (Yes at Step S101), then the system control proceeds to Step S102. At Step S102, the application control unit 116 determines whether or not the SNS application unit 100 has received a message that is sent from another terminal device 1 using the corresponding SNS application 5. If the application control unit 116 determines that the SNS application unit 100 has not received a message (No at Step S102), then the system control returns to Step S102.

On the other hand, if the application control unit 116 determines that the SNS application unit 100 has received a message (Yes at Step S102), then the system control proceeds to Step S103. At Step S103, the application control unit 116 turns ON the ranging unit 1004 and the light source unit 1005.

Subsequently, at Step S104, the application control unit 116 detects the movement of the terminal device 1 based on the output of the movement estimating unit 115 and determines whether or not the terminal device 1 has been moved during a predetermined period of time since the point of time of reception of the message at Step S102. If the application control unit 116 determines that the terminal device 1 has not been moved (No at Step S104), then the system control proceeds to Step S306.

On the other hand, if the application control unit **116** determines at Step S**104** that the terminal device **1** has been moved during the predetermined period of time (Yes at Step S**104**), then the system control proceeds to Step S**105**. At Step S**105**, the application control unit **116** obtains the distance to the object (face) based on the face detection result obtained by the first face detecting unit **112**.

Subsequently, at Step S**106**, based on the distance obtained at Step S**105**, the application control unit **116** determines whether or not the object (face) has moved closer within a predetermined distance during a predetermined period of time. In an identical manner to the explanation given with reference to FIG. **11**; in practice, the operations at Steps S**105** and S**106** are performed in a loop until the condition at Step S**106** is satisfied.

At Step S**106**, if the application control unit **116** determines that the object (face) has not moved closer within the predetermined distance during the predetermined period of time (No at Step S**106**), then the system control proceeds to Step S**306**, and the subsequent operations related to voice message transmission are canceled.

On the other hand, if the application control unit **116** determines at Step S**106** that the object (face) has moved closer within the predetermined distance during the predetermined period of time (Yes at Step S**106**), then the system control proceeds to Step S**107**. At Step S**107**, the application control unit **116** instructs the SNS application unit **100** to turn ON the voice input mode.

Subsequently, at Step S**300**, the application control unit **116** turns ON the functions of the imaging unit **1003**. More particularly, the application control unit **116** instructs, for example, the overall control unit **120** to start supplying power to the imaging unit **1003**. In response to the instruction, the overall control unit **120** turns ON the switch **1062** and starts the power supply from the power source unit **1060** to the imaging unit **1003**. As a result, the functions of the imaging unit **1003** are enabled, and the imaging processing unit **113** starts obtaining a taken image.

Then, at Step S**301**, the application control unit **116** instructs the second face detecting unit **114** to start detecting the movement of the mouth in the face using the face detection result that is based on the taken image. In response to the instruction, the second face detecting unit **114** compares a plurality of taken images obtained in, for example, chronological order and detects the movement of the mouth.

Subsequently, at Step S**302**, in the SNS application unit **100**, the communication processing unit **102** sends the voice data, which is obtained as a result of processing performed by the sound processing unit **103**, as a voice message to the sender of the message received at Step S**102**.

Then, at Step S**303**, based on the result of mouth movement detection started by the second face detecting unit **114** at Step S**301**, the application control unit **116** determines whether or not the movement of the mouth has stopped for a predetermined period of time. At Step S**303**, if the application control unit **116** determines that the movement of the mouth has not stopped for the predetermined period of time (No at Step S**303**), then the system control returns to Step S**302**. On the other hand, if the application control unit **116** determines that the movement of the mouth has stopped for the predetermined period of time (Yes at Step S**303**), then the system control proceeds to Step S**304**.

Meanwhile, in FIG. **13**, although it is illustrated that the operations at Steps S**302** and S**303** are over in only one iteration; in practice, the operations at Steps S**302** and S**303** are performed in a loop until the condition at Step S**303** is satisfied.

The operations performed from Step S**304** onward are identical to the operations performed from Step S**110** onward illustrated in the flowchart in FIG. **11** according to the first embodiment. That is, at Step S**304**, the application control unit **116** instructs the SNS application unit **100** to end (turn OFF) the voice input mode. In response to the instruction, the SNS application unit **100** ends the voice input processing performed using the sound processing unit **103**, and ends the voice message transmission operation performed using the communication processing unit **102**.

Subsequently, at Step S**304**, the application control unit **116** determines whether or not the next message is received within a predetermined period of time since ending the voice input mode at Step S**304**. If the application control unit **116** determines that the next message is received (Yes at Step S**304**), then the system control returns to Step S**104**.

On the other hand, if the application control unit **116** determines that the next message is not received within the predetermined period of time (No at Step S**305**), then the system control proceeds to Step S**306**. At Step S**306**, the application control unit **116** turns OFF the imaging unit **1003**, the ranging unit **1004**, and the light source unit **1005**. More particularly, the application control unit **116** instructs, for example, the overall control unit **120** to stop the power supply to the imaging unit **1003**, the ranging unit **1004**, and the light source unit **1005**. In response to the instruction, the overall control unit **120** turns OFF the switches **1061***a*, **1061***b*, and **1062**; and thus stops the power supply to the imaging unit **1003**, the ranging unit **1004**, and the light source unit **1005**.

When the operation at Step S**306** is finished, the sequence of operations illustrated in the flowchart in FIG. **13** is ended.

In this way, in the second modification example of the first embodiment, the control for turning OFF the voice input mode is performed according to the result of detecting the movement of the mouth based on the taken image. Herein, in contrast to the fact that the ToF sensor **1041** obtains the depth information consistently based on the point group information, the image sensor of the imaging unit **1003** can output taken images representing, for example, full-color images taken using R (red), G (green), and B (blue) colors. Hence, the movement of the mouth can be detected with higher accuracy. Thus, in the second modification example of the first embodiment, voice message transmission can be controlled with higher accuracy than in the first modification example of the first embodiment.

Moreover, in the second modification example of the first embodiment, in an identical manner to the first embodiment, the user need not perform an operation such as tapping the touch-sensitive panel **1030** of the terminal device **1** in order to turn ON or turn OFF the voice input mode, and can send a voice message, for example, just by holding the terminal device **1** in one hand and moving it closer to the face.

Second Embodiment

Given below is the explanation of a second embodiment. In the second embodiment, when the SNS application **5** receives a message during the display lock applied by the OS (the overall control unit **120**), face authentication is performed based on the depth information and the display lock is released.

Meanwhile, in the second embodiment, the configuration of the terminal device **1** as explained with reference to FIGS. **6** to **10** according to the first embodiment can be implemented without modification.

FIG. **14** is an exemplary flowchart for explaining a voice message transmission operation performed in the terminal device **1** according to the second embodiment. At the start of the operations illustrated in the flowchart in FIG. **14**, it is assumed that the switches **1061***a*, **1061***b*, and **1062** are in the OFF state.

Prior to the operations illustrated in the flowchart in FIG. **14**; in the terminal device **1**, it is assumed that the OS (the overall control unit **120**) has locked the display of the display unit **10** so that, for example, there is a restriction on the operations that the input receiving unit **123** can receive from among the user operations performed using the input device **1007**. Moreover, in the display lock state, for example, only some of the functions of the SNS application **5** (for example, the communication processing unit **102**) are activated and are implemented in the background.

At Step S**500**, the application control unit **116** determines whether or not the SNS application unit **100** has received a message that is sent from another terminal device **1** using the corresponding SNS application **5**. If the application control unit **116** determines that the SNS application unit **100** has not received a message (No at Step S**500**), then the system control returns to Step S**500**. On the other hand, if the application control unit **116** determines that the SNS application unit **100** has received a message (Yes at Step S**500**), then the system control proceeds to Step S**501**.

At that time, for example, the UI unit **101** of the SNS application unit **100** displays a banner image in the display unit **10** as an indication that a message has been received. FIG. **15**A is a diagram illustrating an example of a banner image **16** that is displayed in the display unit **10** in the display lock state. In the example illustrated in FIG. **15**A, the banner image **16** including the brief of the received message is displayed in the upper end of the display unit **10**. In the existing technology, for example, when the banner image **16** is tapped (touched by a finger), a display lock release screen meant for inputting the information to release the display lock is displayed in the display unit **10**. FIG. **15**B is a diagram illustrating an example of a display lock release screen **17** to be used for releasing the display lock according to face authentication.

At Step S**501**, the application control unit **116** determines whether or not the voice input autodetection mode is turned ON in the settings. If the application control unit **116** determines that the voice input autodetection mode is not turned ON in the settings (No at Step S**501**), then the system control proceeds to Step S**520**. At Step S**520**, the application control unit **116** instructs the SNS application unit **100** to maintain the operation mode for inputting messages to the normal character input mode. That marks the end of the sequence of operations illustrated in the flowchart in FIG. **14**.

On the other hand, if the application control unit **116** determines that the voice input autodetection mode is turned ON in the settings (Yes at Step S**501**), then the system control proceeds to Step S**502**. At Step S**502**, the application control unit **116** turns ON the ranging unit **1004** and the light source unit **1005**.

Subsequently, at Step S**503**, the application control unit **116** instructs the authenticating unit **124** to perform face authentication based on the depth information obtained by the first face detecting unit **112**. At that time, it is desirable that the application control unit **116** instructs the overall control unit **120** to display the display lock release screen **17** illustrated in FIG. **15**B, so as to prompt the user to carry out face authentication.

Then, at Step S**504**, the application control unit **116** determines whether or not the face authentication performed by the authenticating unit **124** was successful. If the application control unit **116** determines that the face authentication was not successful (No at Step S**504**), then the sequence of operations illustrated in the flowchart in FIG. **14** is ended. On the other hand, if the application control unit **116** determines that the face authentication was successful (Yes at Step S**504**), then the system control proceeds to Step S**505**. At Step S**505**, the application control unit **116** instructs the overall control unit **120** to release the display lock. Subsequently, at Step S**506**, the application control unit **116** activates the main unit of the SNS application **5** (i.e., activates the entire SNS application unit **100** including the UI unit **101**, the communication processing unit **102**, and the sound processing unit **103**).

The operations performed from Step S**507** onward are identical to the operations performed from Step S**104** onward illustrated in the flowchart in FIG. **11** according to the first embodiment. That is, at Step S**507**, the application control unit **116** detects the movement of the terminal device **1** based on the output of the movement estimating unit **115** and determines whether or not the terminal device **1** has been moved during a predetermined period of time since the point of time of reception of the message at Step S**102**. If the application control unit **116** determines that the terminal device **1** has not been moved (No at Step S**507**), then the system control proceeds to Step S**515**.

On the other hand, if the application control unit **116** determines that the terminal device **1** has been moved during the predetermined period of time (Yes at Step S**507**), then the system control proceeds to Step S**508**. At Step S**508**, the application control unit **116** obtains the distance to the object (face) based on the face detection result obtained by the first face detecting unit **112**.

Subsequently, at Step S**509**, based on the distance obtained at Step S**508**, the application control unit **116** determines whether or not the object (face) has moved closer within a predetermined distance during a predetermined period of time. Meanwhile, in FIG. **14**, although it is illustrated that the operations at Steps S**508** and S**509** are over in only one iteration; in practice, the operations at Steps S**508** and S**509** are performed in a loop until the condition at Step S**509** is satisfied.

If the application control unit **116** determines at Step S**509** that the object (face) has not moved closer within the predetermined distance during the predetermined period of time (No at Step S**509**), then the system control proceeds to Step S**515**, and the subsequent operations related to voice message transmission are canceled.

On the other hand, if the application control unit **116** determines at Step S**509** that the object (face) has moved closer within the predetermined distance during the predetermined period of time (Yes at Step S**509**), then the system control proceeds to Step S**510**. At Step S**510**, the application control unit **116** instructs the SNS application unit **100** to turn ON the voice input mode. Then, at Step S**511**, in the SNS application unit **100**, the communication processing unit **102** sends the voice data, which is obtained as a result of processing performed by the sound processing unit **103**, as a voice message to the sender of the message received at Step S**500**.

Subsequently, at Step S**512**, the application control unit **116** determines whether or not the object (face) has moved away from the predetermined distance from the terminal device **1**. If the application control unit **116** determines that the object (face) has not moved away from the predeter-

mined distance (No at Step S512), then the system control returns to Step S511. On the other hand, if the application control unit **116** determines that the object (face) has not moved away from the predetermined distance (Yes at Step S512), then the system control proceeds to Step S513.

Meanwhile, in FIG. **14**, although it is illustrated that the operations at Steps S511 and S512 are over in only one iteration; in practice, the operations at Steps S511 and S512 are performed in a loop until the condition at Step S512 is satisfied.

At Step S513, the application control unit **116** instructs the SNS application unit **100** to end (turn OFF) the voice input mode. In response to that instruction, the SNS application unit **100** ends the voice input processing performed by the sound processing unit **103**, and ends the voice message transmission performed by the communication processing unit **102**.

Subsequently, at Step S514, the application control unit **116** determines whether or not the next message is received within a predetermined period of time since ending the voice input mode at Step S513. If the application control unit **116** determines that the next message is received (Yes at Step S513), then the system control returns to Step S507.

On the other hand, if the application control unit **116** determines that the next message is not received within the predetermined period of time (No at Step S514), then the system control proceeds to Step S515. At Step S515, the application control unit **116** turns OFF the ranging unit **1004** and the light source unit **1005**. When the operation at Step S515 is finished, the sequence of operations illustrated in the flowchart in FIG. **14** is ended.

In this way, in the second embodiment, when a message is received by the SNS application **5** that runs in the background in the display lock state, the display lock is released by performing face authentication using the depth information, and the main unit of the SNS application **5** is activated. Thus, even if a message is received by the SNS application **5** in the display lock state, the user can still release the display lock and send a voice message using the SNS application **5**, for example, just by holding the terminal device **1** in one hand and performing face authentication, without having to perform the operation of tapping the touch-sensitive panel **1030** of the terminal device **1**.

At that time, face authentication is performed based on the output of the ToF sensor **1041** for which infrared light is used as the light source. Hence, even in a dark environment such as in the night time, when a message is received by the SNS application **5** in the display lock state, it becomes possible to release the display lock. Moreover, as far as turning ON or turning OFF the voice input mode by the SNS application unit **100** is concerned, since the control is performed based on the output of the ToF sensor **1041** for which infrared light is used as the light source, the ON/OFF control of the voice input mode can be performed even in a dark environment such as in the night time.

Furthermore, in the second embodiment, in an identical manner to the first embodiment, the SNS application unit **100** controls the operation of turning ON and turning OFF the voice input mode based on the distance between the terminal device **1** and the face. That eliminates the need for the user to perform an operation such as tapping the touch-sensitive panel **1030** of the terminal device **1** in order to turn ON or turn OFF the voice input mode, and can send a voice message, for example, just by holding the terminal device **1** in one hand and moving it closer to the face.

Moreover, in the second embodiment, at the time of performing a voice input for sending a voice message, the distance to the face is measured. Hence, the sensitivity of the microphone **12** (the gain with respect to the output of the microphone **12**) can be adjusted based on the distance to the face. That enables transmission of the voice message with an appropriate sound level.

First Modification Example of Second Embodiment

Given below is the explanation of a first modification example of the second embodiment. In the first modification example of the second embodiment, when a message is received by the SNS application **5** in the display lock state applied by the OS (the overall control unit **120**), face authentication is performed based on the depth information and the display lock is released. In addition, in an identical manner to the first modification example of the first embodiment, the SNS application unit **100** controls the voice input mode by detecting the movement of the mouth based on the depth information.

In the first modification example of the second embodiment, the configuration of the terminal device **1** as explained with reference to FIGS. **6** to **10** according to the first embodiment can be implemented without modification.

FIG. **16** is an exemplary flowchart for explaining a voice message transmission operation performed in the terminal device **1** according to the first modification example of the second embodiment. In FIG. **16**, the operations identical to the operations illustrated in the flowchart in FIG. **14** are referred to by the same step numbers, and their explanation is given in short. At the start of the operations illustrated in the flowchart in FIG. **16**, it is assumed that the switches **1061***a*, **1061***b*, and **1062** are in the OFF state.

Prior to the operations illustrated in the flowchart in FIG. **16**; in the terminal device **1**, it is assumed that the OS (the overall control unit **120**) has locked the display of the display unit **10**; and, for example, some functions of the SNS application **5** are implemented in the background.

The operations performed from Step S500 to Step S510 are identical to the operations performed from Step S500 to Step S510 illustrated in the flowchart in FIG. **14**. That is, at Step S500, the application control unit **116** determines whether or not the SNS application unit **100** has received a message that is sent from another terminal device **1** using the corresponding SNS application **5**. If the application control unit **116** determines that the SNS application unit **100** has not received a message (No at Step S500), then the system control returns to Step S500.

On the other hand, if the application control unit **116** determines that the SNS application unit **100** has received a message (Yes at Step S500), then the system control proceeds to Step S501. At that time, for example, the UI unit **101** of the SNS application unit **100** displays, as illustrated in FIG. **15**A, the banner image **16** in the display unit **10** as an indication that a message has been received.

At Step S501, the application control unit **116** determines whether or not the voice input autodetection mode is turned ON in the settings. If the application control unit **116** determines that the voice input autodetection mode is not turned ON in the settings (No at Step S501), then the system control proceeds to Step S520. At Step S520, the application control unit **116** instructs the SNS application unit **100** to maintain the operation mode for inputting messages to the normal character input mode. That marks the end of the sequence of operations illustrated in the flowchart in FIG. **16**.

On the other hand, if the application control unit **116** determines that the voice input autodetection mode is turned

ON in the settings (Yes at Step S501), then the system control proceeds to Step S502. At Step S502, the application control unit 116 turns ON the ranging unit 1004 and the light source unit 1005.

Subsequently, at Step S503, the application control unit 116 instructs the authenticating unit 124 to perform face authentication based on the depth information obtained by the first face detecting unit 112. At that time, it is desirable that the application control unit 116 instructs the overall control unit 120 to display the display lock release screen 17 illustrated in FIG. 15B, so as to prompt the user to carry out face authentication.

Then, at Step S504, the application control unit 116 determines whether or not the face authentication performed by the authenticating unit 124 was successful. If the application control unit 116 determines that the face authentication was not successful (No at Step S504), then the sequence of operations illustrated in the flowchart in FIG. 16 is ended. On the other hand, if the application control unit 116 determines that the face authentication was successful (Yes at Step S504), then the system control proceeds to Step S505. At Step S505, the application control unit 116 instructs the overall control unit 120 to release the display lock. At Step S505, the application control unit 116 instructs the overall control unit 120 to release the display lock. Subsequently, at Step S506, the application control unit 116 activates the main unit of the SNS application 5.

The operations performed from Step S507 onward are identical to the operations performed from Step S104 onward illustrated in the flowchart in FIG. 12 according to the first modification example of the first embodiment. That is, at Step S507, the application control unit 116 detects the movement of the terminal device 1 based on the output of the movement estimating unit 115 and determines whether or not the terminal device 1 has been moved during a predetermined period of time since the point of time of reception of the message at Step S500. If the application control unit 116 determines that the terminal device 1 has not been moved (No at Step S507), then the system control proceeds to Step S535.

On the other hand, if the application control unit 116 determines that the terminal device 1 has been moved during the predetermined period of time (Yes at Step S507), then the system control proceeds to Step S508. At Step S508, the application control unit 116 obtains the distance to the object (face) based on the face detection result obtained by the first face detecting unit 112.

Subsequently, at Step S509, based on the distance obtained at Step S508, the application control unit 116 determines whether or not the object (face) has moved closer within a predetermined distance during a predetermined period. In an identical manner to the explanation with reference to FIG. 11; in practice, the operations at Steps S508 and S509 are performed in a loop until the condition at Step S509 is satisfied.

If the application control unit 116 determines at Step S509 that the object (face) has not moved closer within the predetermined distance during the predetermined period of time (No at Step S509), then the system control proceeds to Step S535, and the subsequent operations related to voice message transmission are canceled.

On the other hand, if the application control unit 116 determines at Step S509 that the object (face) has moved closer within the predetermined distance during the predetermined period of time (Yes at Step S509), then the system control proceeds to Step S510. At Step S510, the application control unit 116 instructs the SNS application unit 100 to turn ON the voice input mode.

Subsequently, at Step S530, the application control unit 116 instructs the first face detecting unit 112 to start detecting the movement of the mouth in the face using the face detection result that is based on the depth information. In response to the instruction, the first face detecting unit 112 compares a plurality of sets of depth information obtained in, for example, chronological order and detects the movement of the mouth.

Subsequently, at Step S531, in the SNS application unit 100, the communication processing unit 102 sends the voice data, which has been processed by the sound processing unit 103, as a voice message to the sender of the message received at Step S500.

Then, at Step S532, based on the result of mouth movement detection started by the first face detecting unit 112 at Step S530, the application control unit 116 determines whether or not the movement of the mouth has stopped for a predetermined period of time. At Step S532, if the application control unit 116 determines that the movement of the mouth has not stopped for the predetermined period of time (No at Step S532), then the system control returns to Step S531. On the other hand, if the application control unit 116 determines that the movement of the mouth has stopped for the predetermined period of time (Yes at Step S532), then the system control proceeds to Step S533.

Meanwhile, in FIG. 16, although it is illustrated that the operations at Steps S531 and S532 are over in only one iteration; in practice, the operations at Steps S532 and S532 are performed in a loop until the condition at Step S202 is satisfied.

The operations performed from Step S533 onward are identical to the operations performed from Step S110 onward illustrated in the flowchart in FIG. 11 according to the first embodiment. That is, at Step S533, the application control unit 116 instructs the SNS application unit 100 to end (turn OFF) the voice input mode. In response to the instruction, the SNS application unit 100 ends the voice input processing performed using the sound processing unit 103, and ends the voice message transmission operation performed using the communication processing unit 102.

Subsequently, at Step S534, the application control unit 116 determines whether or not the next message is received within a predetermined period of time since ending the voice input mode at Step S533. If the application control unit 116 determines that the next message is received (Yes at Step S533), then the system control returns to Step S507.

On the other hand, if the application control unit 116 determines that the next message is not received within the predetermined period of time (No at Step S534), then the system control proceeds to Step S535. At Step S535, the application control unit 116 turns OFF the ranging unit 1004 and the light source unit 1005. When the operation at Step S535 is finished, the sequence of operations illustrated in the flowchart in FIG. 16 is ended.

In this way, in the first modification example of the second embodiment, in an identical manner to the second embodiment, when a message is received by the SNS application 5 that runs in the background in the display lock state, the display lock is released by performing face authentication using the depth information, and the main unit of the SNS application 5 is activated. Thus, even if a message is received by the SNS application 5 in the display lock state, the user can still release the display lock and send a voice message using the SNS application 5, for example, just by holding the terminal device 1 in one hand and performing

face authentication, without having to perform the operation of tapping the touch-sensitive panel **1030** of the terminal device **1**.

Moreover, in the first modification example of the second embodiment, the control for turning OFF the voice input mode is performed according to the result of detecting the movement of the mouth based on the depth information. Hence, voice message transmission can be controlled with higher accuracy.

Furthermore, in the first modification example of the second embodiment, in an identical manner to the second embodiment, the user need not perform an operation such as tapping the touch-sensitive panel **1030** of the terminal device **1** in order to turn ON or turn OFF the voice input mode, and can send a voice message, for example, just by holding the terminal device **1** in one hand and moving it closer to the face.

Moreover, in the first modification example of the second embodiment, in an identical manner to the second embodiment, as far as turning ON or turning OFF the voice input mode by the SNS application unit **100** is concerned, since the control is performed based on the output of the ToF sensor **1041** for which infrared light is used as the light source, the ON/OFF control of the voice input mode can be performed even in a dark environment such as in the night time.

Furthermore, in the first modification example of the second embodiment, in an identical manner to the second embodiment, the distance to the face is measured at the time when a voice input is performed for sending a voice message. Hence, the sensitivity of the microphone **12** (the gain with respect to the output of the microphone **12**) can be adjusted based on the distance to the face. That enables transmission of the voice message with an appropriate sound level.

Second Modification Example of Second Embodiment

Given below is the explanation of a second modification example of the second embodiment. In the second modification example of the second embodiment, when a message is received by the SNS application **5** in the display lock state applied by the OS (the overall control unit **120**), face authentication is performed based on the depth information and the display lock is released. In addition, in an identical manner to the second modification example of the first embodiment, the SNS application unit **100** controls the voice input mode by detecting the movement of the mouth based on a taken image.

In the second modification example of the second embodiment, the configuration of the terminal device **1** as explained with reference to FIGS. **6** to **10** according to the first embodiment can be implemented without modification.

FIG. **17** is an exemplary flowchart for explaining a voice message transmission operation performed in the terminal device **1** according to the second modification example of the second embodiment. In FIG. **17**, the operations identical to the operations illustrated in the flowchart in FIG. **14** are referred to by the same step numbers, and their explanation is given in short. At the start of the operations illustrated in the flowchart in FIG. **17**, it is assumed that the switches **1061***a*, **1061***b*, and **1062** are in the OFF state.

Prior to the operations illustrated in the flowchart in FIG. **17**; in the terminal device **1**, it is assumed that the OS (the overall control unit **120**) has locked the display of the display unit **10**; and, for example, some functions of the SNS application **5** are implemented in the background.

The operations performed from Step S**500** to Step S**510** are identical to the operations performed from Step S**500** to Step S**510** illustrated in the flowchart in FIG. **14**. That is, at Step S**500**, the application control unit **116** determines whether or not the SNS application unit **100** has received a message that is sent from another terminal device **1** using the corresponding SNS application **5**. If the application control unit **116** determines that the SNS application unit **100** has not received a message (No at Step S**500**), then the system control returns to Step S**500**.

On the other hand, if the application control unit **116** determines that the SNS application unit **100** has received a message (Yes at Step S**500**), then the system control proceeds to Step S**501**. At that time, for example, the UI unit **101** of the SNS application unit **100** displays, as illustrated in FIG. **15**A, the banner image **16** in the display unit **10** as an indication that a message has been received.

At Step S**501**, the application control unit **116** determines whether or not the voice input autodetection mode is turned ON in the settings. If the application control unit **116** determines that the voice input autodetection mode is not turned ON in the settings (No at Step S**501**), then the system control proceeds to Step S**520**. At Step S**520**, the application control unit **116** instructs the SNS application unit **100** to maintain the operation mode for inputting messages to the normal character input mode. That marks the end of the sequence of operations illustrated in the flowchart in FIG. **16**.

On the other hand, if the application control unit **116** determines that the voice input autodetection mode is turned ON in the settings (Yes at Step S**501**), then the system control proceeds to Step S**502**. At Step S**502**, the application control unit **116** turns ON the ranging unit **1004** and the light source unit **1005**.

Subsequently, at Step S**503**, the application control unit **116** instructs the authenticating unit **124** to perform face authentication based on the depth information obtained by the first face detecting unit **112**. At that time, it is desirable that the application control unit **116** instructs the overall control unit **120** to display the display lock release screen **17** illustrated in FIG. **15**B, so as to prompt the user to carry out face authentication.

Then, at Step S**504**, the application control unit **116** determines whether or not the face authentication performed by the authenticating unit **124** was successful. If the application control unit **116** determines that the face authentication was not successful (No at Step S**504**), then the sequence of operations illustrated in the flowchart in FIG. **17** is ended. On the other hand, if the application control unit **116** determines that the face authentication was successful (Yes at Step S**504**), then the system control proceeds to Step S**505**. At Step S**505**, the application control unit **116** instructs the overall control unit **120** to release the display lock. Subsequently, at Step S**506**, the application control unit **116** activates the main unit of the SNS application **5**.

The operations performed from Step S**507** onward are identical to the operations performed from Step S**104** onward illustrated in the flowchart in FIG. **13** according to the second modification example of the first embodiment. That is, at Step S**507**, the application control unit **116** detects the movement of the terminal device **1** based on the output of the movement estimating unit **115** and determines whether or not the terminal device **1** has been moved during a predetermined period of time since the point of time of reception of the message at Step S**500**. If the application

control unit **116** determines that the terminal device **1** has not been moved (No at Step S**507**), then the system control proceeds to Step S**546**.

On the other hand, if the application control unit **116** determines that the terminal device **1** has been moved during the predetermined period of time (Yes at Step S**507**), then the system control proceeds to Step S**508**. At Step S**508**, the application control unit **116** obtains the distance to the object (face) based on the face detection result obtained by the first face detecting unit **112**.

Subsequently, at Step S**509**, based on the distance obtained at Step S**508**, the application control unit **116** determines whether or not the object (face) has moved closer within a predetermined distance during a predetermined period of time. In an identical manner to the explanation given with reference to FIG. **13**; in practice, the operations at Steps S**508** and S**509** are performed in a loop until the condition at Step S**509** is satisfied.

If the application control unit **116** determines at Step S**509** that the object (face) has not moved closer within the predetermined distance during the predetermined period of time (No at Step S**509**), then the system control proceeds to Step S**546**, and the subsequent operations related to voice message transmission are canceled.

On the other hand, if the application control unit **116** determines at Step S**509** that the object (face) has moved closer within the predetermined distance during the predetermined period of time (Yes at Step S**509**), then the system control proceeds to Step S**510**. At Step S**510**, the application control unit **116** instructs the SNS application unit **100** to turn ON the voice input mode.

The operations performed from Step S**540** onward are identical to the operations performed from Step S**300** onward illustrated in the flowchart in FIG. **13** according to the second modification example of the first embodiment. That is, at Step S**540**, the application control unit **116** turns ON the functions of the imaging unit **1003** and starts obtaining a taken image using the imaging processing unit **113**. Then, at Step S**541**, the application control unit **116** instructs the second face detecting unit **114** to start detecting the movement of the mouth in the face using the face detection result that is based on the taken image.

Subsequently, at Step S**542**, in the SNS application unit **100**, the communication processing unit **102** sends the voice data, which is obtained as a result of processing performed by the sound processing unit **103**, as a voice message to the sender of the message received at Step S**102**.

Then, at Step S**543**, based on the result of mouth movement detection started by the second face detecting unit **114** at Step S**541**, the application control unit **116** determines whether or not the movement of the mouth has stopped for a predetermined period of time. At Step S**543**, if the application control unit **116** determines that the movement of the mouth has not stopped for the predetermined period of time (No at Step S**543**), then the system control returns to Step S**542**. On the other hand, if the application control unit **116** determines that the movement of the mouth has stopped for the predetermined period of time (Yes at Step S**543**), then the system control proceeds to Step S**544**.

Meanwhile, in an identical manner to the explanation given with reference to FIG. **13**; in practice, the operations at Steps S**542** and S**543** are performed in a loop until the condition at Step S**543** is satisfied.

At Step S**544**, the application control unit **116** instructs the SNS application unit **100** to end (turn OFF) the voice input mode. In response to that instruction, the SNS application unit **100** ends the voice input processing performed by the sound processing unit **103**, and ends the voice message transmission performed by the communication processing unit **102**.

Subsequently, at Step S**544**, the application control unit **116** determines whether or not the next message is received within a predetermined period of time since ending the voice input mode at Step S**544**. If the application control unit **116** determines that the next message is received (Yes at Step S**544**), then the system control returns to Step S**507**.

On the other hand, if the application control unit **116** determines that the next message is not received within the predetermined period of time (No at Step S**545**), then the system control proceeds to Step S**546**. At Step S**546**, the application control unit **116** turns OFF the imaging unit **1003**, the ranging unit **1004**, and the light source unit **1005**. When the operation at Step S**546** is finished, the sequence of operations illustrated in the flowchart in FIG. **17** is ended.

In this way, in the second modification example of the second embodiment, in an identical manner to the second embodiment, when the SNS application **5**, which runs in the background in the display lock state, receives a message; the display lock is released by performing face authentication based on the depth information, and the main unit of the SNS application **5** is activated. Hence, even if a message is received by the SNS application **5** in the display lock state, the user can still release the display lock and send a voice message using the SNS application **5**, for example, just by holding the terminal device **1** in one hand and performing face authentication, without having to perform the operation of tapping the touch-sensitive panel **1030** of the terminal device **1**.

Moreover, in the second modification example of the second embodiment, the control for turning OFF the voice input mode is performed according to the result of detecting the movement of the mouth based on the taken image. Herein, in contrast to the fact that the ToF sensor **1041** obtains the depth information based on the point group information, the image sensor of the imaging unit **1003** can output taken images representing, for example, full-color images taken using RGB colors. Hence, the movement of the mouth can be detected with higher accuracy. Thus, in the second modification example of the second embodiment, voice message transmission can be controlled with higher accuracy than in the first modification example of the second embodiment.

Furthermore, in the second modification example of the second embodiment, in an identical manner to the second embodiment, the user need not perform an operation such as tapping the touch-sensitive panel **1030** of the terminal device **1** in order to turn ON or turn OFF the voice input mode, and can send a voice message, for example, just by holding the terminal device **1** in one hand and moving it closer to the face.

Third Embodiment

Given below is the explanation of a third embodiment. In the third embodiment, the explanation is given about an example in which a notification about the reception of a message from another terminal device **1***a* is received by the SNS application **5** in the form of a push notification in the display lock state applied by the OS (the overall control unit **120**). FIG. **18** is a diagram that schematically illustrates an example of an information processing system that is applicable to the third embodiment and that is used in the case of implementing a push notification. With reference to FIG. **18**, a plurality of terminal devices **1***a* is connected to an SNS

system **3***a* via the network **2** such as the Internet. Moreover, a push notification server **6** that provides a known push notification service is connected to the network **2**.

(Configuration Applicable to Third Embodiment)

In the terminal devices **1***a*, the hardware configuration explained with reference to FIGS. **6** and **7** can be applied without modification. Each terminal device **1***a* has the SNS application **5** installed therein for using the SNS provided by the SNS system **3***a*, and has a driver program **500** according to the third embodiment installed therein. The driver program **500** runs in coordination with the SNS application **5**, and controls the ranging unit **1004** in the terminal device **1***a* by mediating between the OS (Operating System) and the ranging unit **1004**.

The SNS system **3***a* includes an SNS server **300**, a storage **301**, a notification server **310**, and a message server **311**. The SNS server **300** has equivalent functions of the functions of the server **3**. For example, the SNS server **300** provides the service for enabling transmission and reception of messages including voice messages among the terminal devices **1***a* via the network **2**. The storage **301** corresponds to the storage **4** illustrated in FIG. **1**.

The notification server **310** and the message server **311** represent the configuration for issuing push notifications. The message server **311** receives the messages that are sent by the SNS application **5** of each terminal device **1***a* to the SNS system **3***a*. When the message server **311** receives a message, the notification server **310** instructs the push notification server **6** to issue a push notification for that message.

Regarding the existing push notifications, the schematic explanation is given with reference to the configuration illustrated in FIG. **18**. A push notification is issued from the push notification server **6** to the devices (the terminal devices **1***a*) in which an application program corresponding to the push notification is installed. In the third embodiment, the SNS application **5** is assumed to be the application program corresponding to push notifications. When a user operation is performed to allow a push notification to the SNS application **5** installed in the concerned terminal device **1***a*, the SNS application **5** sends identification information, which enables identification thereof, to the push notification server **6** at a predetermined timing such as at the time of activation of the terminal device **1***a* or the SNS application **5**; and requests for a notification ID.

In response to the request, the push notification server **6** issues a notification ID unique to the concerned terminal device **1***a*, stores the issued notification ID, and sends the notification ID along with the identification information of the SNS application to the sender of the notification ID request. The notification ID is identification information enabling the push notification server **6** to identify the SNS application **5** allowing the push notification and the terminal device **1***a* in which the concerned SNS application **5** is installed. When the OS (Operating System) of a device is iOS (registered trademark) provided by the Apple Inc. US, the notification ID represents the device token.

The SNS application **5** stores the obtained notification ID in the memory unit (for example, the RAM **1002**) of the terminal device **1***a*. Moreover, the SNS application **5** sends that notification ID to the provider of the SNS application **5** or to the SNS system **3***a* that is the provider of the message meant for issuing a push notification to the SNS application **5**. The SNS system **3***a* stores the notification ID in the notification server **310**.

In the SNS system **3***a*, when a push notification is to be issued by the notification server **310** to, for example, a particular device; the notification server **310** sends the notification ID for that device to the push notification server **6**; receives a message to be push-notified from the message server **311** and sends that message to the push notification server **6**; and requests the push notification server **6** to issue a push notification. In response to that request, the push notification server **6** sends the notification ID and the message to the terminal device **1***a* that is identified by the notification ID.

When the terminal device **1** receives the notification ID and the message; if the SNS application **5** is running, the OS of that terminal device **1***a* detects the SNS application **5** corresponding to the notification ID, and the detected SNS application **5** displays the message according to a predetermined method. On the other hand, if the OS has locked the display of the display unit **10** and if the SNS application **5** is not running; then, for example, the OS displays the banner image **16** (see FIG. **15**A), which indicates the reception of a message, in the display unit **10** in the locked state.

FIG. **19** is an exemplary functional block diagram for explaining the functions of the terminal device **1***a* according to the third embodiment. In the terminal device **1***a*, a detection/control unit **110'** additionally includes an activation control unit **117** as compared to the detection/control unit **110** explained with reference to FIG. **10**. The activation control unit **117** corresponds to the driver program **500** explained with reference to FIG. **18**, and controls the operations of the ranging unit **1004** by mediating between the OS (Operating System) and the ranging unit **1004**. The activation control unit **117** can be formed in the terminal device **1***a* by installing, in the terminal device **1***a*, a driver installation program that is either downloaded via the network **2** or recorded in a computer-readable recording medium such as a CD, an FD, or a DVD.

Meanwhile, in the third embodiment, regarding the hardware configuration of the terminal device **1***a*, the configuration of the terminal device **1** explained with reference to FIGS. **6** and **7** according to the first embodiment can be applied without modification.

(Details of Operations According to Third Embodiment)

FIG. **20** is an exemplary flowchart for explaining a voice message transmission operation performed in the terminal device **1***a* according to the third embodiment.

At the start of the operations illustrated in the flowchart in FIG. **20**, it is assumed that the switches **1061***a*, **1061***b*, and **1062** are in the OFF state. Prior to the operations illustrated in the flowchart in FIG. **20**; in the terminal device **1***a*, it is assumed that the OS (the overall control unit **120**) has locked the display of the display unit **10**. Moreover, at that time, it is assumed that the SNS application **5** is not running even in the background.

At Step S**600**, the activation control unit **117** makes an inquiry to the overall control unit **120** about the presence or absence of a message reception notification in the form of a push notification. If the activation control unit **117** determines according to the result of the inquiry that there is no notification (No at Step S**600**), then the system control returns to Step S**600**. On the other hand, if the activation control unit **117** determines according to the result of the inquiry that there is a notification (Yes at Step S**600**), then the system control proceeds to Step S**601**. At that time, for example, the overall control unit **120** displays the banner image **16** (see FIG. **15**A), which indicates that a message is received, in the display unit **10**.

At Step S**601**, the activation control unit **117** makes an inquiry to the overall control unit **120** about whether or not the voice input autodetection mode is turned ON in the

settings. If the activation control unit **117** determines according to the result of the inquiry that the voice input autodetection mode is not turned ON in the settings (No at Step S**601**), then the sequence of operations illustrated in FIG. **20** is ended.

In that case, under the normal control of the overall control unit **120**, for example, as a result of tapping on the position of the banner image **16** displayed in the display unit **10**, the overall control unit **120** displays the display lock release screen in the display unit **10**. Then, in response to a predetermined display lock release operation, the overall control unit **120** activates the SNS application **5**. That enables transmission and reception of messages using the SNS application **5**.

On the other hand, if the activation control unit **117** determines according to the result of the inquiry that the voice input autodetection mode is turned ON in the settings (Yes at Step S**601**), then the system control proceeds to Step S**602**. At Step S**602**, the activation control unit **117** turns ON the ranging unit **1004** and the light source unit **1005**.

Subsequently, at Step S**603**, the activation control unit **117** requests the overall control unit **120** to ensure that the authenticating unit **124** performs face authentication based on the depth information obtained by the first face detecting unit **112**. In response to that request, the overall control unit **120** performs face authentication based on the depth information. At that time, the overall control unit **120** can display the display lock release screen **17** illustrated in FIG. **15**B in the display unit **10**, so as to prompt the user to carry out face authentication.

Then, at Step S**604**, the activation control unit **117** makes an inquiry to the overall control unit **120** about whether or not the face authentication performed by the authenticating unit **124** was successful. If the activation control unit **117** determines according to the result of the inquiry that the authentication was not successful (No at Step S**604**), then the sequence of operations illustrated in the flowchart in FIG. **20** is ended. On the other hand, if the activation control unit **117** determines according to the result of the inquiry that the authentication was successful (Yes at Step S**604**), then the system control proceeds to Step S**605**.

At Step S**605**, the activation control unit **117** requests the overall control unit **120** to release the display lock. In response to that request, the overall control unit **120** releases the display lock. Then, at Step S**606**, the activation control unit **117** activates the main unit of the SNS application **5**. The activation of the main unit of the SNS application **5** can be alternatively performed by the overall control unit **120**.

The operations performed from Step S**607** onward are identical to the operations performed from Step S**104** onward illustrated in the flowchart in FIG. **11** according to the first embodiment. That is, at Step S**607**, the application control unit **116** detects the movement of the terminal device **1***a* based on the output of the movement estimating unit **115** and determines whether or not the terminal device **1** has been moved during a predetermined period of time since, for example, the point of time of reception of a message at Step S**600**. If the application control unit **116** determines that the terminal device **1***a* has not been moved (No at Step S**607**), then the system control proceeds to Step S**615**.

On the other hand, if the application control unit **116** determines at Step S**607** that the terminal device **1***a* has been moved during the predetermined period of time (Yes at Step S**607**), then the system control proceeds to Step S**608**. At Step S**608**, the application control unit **116** obtains the distance to the object (face) based on the face detection result obtained by the first face detecting unit **112**.

Subsequently, at Step S**609**, based on the distance obtained at Step S**608**, the application control unit **116** determines whether or not the object (face) has moved closer within a predetermined distance during a predetermined period of time. Meanwhile, in FIG. **20**, although it is illustrated that the operations at Steps S**608** and S**609** are over in only one iteration; in practice, the operations at Steps S**608** and S**609** are performed in a loop until the condition at Step S**609** is satisfied.

If the application control unit **116** determines at Step S**609** that the object (face) has not moved closer within the predetermined distance during the predetermined period of time (No at Step S**609**), then the system control proceeds to Step S**615** and the subsequent operations related to voice message transmission are cancelled.

On the other hand, if the application control unit **116** determines at Step S**609** that the object (face) has moved closer within the predetermined distance during the predetermined period of time (Yes at Step S**609**), then the system control proceeds to Step S**610**. At Step S**610**, the application control unit **116** instructs the SNS application unit **100** to turn ON the voice input mode. Then, at Step S**611**, in the SNS application unit **100**, the communication processing unit **102** sends the voice data, which is obtained as a result of processing performed by the sound processing unit **103**, as a voice message to the sender of the message received at Step S**600**.

Subsequently, at Step S**612**, based on the face detection result obtained by the first face detecting unit **112**, the application control unit **116** determines whether or not the object (face) has moved away from the predetermined distance from the terminal device **1***a*. If the application control unit **116** determines that the object (face) has not moved away from the predetermined distance (No at Step S**612**), then the system control returns to Step S**611**. On the other hand, at Step S**612**, if the application control unit **116** determines that the object (face) has moved away from the predetermined distance (Yes at Step S**612**), then the system control proceeds to Step S**613**.

Meanwhile, in FIG. **20**, although it is illustrated that the operations at Steps S**611** and S**612** are over in only one iteration; in practice, the operations at Steps S**611** and S**612** are performed in a loop until the condition at Step S**612** is satisfied.

At Step S**613**, the application control unit **116** instructs the SNS application unit **100** to end (turn OFF) the voice input mode. In response to that instruction, the SNS application unit **100** ends the voice input processing performed by the sound processing unit **103**, and ends the voice message transmission performed by the communication processing unit **102**.

Subsequently, at Step S**614**, the application control unit **116** determines whether or not the next message is received within a predetermined period of time since ending the voice input mode at Step S**613**. If the application control unit **116** determines that the next message is received (Yes at Step S**614**), then the system control returns to Step S**607**.

On the other hand, if the application control unit **116** determines that the next message is not received within the predetermined period of time (No at Step S**614**), then the system control proceeds to Step S**615**. At Step S**615**, the activation control unit **117** turns OFF the ranging unit **1004** and the light source unit **1005**. When the operation at Step S**615** is finished, the sequence of operations illustrated in the flowchart in FIG. **20** is ended.

In this way, in the third embodiment, the ranging unit **1004** and the light source unit **1005** are turned ON in

response to a push notification, and the face authentication is performed based on the depth information. Thus, even if a message sent from another terminal device **1***a* using the corresponding SNS application **5** is received in the display lock state, the user can still release the display lock and send a voice message using the SNS application **5**, for example, just by holding the terminal device **1***a* in one hand and performing face authentication, without having to perform the operation of tapping the touch-sensitive panel **1030** of the terminal device **1***a*.

Moreover, in the third embodiment, in an identical manner to the first embodiment, the SNS application unit **100** controls the operation of turning ON and turning OFF the voice input mode based on the distance between the terminal device **1***a* and the face. That eliminates the need for the user to perform an operation such as tapping the touch-sensitive panel **1030** of the terminal device **1***a* in order to turn ON or turn OFF the voice input mode, and can send a voice message, for example, just by holding the terminal device **1***a* in one hand and moving it closer to the face.

Furthermore, in the third embodiment, the distance to the face is measured at the time when a voice input is performed for sending a voice message. Hence, the sensitivity of the microphone **12** (the gain with respect to the output of the microphone **12**) can be adjusted based on the distance to the face. That enables transmission of the voice message with an appropriate sound level.

First Modification Example of Third Embodiment

Given below is the explanation of a first modification example of the third embodiment. In the first modification example of the third embodiment, a notification about the reception of a message from another terminal device **1***a* is received by the SNS application **5** in the form of a push notification in the display lock state applied by the OS (the overall control unit **120**). Along with that, in an identical manner to the first modification example of the first embodiment, the SNS application unit **100** controls the voice input mode by detecting the movement of the mouth based on the depth information.

Meanwhile, in the first modification example of the third embodiment; regarding the hardware configuration of the terminal device **1***a*, the configuration of the terminal device **1** explained with reference to FIGS. **6** and **7** according to the first embodiment can be applied without modification.

FIG. **21** is an exemplary flowchart for explaining a voice message transmission operation performed in the terminal device **1***a* according to the first modification example of the third embodiment.

In FIG. **21**, the operations identical to the operations illustrated in the flowchart in FIG. **20** are referred to by the same step numbers, and their explanation is given in short. At the start of the operations illustrated in the flowchart in FIG. **21**, it is assumed that the switches **1061***a*, **1061***b*, and **1062** are in the OFF state. Moreover, in an identical manner to the flowchart illustrated in FIG. **20**, prior to the operations illustrated in the flowchart in FIG. **21**; in the terminal device **1***a*, it is assumed that the OS (the overall control unit **120**) has locked the display of the display unit **10**. Moreover, at that time, it is assumed that the SNS application **5** is not running even in the background.

In FIG. **21**, the operations from Step **S600** to Step **S606** are identical to the operations from Step **S600** to Step **S606** illustrated in the flowchart in FIG. **20**. That is, at Step **S600**, the activation control unit **117** makes an inquiry to the overall control unit **120** about the presence or absence of a message reception notification in the form of a push notification. If the activation control unit **117** determines according to the result of the inquiry that there is no notification (No at Step **S600**), then the system control returns to Step **S600**. On the other hand, if the activation control unit **117** determines according to the result of the inquiry that there is a notification (Yes at Step **S600**), then the system control proceeds to Step **S601**. At that time, for example, the overall control unit **120** displays the banner image **16** (see FIG. **15**A), which indicates that a message is received, in the display unit **10**.

At Step **S601**, the activation control unit **117** makes an inquiry to the overall control unit **120** about whether or not the voice input autodetection mode is turned ON in the settings. If the activation control unit **117** determines according to the result of the inquiry that the voice input autodetection mode is not turned ON in the settings (No at Step **S601**), then the sequence of operations illustrated in FIG. **20** is ended.

In that case, under the normal control of the overall control unit **120**, for example, as a result of tapping on the position of the banner image **16** displayed in the display unit **10**, the overall control unit **120** displays the display lock release screen in the display unit **10**. Then, in response to a predetermined display lock release operation, the overall control unit **120** activates the SNS application **5**. That enables transmission and reception of messages using the SNS application **5**.

On the other hand, if the activation control unit **117** determines according to the result of the inquiry that the voice input autodetection mode is turned ON in the settings (Yes at Step **S601**), then the system control proceeds to Step **S602**. At Step **S602**, the activation control unit **117** turns ON the ranging unit **1004** and the light source unit **1005**.

Subsequently, at Step **S603**, the activation control unit **117** requests the overall control unit **120** to ensure that the authenticating unit **124** performs face authentication based on the depth information obtained by the first face detecting unit **112**. In response to that request, the overall control unit **120** performs face authentication based on the depth information.

Then, at Step **S604**, the activation control unit **117** makes an inquiry to the overall control unit **120** about whether or not the face authentication performed by the authenticating unit **124** was successful. If the activation control unit **117** determines according to the result of the inquiry that the authentication was not successful (No at Step **S604**), then the sequence of operations illustrated in the flowchart in FIG. **20** is ended. On the other hand, if the activation control unit **117** determines according to the result of the inquiry that the authentication was successful (Yes at Step **S604**), then the system control proceeds to Step **S605**.

At Step **S605**, the activation control unit **117** requests the overall control unit **120** to release the display lock. In response to that request, the overall control unit **120** releases the display lock. Then, at Step **S606**, the activation control unit **117** activates the main unit of the SNS application **5**. The activation of the main unit of the SNS application **5** can be alternatively performed by the overall control unit **120**.

The operations performed from Step **S607** onward are identical to the operations performed from Step **S104** onward illustrated in the flowchart in FIG. **12** according to the first modification example of the first embodiment. That is, at Step **S607**, the application control unit **116** detects the movement of the terminal device **1** based on the output of the movement estimating unit **115** and determines whether or not the terminal device **1** has been moved during a

predetermined period of time since the point of time of reception of the message at Step **S600**. If the application control unit **116** determines that the terminal device **1** has not been moved (No at Step **S607**), then the system control proceeds to Step **S625**.

On the other hand, if the application control unit **116** determines that the terminal device **1** has been moved within the predetermined period of time (Yes at Step **S607**), then the system control proceeds to Step **S608**. At Step **S608**, the application control unit **116** obtains the distance to the object (face) based on the face detection result obtained by the first face detecting unit **112**.

Subsequently, at Step **S609**, based on the distance obtained at Step **S608**, the application control unit **116** determines whether or not the object (face) has moved closer within a predetermined distance during a predetermined period of time. In an identical manner to the explanation given with reference to FIG. **11**; in practice, the operations at Steps **S608** and **S609** are performed in a loop until the condition at Step **S609** is satisfied.

If the application control unit **116** determines at Step **S609** that the object (face) has not moved closer within the predetermined distance during the predetermined period of time (No at Step **S609**), then the system control proceeds to Step **S625** and the subsequent operations related to voice message transmission are cancelled.

On the other hand, if the application control unit **116** determines at Step **S609** that the object (face) has moved closer within the predetermined distance during the predetermined period of time (Yes at Step **S609**), then the system control proceeds to Step **S610**. At Step **S610**, the application control unit **116** instructs the SNS application unit **100** to turn ON the voice input mode).

Then, at Step **S620**, the application control unit **116** instructs the first face detecting unit **112** to start detecting the movement of the mouth in the face using the face detection result that is based on the depth information. In response to the instruction, the first face detecting unit **112** compares a plurality of sets of depth information obtained in, for example, chronological order and detects the movement of the mouth.

Subsequently, at Step **S621**, in the SNS application unit **100**, the communication processing unit **102** sends the voice data, which has been processed by the sound processing unit **103**, as a voice message to the sender of the message received at Step **S600**.

Then, at Step **S622**, based on the result of mouth movement detection started by the first face detecting unit **112** at Step **S620**, the application control unit **116** determines whether or not the movement of the mouth has stopped for a predetermined period of time. At Step **S622**, if the application control unit **116** determines that the movement of the mouth has not stopped for the predetermined period of time (No at Step **S622**), then the system control returns to Step **S621**. On the other hand, if the application control unit **116** determines that the movement of the mouth has stopped for the predetermined period of time (Yes at Step **S622**), then the system control proceeds to Step **S623**.

Meanwhile, in FIG. **21**, although it is illustrated that the operations at Steps **S621** and **S622** are over in only one iteration; in practice, the operations at Steps **S621** and **S622** are performed in a loop until the condition at Step **S202** is satisfied.

The operations performed from Step **S623** onward are identical to the operations performed from Step **S110** onward illustrated in the flowchart in FIG. **11** according to the first embodiment. That is, at Step **S623**, the application control unit **116** instructs the SNS application unit **100** to end (turn OFF) the voice input mode. In response to the instruction, the SNS application unit **100** ends the voice input processing performed using the sound processing unit **103**, and ends the voice message transmission operation performed using the communication processing unit **102**.

Subsequently, at Step **S624**, the application control unit **116** determines whether or not the next message is received within a predetermined period of time since ending the voice input mode at Step **S623**. If the application control unit **116** determines that the next message is received (Yes at Step **S623**), then the system control returns to Step **S607**.

On the other hand, if the application control unit **116** determines that the next message is not received within the predetermined period of time (No at Step **S624**), then the system control proceeds to Step **S625**. At Step **S625**, the application control unit **116** turns OFF the ranging unit **1004** and the light source unit **1005**. When the operation at Step **S625** is finished, the sequence of operations illustrated in the flowchart in FIG. **21** is ended.

In this way, in the first modification example of the third embodiment, the ranging unit **1004** and the light source unit **1005** are turned ON in response to a push notification, and the face authentication is performed based on the depth information. Thus, even if a message sent from another terminal device **1***a* using the corresponding SNS application **5** is received in the display lock state, the user can still release the display lock and send a voice message using the SNS application **5**, for example, just by holding the terminal device **1***a* in one hand and performing face authentication, without having to perform the operation of tapping the touch-sensitive panel **1030** of the terminal device **1***a*.

Moreover, in the first modification example of the third embodiment, the control for turning OFF the voice input mode is performed according to the result of detecting the movement of the mouth based on the depth information. Hence, voice message transmission can be controlled with higher accuracy.

Furthermore, in the first modification example of the third embodiment, in an identical manner to the second embodiment, the user need not perform an operation such as tapping the touch-sensitive panel **1030** of the terminal device **1** in order to turn ON or turn OFF the voice input mode, and can send a voice message, for example, just by holding the terminal device **1** in one hand and moving it closer to the face.

Moreover, in the first modification example of the third embodiment, in an identical manner to the second embodiment, as far as turning ON or turning OFF the voice input mode by the SNS application unit **100** is concerned, since the control is performed based on the output of the ToF sensor **1041** for which infrared light is used as the light source, the ON/OFF control of the voice input mode can be performed even in a dark environment such as in the night time.

Furthermore, in the first modification example of the third embodiment, in an identical manner to the second embodiment, the distance to the face is measured at the time when a voice input is performed for sending a voice message. Hence, the sensitivity of the microphone **12** (the gain with respect to the output of the microphone **12**) can be adjusted based on the distance to the face. That enables transmission of the voice message with an appropriate sound level.

Second Modification Example of Third Embodiment

Given below is the explanation of a second modification example of the third embodiment. In the first modification

example of the third embodiment, a notification about the reception of a message from another terminal device **1***a* is received by the SNS application **5** in the form of a push notification in the display lock state applied by the OS (the overall control unit **120**). Along with that, in an identical manner to the second modification example of the first embodiment, the SNS application unit **100** controls the voice input mode by detecting the movement of the mouth based on a taken image.

Meanwhile, in the second modification example of the third embodiment; regarding the hardware configuration of the terminal device **1***a*, the configuration of the terminal device **1** explained with reference to FIGS. **6** and **7** according to the first embodiment can be applied without modification.

FIG. **22** is an exemplary flowchart for explaining a voice message transmission operation performed in the terminal device **1***a* according to the second modification example of the third embodiment.

In FIG. **22**, the operations identical to the operations illustrated in the flowchart in FIG. **20** are referred to by the same step numbers, and their explanation is given in short. At the start of the operations illustrated in the flowchart in FIG. **22**, it is assumed that the switches **1061***a*, **1061***b*, and **1062** are in the OFF state. Moreover, in an identical manner to the flowchart illustrated in FIG. **20**, prior to the operations illustrated in the flowchart in FIG. **21**, in the terminal device **1***a*, it is assumed that the OS (the overall control unit **120**) has locked the display of the display unit **10**. Moreover, at that time, it is assumed that the SNS application **5** is not running even in the background.

In FIG. **21**, the operations from Step S**600** to Step S**606** are identical to the operations from Step S**600** to Step S**606** illustrated in the flowchart in FIG. **20**. That is, at Step S**600**, the activation control unit **117** makes an inquiry to the overall control unit **120** about the presence or absence of a message reception notification in the form of a push notification. If the activation control unit **117** determines according to the result of the inquiry that there is no notification (No at Step S**600**), then the system control returns to Step S**600**. On the other hand, if the activation control unit **117** determines according to the result of the inquiry that there is a notification (Yes at Step S**600**), then the system control proceeds to Step S**601**. At that time, for example, the overall control unit **120** displays the banner image **16** (see FIG. **15**A), which indicates that a message is received, in the display unit **10**.

At Step S**601**, the activation control unit **117** makes an inquiry to the overall control unit **120** about whether or not the voice input autodetection mode is turned ON in the settings. If the activation control unit **117** determines according to the result of the inquiry that the voice input autodetection mode is not turned ON in the settings (No at Step S**601**), then the sequence of operations illustrated in FIG. **22** is ended.

In that case, under the normal control of the overall control unit **120**, for example, as a result of tapping on the position of the banner image **16** displayed in the display unit **10**, the overall control unit **120** displays the display lock release screen in the display unit **10**. Then, in response to a predetermined display lock release operation, the overall control unit **120** activates the SNS application **5**. That enables transmission and reception of messages using the SNS application **5**.

On the other hand, if the activation control unit **117** determines according to the result of the inquiry that the voice input autodetection mode is turned ON in the settings (Yes at Step S**601**), then the system control proceeds to Step S**602**. At Step S**602**, the activation control unit **117** turns ON the ranging unit **1004** and the light source unit **1005**.

Subsequently, at Step S**603**, the activation control unit **117** requests the overall control unit **120** to ensure that the authenticating unit **124** performs face authentication based on the depth information obtained by the first face detecting unit **112**. In response to that request, the overall control unit **120** performs face authentication based on the depth information.

Then, at Step S**604**, the activation control unit **117** makes an inquiry to the overall control unit **120** about whether or not the face authentication performed by the authenticating unit **124** was successful. If the activation control unit **117** determines according to the result of the inquiry that the authentication was not successful (No at Step S**604**), then the sequence of operations illustrated in the flowchart in FIG. **22** is ended. On the other hand, if the activation control unit **117** determines according to the result of the inquiry that the authentication was successful (Yes at Step S**604**), then the system control proceeds to Step S**605**.

At Step S**605**, the activation control unit **117** requests the overall control unit **120** to release the display lock. In response to that request, the overall control unit **120** releases the display lock. Then, at Step S**606**, the activation control unit **117** activates the main unit of the SNS application **5**. The activation of the main unit of the SNS application **5** can be alternatively performed by the overall control unit **120**.

The operations performed from Step S**607** onward are identical to the operations performed from Step S**104** onward illustrated in the flowchart in FIG. **13** according to the second modification example of the first embodiment. That is, at Step S**607**, the application control unit **116** detects the movement of the terminal device **1***a* based on the output of the movement estimating unit **115** and determines whether or not the terminal device **1** has been moved during a predetermined period of time since, for example, the point of time of reception of a message at Step S**600**. If the application control unit **116** determines that the terminal device **1***a* has not been moved (No at Step S**607**), then the system control proceeds to Step S**636**.

On the other hand, the application control unit **116** determines at Step S**607** that the terminal device **1***a* has been moved during the predetermined period of time (Yes at Step S**607**), then the system control proceeds to Step S**608**. At Step S**608**, the application control unit **116** obtains the distance to the object (face) based on the face detection result obtained by the first face detecting unit **112**.

Subsequently, at Step S**609**, based on the distance obtained at Step S**608**, the application control unit **116** determines whether or not the object (face) has moved closer within a predetermined distance during a predetermined period of time. In an identical manner to the explanation given with reference to FIG. **13**; in practice, the operations at Steps S**608** and S**609** are performed in a loop until the condition at Step S**609** is satisfied.

If the application control unit **116** determines at Step S**609** that the object (face) has not moved closer within the predetermined distance during the predetermined period of time (No at Step S**609**), then the system control proceeds to Step S**636** and the subsequent operations related to voice message transmission are cancelled.

On the other hand, if the application control unit **116** determines at Step S**609** that the object (face) has moved closer within the predetermined distance during the predetermined period of time (Yes at Step S**609**), then the system control proceeds to Step S**610**. At Step S**610**, the application

control unit **116** instructs the SNS application unit **100** to turn ON the voice input mode).

The operations performed from Step S**630** onward are identical to the operations performed from Step S**300** onward illustrated in the flowchart in FIG. **13** according to the second modification example of the first embodiment. That is, at Step S**630**, the application control unit **116** turns ON the functions of the imaging unit **1003** and starts obtaining a taken image using the imaging processing unit **113**. Then, at Step S**631**, the application control unit **116** instructs the second face detecting unit **114** to start detecting the movement of the mouth in the face using the face detection result that is based on the taken image.

Subsequently, at Step S**632**, in the SNS application unit **100**, the communication processing unit **102** sends the voice data, which is obtained as a result of processing performed by the sound processing unit **103**, as a voice message to the sender of the message received at Step S**600**.

Then, at Step S**633**, based on the result of mouth movement detection started by the second face detecting unit **114** at Step S**631**, the application control unit **116** determines whether or not the movement of the mouth has stopped for a predetermined period of time. At Step S**633**, if the application control unit **116** determines that the movement of the mouth has not stopped for the predetermined period of time (No at Step S**633**), then the system control returns to Step S**632**. On the other hand, if the application control unit **116** determines that the movement of the mouth has stopped for the predetermined period of time (Yes at Step S**633**), then the system control proceeds to Step S**634**.

In an identical manner to the explanation given with reference to FIG. **13**; in practice, the operations at Steps S**632** and S**633** are performed in a loop until the condition at Step S**633** is satisfied.

At Step S**634**, the application control unit **116** instructs the SNS application unit **100** to end (turn OFF) the voice input mode. In response to that instruction, the SNS application unit **100** ends the voice input processing performed by the sound processing unit **103**, and ends the voice message transmission performed by the communication processing unit **102**.

Subsequently, at Step S**634**, the application control unit **116** determines whether or not the next message is received within a predetermined period of time since ending the voice input mode at Step S**634**. If the application control unit **116** determines that the next message is received (Yes at Step S**634**), then the system control returns to Step S**607**.

On the other hand, if the application control unit **116** determines that the next message is not received within the predetermined period of time (No at Step S**635**), then the system control proceeds to Step S**636**. At Step S**636**, the application control unit **116** turns OFF the imaging unit **1003**, the ranging unit **1004**, and the light source unit **1005**. When the operation at Step S**636** is finished, the sequence of operations illustrated in the flowchart in FIG. **22** is ended.

In this way, in the second modification example of the third embodiment, the ranging unit **1004** and the light source unit **1005** are turned ON in response to a push notification, and the face authentication is performed based on the depth information. Thus, even if a message sent from another terminal device **1***a* using the corresponding SNS application **5** is received in the display lock state, the user can still release the display lock and send a voice message using the SNS application **5**, for example, just by holding the terminal device **1***a* in one hand and performing face authentication, without having to perform the operation of tapping the touch-sensitive panel **1030** of the terminal device **1***a*.

Moreover, in the second modification example of the third embodiment, the control for turning OFF the voice input mode is performed according to the result of detecting the movement of the mouth based on the taken image. Herein, in contrast to the fact that the ToF sensor **1041** obtains the depth information based on the point group information, the image sensor of the imaging unit **1003** can output taken images representing, for example, full-color images taken using RGB colors. Hence, the movement of the mouth can be detected with higher accuracy. Thus, in the second modification example of the third embodiment, voice message transmission can be controlled with higher accuracy than in the first modification example of the third embodiment.

Furthermore, in the second modification example of the third embodiment, in an identical manner to the third embodiment, the user need not perform an operation such as tapping the touch-sensitive panel **1030** of the terminal device **1** in order to turn ON or turn OFF the voice input mode, and can send a voice message, for example, just by holding the terminal device **1** in one hand and moving it closer to the face.

Meanwhile, the effects described in the present written description are only explanatory and exemplary, and are not limited in scope. That is, it is also possible to achieve other effects.

Meanwhile, a configuration as explained below also falls within the technical scope of the application concerned.

(1) A terminal device comprising:
- a microphone;
- a communication unit that performs communication via a network;
- a first sensor that obtains depth information;
- a first face detecting unit that performs first-type face detection for detecting a face and distance to the face based on the depth information; and
- a processor, wherein
- when a communication program, which is meant for making the processor perform transmission and reception of messages including voice messages and which has a sound input mode for enabling collection of sounds using the microphone and transmission of voice messages based on the collected sounds, is executed, and when a message is received by the communication unit under control of the communication program being executed,
- the processor performs the first-type face detection using the first face detecting unit and controls turning ON and turning OFF the sound input mode according to result of the first-type face detection.

(2) The terminal device according to (1), wherein, when the distance detected by the first face detecting unit is shorter than a predetermined distance, the processor performs control to turn ON the sound input mode.

(3) The terminal device according to (1) or (2), wherein, when the distance detected by the first face detecting unit is equal to or greater than a predetermined distance, the processor performs control to turn OFF the sound input mode.

(4) The terminal device according to any one of (1) to (3), further comprising a face authenticating unit that performs authentication based on the face detected by the first face detecting unit, wherein
- when the communication program is executed and when the message is received by the communication unit in a state in which the processor has applied display

restriction on display in the terminal device, the processor performs face authentication using the face authenticating unit, and

when a face gets authenticated in the face authentication, the processor releases the display restriction.

(5) The terminal device according to any one of (1) to (4), wherein, when the message is received by the communication unit, the processor performs control to turn ON function of the first sensor.

(6) The terminal device according to any one to (1) to (5), further comprising a movement detecting unit that performs movement detection for detecting movement of the terminal device, wherein

when a predetermined movement is detected in the movement detection performed by the movement detecting unit, the processor performs the first-type face detection using the first face detecting unit and performs control to turn ON and turn OFF the sound input mode according to result of the first-type face detection.

(7) The terminal device according to (1), further comprising:

a second sensor that obtains image information; and

a second face detecting unit that performs second-type face detection in which a face is detected based on the image information, wherein

when the distance detected by the first face detecting unit is shorter than a predetermined distance and when the sound input mode is turned ON, the processor performs the second-type face detection using the second face detecting unit and detects movement of mouth in a face, and

when the movement of mouth is not detected for a predetermined period of time, the processor performs control to turn OFF the sound input mode.

(8) The terminal device according to (1), wherein

when the distance detected by the first face detecting unit is shorter than a predetermined distance and when the sound input mode is turned ON, the processor detects movement of mouth in the face with respect to which the first face detecting unit performed the first-type face detection, and

when the movement of mouth is not detected for a predetermined period of time, the processor performs control to turn OFF the sound input mode.

(9) A terminal device control method comprising:

a depth information obtaining step that includes obtaining depth information using a first sensor;

a first face detection step that includes performing first-type face detection for detecting a face and distance to the face based on the depth information obtained in the depth information obtaining step;

an execution step that includes executing a communication program, which is meant for making a processor perform transmission and reception of messages including voice messages and which has a sound input mode for enabling collection of sounds using a microphone and transmission of voice messages based on the collected sounds;

a determination step that includes determining, by the processor, whether or not a message is received based on the communication program executed in the execution step; and

a control step that, when it is determined in the determination step that the message is received, includes performing the first-type face detection in the first face detection step, and

performing control, by the processor, to turn ON and turn OFF the sound input mode according to result of the first-type face detection.

(10) The terminal device control method according to (9), wherein, when the distance detected in the first face detection step is shorter than a predetermined distance, the control step includes performing control to turn ON the sound input mode.

(11) The terminal device control method according to (9) or (10), wherein, when the distance detected in the first face detection step is equal to or greater than a predetermined distance, the control step includes performing control to turn OFF the sound input mode.

(12) The terminal device control method according to any one of (9) to (11), further comprising a face authentication step that performs authentication based on the face detected in the first face detection step, wherein

when the communication program is executed and when the message is received by a communication unit, which performs communication via a network, in a state in which the processor has applied display restriction on display in the terminal device, the control step includes performing face authentication in the face authentication step, and

when a face gets authenticated in the face authentication, the control step includes releasing the display restriction.

(13) The terminal device control method according to any one to (9) to (12), wherein, when the message is received by a communication unit that performs communication via a network, the control step includes performing control to turn ON function of the first sensor.

(14) The terminal device control method according to any one to (9) to (13), further comprising a movement detection step that includes performing movement detection for detecting movement of the terminal device, wherein

when a predetermined movement is detected in the movement detection performed in the movement detection step, the control step includes performing the first-type face detection in the first face detection step and performing control to turn ON and turn OFF the sound input mode according to result of the first-type face detection.

(15) The terminal device control method according to (9), further comprising:

an image information obtaining step that includes obtaining image information using a second sensor; and

a second face detection step that includes performing second-type face detection in which a face is detected based on the image information obtained in the image information obtaining step, wherein

when the distance detected in the first face detection step is shorter than a predetermined distance and when the sound input mode is turned ON, the control step includes performing the second-type face detection in the second face detection step and detecting movement of mouth in a face, and

when the movement of mouth is not detected for a predetermined period of time, the control step includes performing control to turn OFF the sound input mode.

(16) The terminal device control method according to (9), wherein

when the distance detected in the first face detection step is shorter than a predetermined distance and when the sound input mode is turned ON, the control step includes detecting movement of mouth in face with

respect to which the first-type face detection was performed in the first face detection step, and

when the movement of mouth is not detected for a predetermined period of time, the control step includes performing control to turn OFF the sound input mode.

(17) A computer-readable memory medium that is used to store a control program meant for making a processor execute:

a face detection step that includes performing face detection for detecting a face and distance to the face based on depth information obtained by a sensor;

an execution step that includes executing a communication program, which is meant for making the processor perform transmission and reception of messages including voice messages and which has, as an operation mode at time of being executed in the processor, a sound input mode enabling collection of sounds using a microphone and transmission of voice messages based on the collected sounds;

a determination step that includes determining whether or not a message is received based on the communication program executed in the execution step; and

a control step that, when it is determined in the determination step that the message is received, includes

performing the face detection in the face detection step, and

performing control to turn ON and turn OFF the sound input mode according to result of the face detection.

REFERENCE SIGNS LIST

1 terminal device
2 network
3 server
5 SNS application
10 display unit
12 microphone
13 speaker
14 first sensor
15 second sensor
16 banner image
17 display lock release screen
100 SNS application unit
101 UI unit
102 communication processing unit
103 sound processing unit
110 detection/control unit
111 ranging processing unit
112 first face detecting unit
113 imaging processing unit
114 second face detecting unit
115 movement estimating unit
116 application control unit
117 activation control unit
120 overall control unit
124 authenticating unit
500 driver program
1003 imaging unit
1004 ranging unit
1005 light source unit
1013 orientation detecting unit
1041 ToF sensor
1051 VCSEL

What is claimed is:

1. A terminal device, comprising:

a microphone;

a communication unit that performs communication with another terminal device via a network;

a first sensor that obtains depth information;

a first face detecting unit that performs first-type face detection for detecting a face and distance to the face based on the depth information; and

a processor,

wherein when a communication program, which is meant for making the processor perform transmission and reception of messages including voice messages and which has a sound input mode for enabling collection of sounds using the microphone and transmission of voice messages based on the collected sounds, is executed, and when a message is received from the another terminal device by the communication unit under control of the communication program being executed, the processor performs the first-type face detection using the first face detecting unit and controls turning ON and turning OFF the sound input mode according to a result of the first-type face detection.

2. The terminal device according to claim **1**, wherein when the distance detected by the first face detecting unit is shorter than a predetermined distance, the processor performs control to turn ON the sound input mode.

3. The terminal device according to claim **1**, wherein when the distance detected by the first face detecting unit is equal to or greater than a predetermined distance, the processor performs control to turn OFF the sound input mode.

4. The terminal device according to claim **1**, further comprising a face authenticating unit that performs authentication based on the face detected by the first face detecting unit,

wherein when the communication program is executed and when the message is received by the communication unit in a state in which the processor has applied display restriction on display in the terminal device, the processor performs face authentication using the face authenticating unit, and

wherein when a face gets authenticated in the face authentication, the processor releases the display restriction.

5. The terminal device according to claim **1**, wherein when the message is received by the communication unit, the processor performs control to turn ON function of the first sensor.

6. The terminal device according to claim **1**, further comprising a movement detecting unit that performs movement detection for detecting movement of the terminal device,

wherein when a predetermined movement is detected in the movement detection performed by the movement detecting unit, the processor performs the first-type face detection using the first face detecting unit and performs control to turn ON and turn OFF the sound input mode according to the result of the first-type face detection.

7. The terminal device according to claim **1**, further comprising:

a second sensor that obtains image information; and

a second face detecting unit that performs second-type face detection in which a face is detected based on the image information,

wherein when the distance detected by the first face detecting unit is shorter than a predetermined distance and when the sound input mode is turned ON, the processor performs the second-type face detection

using the second face detecting unit and detects movement of mouth in a face, and

wherein when the movement of mouth is not detected for a predetermined period of time, the processor performs control to turn OFF the sound input mode.

8. The terminal device according to claim **1**,

wherein when the distance detected by the first face detecting unit is shorter than a predetermined distance and when the sound input mode is turned ON, the processor detects movement of mouth in the face with respect to which the first face detecting unit performed the first-type face detection, and

wherein when the movement of mouth is not detected for a predetermined period of time, the processor performs control to turn OFF the sound input mode.

9. A terminal device control method, comprising:

a depth information obtaining step that includes obtaining depth information using a first sensor;

a first face detection step that includes performing first-type face detection for detecting a face and distance to the face based on the depth information obtained in the depth information obtaining step;

an execution step that includes executing a communication program, which is meant for making a processor perform transmission and reception of messages including voice messages and which has a sound input mode for enabling collection of sounds using a microphone and transmission of voice messages based on the collected sounds;

a determination step that includes determining, by the processor, whether or not a message is received by the terminal device from another terminal device via a network, based on the communication program executed in the execution step; and

a control step that, when it is determined in the determination step that the message is received, includes:

performing the first-type face detection in the first face detection step, and

performing control, by the processor, to turn ON and turn OFF the sound input mode according to a result of the first-type face detection.

10. The terminal device control method according to claim **9**, wherein when the distance detected in the first face detection step is shorter than a predetermined distance, the control step includes performing control to turn ON the sound input mode.

11. The terminal device control method according to claim **9**, wherein when the distance detected in the first face detection step is equal to or greater than a predetermined distance, the control step includes performing control to turn OFF the sound input mode.

12. The terminal device control method according to claim **9**, further comprising a face authentication step that performs authentication based on the face detected in the first face detection step,

wherein when the communication program is executed and when the message is received by a communication unit, which performs communication via the network, in a state in which the processor has applied display restriction on display in the terminal device, the control step includes performing face authentication in the face authentication step, and

wherein when a face gets authenticated in the face authentication, the control step includes releasing the display restriction.

13. The terminal device control method according to claim **9**, wherein when the message is received by a communication unit that performs communication via the network, the control step includes performing control to turn ON function of the first sensor.

14. The terminal device control method according to claim **9**, further comprising a movement detection step that includes performing movement detection for detecting movement of the terminal device,

wherein when a predetermined movement is detected in the movement detection performed in the movement detection step, the control step includes performing the first-type face detection in the first face detection step and performing control to turn ON and turn OFF the sound input mode according to the result of the first-type face detection.

15. The terminal device control method according to claim **9**, further comprising:

an image information obtaining step that includes obtaining image information using a second sensor; and

a second face detection step that includes performing second-type face detection in which a face is detected based on the image information obtained in the image information obtaining step,

wherein when the distance detected in the first face detection step is shorter than a predetermined distance and when the sound input mode is turned ON, the control step includes performing the second-type face detection in the second face detection step and detecting movement of mouth in a face, and

wherein when the movement of mouth is not detected for a predetermined period of time, the control step includes performing control to turn OFF the sound input mode.

16. The terminal device control method according to claim **9**,

wherein when the distance detected in the first face detection step is shorter than a predetermined distance and when the sound input mode is turned ON, the control step includes detecting movement of mouth in face with respect to which the first-type face detection was performed in the first face detection step, and

wherein when the movement of mouth is not detected for a predetermined period of time, the control step includes performing control to turn OFF the sound input mode.

17. A non-transitory computer-readable memory medium that is used to store a control program meant for making a processor execute:

a face detection step that includes performing face detection for detecting a face and distance to the face based on depth information obtained by a sensor;

an execution step that includes executing a communication program, which is meant for making the processor perform transmission and reception of messages including voice messages and which has, as an operation mode at time of being executed in the processor, a sound input mode enabling collection of sounds using a microphone and transmission of voice messages based on the collected sounds;

a determination step that includes determining whether or not a message is received by a terminal device from another terminal device via a network, based on the communication program executed in the execution step; and

a control step that, when it is determined in the determination step that the message is received, includes:

performing the face detection in the face detection step, and

performing control to turn ON and turn OFF the sound input mode according to a result of the face detection.

18. The non-transitory computer-readable memory medium according to claim **17**, wherein when the distance detected in the face detection step is shorter than a predetermined distance, the control step includes performing control to turn ON the sound input mode.

19. The non-transitory computer-readable memory medium according to claim **17**, wherein when the distance detected in the face detection step is equal to or greater than a predetermined distance, the control step includes performing control to turn OFF the sound input mode.

20. The non-transitory computer-readable memory medium according to claim **17**, wherein when the message is received by a communication unit of the terminal device that performs communication via the network, the control step includes performing control to turn ON function of the sensor.

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