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(54) WIRELESS COMMUNICATION IN AN ELEVATOR SYSTEM

(57) The invention relates to an apparatus and a method of wireless communication in an elevator system (2, 3). The wireless communication apparatus comprises a user interface module (211, 7B) placed in an elevator car (17, 18, 20, 6, 7A) of the elevator system (2, 3), the user interface module (211, 7B) providing a user interface (7A, 7B, 7C) for a passenger in the elevator car (17, 18, 20, 6, 7A) and including a microphone (211A, 7C, 7D) and a speaker (7D, 8);a voice recognition module (101, 103, 12, 207, 209) configured to recognize voice data inputted through the microphone (211A, 7C, 7D) by the passenger and to convert the recognized voice into text data;a wireless communication module (109, 201, 203) configured to make a wireless connection with a remote communication device (20, 30) to transmit the text data over a wireless communication network (101, 30, 40);and a control module (105, 107, 203, 205) configured to control the wireless communication module (109, 201, 203) to set up the wireless connection with the remote communication device (20, 30) over the wireless communication network (101, 30, 40).

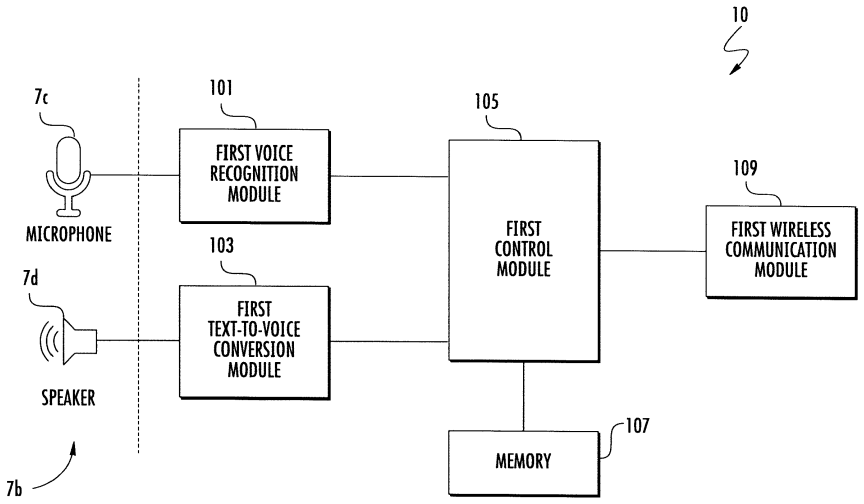

FIG. 3

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Description

[0001] The invention relates to an elevator system, in particular to an apparatus and a method of wireless communication in the elevator system.

[0002] In an elevator system, e.g. during maintenance or in emergency situations, particularly when passengers are trapped in an elevator car, it is essential to allow communication between the passengers and people who are located apart from the elevator car, e.g. in an external management center. Conventionally, a wired communication system has been used for such a purpose, but wireless communication systems, such as 3rd and 4th generation mobile communication systems using cellular networks like GSM, WCDMA, LTE, or LTE-A, have recently been replacing the wired communication system for the communication purpose in the elevator system. Voice communication over cellular networks, however, has a problem of requiring a relatively broad bandwidth and high cost.

[0003] It would therefore be beneficial to provide a wireless communication system for an elevator system occupying a narrower bandwidth with lower cost.

[0004] According to an exemplary embodiment of the invention, a wireless communication apparatus for an elevator system comprises a user interface module placed in an elevator car of the elevator system, the user interface module providing a user interface for a passenger in the elevator car and including a microphone; a voice recognition module configured to recognize voice data input through the microphone by the passenger and to convert the recognized voice into text data; a wireless communication module configured to make a wireless connection with a remote communication device to transmit the text data over a wireless communication network; and a control module configured to control the wireless communication module to set up the wireless connection with the remote communication device over the wireless communication network.

[0005] A number of optional features are set out in the following. These features may be realized in particular embodiments, alone or in combination with any of the other features.

[0006] The user interface may further comprise a speaker, and the wireless communication apparatus may further comprise a text-to-voice conversion module configured to convert text data received from the remote communication unit into voice data and to transfer the voice data to the speaker.

[0007] The voice recognition module, the wireless communication module, the text-to voice conversion module, and the control module may be implemented in a communication unit. Particularly, the communication unit may be provided on a top of the elevator car. Alternatively, the communication unit may be placed in a head room or a machine room above, beneath, or next to a hoistway of the elevator system.

[0008] The user interface module and the communication unit may be configured to make at least one of a wire communication or a wireless communication.

[0009] As another aspect of the present invention, a remote communication device configured to carry out a wireless communication with an apparatus according to the claimed embodiments of the present invention is provided. An exemplary embodiment of the remote communication apparatus comprises a user interface module comprising a microphone and a speaker; a voice recognition module configured to recognize voice data inputted through the microphone and to convert the recognized voice into text data; a wireless communication module configured to make a wireless connection with a communication unit placed in an elevator system to transmit the text data over a wireless communication network; a text-to-voice conversion module configured to convert text data received from the communication unit into voice data and to transfer the voice data to the speaker; and a control module configured to control the wireless communication module to set up the wireless connection with the communication unit over the wireless communication network.

[0010] Particularly, the remote communication device may be configured to be used by a person who is responsible for managing the elevator system or may be configured to be placed in a management center of the elevator system.

[0011] As further another aspect of the present invention, an elevator system equipped with a wireless communication apparatus according to the claimed embodiments of the present invention is provided.

[0012] As further another aspect of the present invention, a method of voice communication in an elevator system is provided. An exemplary embodiment of the method may comprise setting up a wireless connection between a communication unit placed in the elevator system and a remote communication device, upon receiving a passenger's input through an interface module placed in a elevator car of the elevator system; receiving the passenger's voice data via a microphone arranged in the elevator car; performing a voice recognition process for the received voice data to produce corresponding text data; and transmitting the text data to the remote communication device over the wireless communication network.

[0013] Another embodiment of the method may comprise receiving text data from the remote communication device; performing a text-to-voice conversion process for the received text data to produce corresponding voice data; and outputting the produced voice data through a speaker arranged in the elevator car.

[0014] The wireless communication network may be any one of GSM, WCDMA, LTE, and LTE-A networks. Alternatively, the wireless communication network may be any one of Low-Power Wide-Area Network (LPWAN), Low-Range-Wide-Area-Network (LoRaWAN), Wi-Fi, and Bluetooth networks.

[0015] In the following an exemplary embodiment of

the invention is described with reference to the enclosed figures.

Fig. 1A is a schematic diagram depicting an elevator system comprising an elevator car according to an exemplary embodiment of the invention.

Fig. 1B is a schematic diagram depicting an elevator system comprising an elevator car according to another exemplary embodiment of the invention.

Fig. 2 is a schematic diagram showing an overall network structure in accordance with an embodiment of the present invention.

Fig. 3 is a diagram showing an exemplary structure of a communication unit in accordance with an embodiment of the present invention.

Fig. 4 is a diagram showing an exemplary structure of a remote communication device in accordance with an embodiment of the present invention.

Fig. 5 is a flowchart showing a process performed by a communication unit in accordance with an embodiment of the present invention.

Figs. 1A and 1B schematically depict an elevator system 2 comprising an elevator car 6 according to exemplary embodiments of the present invention.

[0016] The elevator system 2 comprises a hoistway 4 extending in a vertical direction between a plurality of landings 8 located on different floors.

[0017] The elevator car 6 comprises a floor 16, a ceiling 18 and sidewalls 17 extending between the floor 16 and the ceiling 18 defining an interior space of the elevator car 6. Only one sidewall 17 is depicted in the schematic illustration of Fig. 1.

[0018] The elevator car 6 is movably suspended within the hoistway 4 by means of a tension member 3. The tension member 3, for example a rope or belt, is connected to a drive 5, which is configured for driving the tension member 3 in order to move the elevator car 6 along the longitudinal direction / height of the hoistway 4 between the plurality of landings 8.

[0019] Each landing 8 is provided with a landing door (elevator hoistway door) 9, and the elevator car 6 is provided with a corresponding elevator car door 11 allowing passengers to transfer between a landing 8 and the interior space of the elevator car 6 when the elevator car 6 is positioned at the respective landing 8.

[0020] The drive 5 is controlled by an elevator control 15 for moving the elevator car 6 along the hoistway 4 between the different landings 8.

[0021] Input to the elevator control 15 may be provided via elevator hall call buttons included in hall call panels 7a, which are provided on each landing 8 close to the elevator landing doors 9, and/or via elevator car control buttons which are incorporated into a user interface 7b provided inside the elevator car 6. Instead of traditional up/down hall call buttons, the hall call panels 7a may have the configuration of destination call panels including buttons for input of a desired destination floor by the passenger. In this case, the user interface 7b inside the elevator car 6 is not required to have elevator car control buttons for input of the desired destination floor.

[0022] The elevator hall call panels 7a and the elevator car control buttons included in the user interface 7a may be connected to the elevator control 15 by means of electrical lines, which are not shown in Fig. 1, in particular by an electric bus, e.g. a field bus such as a CAN bus, or by means of wireless data transmission.

[0023] The exemplary embodiments of the elevator system 2 shown in Figs. 1A and 1B are provided with the user interface 7b and a communication unit 10. The user interface 7b may include an emergency button, a microphone, a speaker, and/or a monitor etc. As described above, the user interface 7b may be implemented together with the elevator car control buttons. Alternatively, the user interface 7b may be located on another place inside the elevator car 6 separately from the elevator car control buttons.

[0024] As depicted in Fig. 1A, the communication unit 10 may be provided on the top of the elevator car 6. As an alternative, as shown in Fig. 1B, the communication unit 10 is incorporated into the elevator control 15. However, the communication unit 10 may be a device separate from the elevator control 15. The communication unit 10 may be placed in a head room of the hoistway 4 or in a machine room located above, beneath, or next to the hoistway 4.

[0025] The operations of the interface unit 7b, the communication unit 10, and the remote communication unit 20 will be described in detail with reference to Figs. 2-5.

[0026] Fig. 2 is a schematic diagram showing an overall network structure in accordance with an embodiment of the present invention.

[0027] Referring to Fig. 2, the user interface 7b is connected to the communication unit 10 by means of the CAN bus or wirelessly. The communication unit 10 is configured to be connected with the remote communication device 20 over a wireless communication network 30. In this embodiment, LPWAN (Low-Power Wide-Area Network, also abbreviated "LPWA" or "LPN") is used as the wireless communication network 30. The LPWAN is a type of wireless telecommunication wide area network designed to allow long range communications at a low bit rate with low power. An example for an LPWAN available in Europe is the SigFox network. A plurality of technical standards for the LPWAN, like SigFox, LoRa, LoRaWAN, Random Phase Multiple Access (RPMA), Symphony Link, Weightless have been set up and the wireless communication network 30 can be implemented in compliance with communication protocols set by any one of these technical standards for the LPWAN.

[0028] The remote communication device 20 may be provided, for example, in a management center (not shown in the Figures) which is responsible for managing the elevator system 2, particularly in an emergency situation. Alternatively, the remote communication unit 20 may be a mobile device carried by a person who is responsible for managing the elevator system 2 or a passenger's acquaintance.

[0029] Figs. 3-4 are diagrams showing exemplary structures of the communication unit 10 and the remote communication device 20, respectively, in accordance with an embodiment of the present invention.

[0030] Referring to Fig. 3, the communication unit 10 includes a first voice recognition module 101, a first text-to-voice conversion module 103, a first control module 105, a memory 107, and a first wireless communication module 109. The first voice recognition module 101 is connected to a microphone 7c of the interface module 7b and voice data from a passenger in the elevator car 6 is transferred to the first voice recognition module 101 via the microphone 7c. The first voice recognition module 101 performs a voice recognition operation upon the voice data using a voice recognition program to output corresponding text data.

[0031] In this document, the term "voice recognition" has the same meaning as "speech recognition". A known voice or speech recognition technology can be used to implement the first voice recognition module 12. There are many open source voice/speech recognition software engines known to the public, like "CMU Sphinx," "Julius," and "Kaldi," etc. There are also many commercial voice/speech recognition software engines known such as "Dragon Dictate," "MacSpeech Scribe," "ViaVoice," "Voice Notebook,and "SpeechTexter," etc.

[0032] The first wireless communication module 109 in Fig. 3 is configured to perform a predefined data processing to communicate with the remote communication device 20 over the wireless communication network 30, e.g. the LPWAN. In particular, the first wireless communication module 109 performs the predefined data processing on the text data transferred from the first voice recognition module 101. The predefined data processing is determined in compliance with communication protocols set by a technical standard based upon which the wireless communication network 30 has been implemented. The first wireless communication module 109 also performs a predetermined data processing on wireless signals received from the remote communication device 20 to output text data to be transferred to the first text-to-voice conversion module 103.

The first text-to-voice conversion module 103 performs text-to-voice conversion operations on the text data transferred from the first wireless communication module 109 to produce corresponding voice data. The voice data is transferred to and outputted by the speaker 7d of the interface module 7b.

[0033] In this document, the term "text-to-voice conversion" can be replaced with simply "text-to-voice," "text-to-speech," or "speech synthesis". A known text-to-voice conversion algorithm can be adopted to implement the first text-to-voice conversion module 103. "Festival Speech Synthesis System," "eSpeak," and "gnuspeech" are examples of open source text-to-voice (or text-to-speech) algorithms.

[0034] The first control module 105 is configured to control the overall operations of the components (101, 103, 107, 109) of the communication unit 10. Algorithms for the voice recognition and the text-to-voice conversion, programs, instructions, and data required to control the communication unit 20 and to communicate with the remote communication device 20 may be stored in the memory 107 which may comprise a RAM and a ROM.

[0035] With reference to Fig. 4, the remote communication device 20 includes a second wireless communication module 201, a second control module 203, a memory 205, a second voice recognition module 207, a second text-to-voice conversion module, and an interface module 211 which comprises a microphone 211a and a speaker. Operations of those modules 201, 203, 205, 207, 209, 211 are analogous to the corresponding modules of the communication unit 10, so that detailed explanations will be omitted.

[0036] Fig. 5 is a flowchart showing a process performed by the communication unit 10 in accordance with an embodiment of the present invention. A process performed by the remote communication unit 20 in accordance with an embodiment of the present invention could be the other way around, so that specific explanations thereof will be omitted.

[0037] Referring to Fig. 5, at S51, a user input is made by a passenger in the elevator car 6, for example, by simply pushing an emergency button or by picking up a handset provided in the user interface 7b. The user input is transferred to the first voice recognition module 101.

[0038] When receiving the user input, at S51, the first control module 105 controls the first wireless communication module 109 to set up a wireless connection with the remote communication device 20 over the wireless communication network 40, e.g. the LPWAN. After setting up the wireless connection at S52, the passenger's voice is received, at S53, by the first voice recognition module 101 through the microphone 7c of the user interface 7b. At S54, the first voice recognition module 101 performs the voice recognition operations on the received voice data to produce corresponding text data. At S55, the text data is transmitted through the first wireless communication module 109 to the remote communication device 20 over the wireless communication network 30.

[0039] At S56, the first wireless communication module 109 receives text data from the remote communication device 20 over the wireless communication network 30 and the received text data is transferred to the first text-to-voice conversion module 103. At S57, the first text-to-voice conversion module 103 performs text-to-voice conversion operations to convert the text data into

corresponding voice data. The voice data is passed to the speaker 7d to be outputted to the passenger in the elevator car 6. The steps of S53-S57 may be repeated until it is determined that the communication is terminated at S58.

[0040] According to the embodiments of the present invention, instead of transmitting voice data, corresponding text data is transmitted over a wireless communication network. Thus, data processing procedures performed by a wireless communication module of a communication unit in an elevator system or a remote communication device could be simplified. In addition, a narrower bandwidth, less power and cost could be required for the wireless communication in the elevator system and thereby providing higher availability and connectivity. As a further benefit, quality of speech signals output from the speakers is standardized.

[0041] While the invention has been described with reference to exemplary embodiments, it will be understood by those skilled in the art that various changes may be made and equivalents may be substituted for elements thereof without departing from the scope of the invention. In addition, many modifications may be made to adopt a particular situation or material to the teachings of the invention without departing from the essential scope thereof. Therefore, it is intended that the invention is not limited to the particular embodiments disclosed, but that the invention includes all embodiments falling within the scope of the claims.

References

[0042]

2	elevator system
3	tension member
4	hoistway
5	drive
6	elevator car
7a	elevator hall call panel
7b	user interface
7c, 211a	microphone
7d,211b	speaker
8	landing
9	landing door frame
10	communication unit
11	elevator car door
15	elevator control
16	floor of the elevator car
17	sidewall of the elevator car
18	ceiling of the elevator car
20	remote communication device
30	wireless communication network
101	first voice recognition module
103	first text-to-voice conversion module
105	first control module
107,205	memory
109	first wireless communication module
201	second wireless communication module
203	second control module
205	memory
207	second voice recognition module
209	second text-to-voice conversion module

Claims

1. A wireless communication apparatus for an elevator system (2), the wireless communication apparatus comprising:

   a user interface module (7b) placed in an elevator car (6) of the elevator system (2), the user interface module (7b) providing a user interface for a passenger in the elevator car (6) and including a microphone (7c);
   a voice recognition module (101) configured to recognize voice data inputted through the microphone (7c) by the passenger and to convert the recognized voice data into text data;
   a wireless communication module (109) configured to make a wireless connection with a remote communication device (20) to transmit the text data over a wireless communication network (30); and
   a control module (105) configured to control the wireless communication module (109) to set up the wireless connection with the remote communication device (20) over the wireless communication network (30).

2. The wireless communication apparatus according to claim 1, wherein the user interface module (7b) further comprises a speaker (7d), and the wireless communication apparatus further comprises:
   a text-to-voice conversion module (103) configured to convert text data received from the remote communication unit (20) into voice data and to transfer the voice data to the speaker (7d).

3. The wireless communication apparatus according to claim 2, wherein the voice recognition module (101), the wireless communication module (109), the text-to voice conversion module (103), and the control module (105) are implemented in a communication unit (10).

4. The wireless communication apparatus according to claim 3, wherein the communication unit (10) is provided on a top of the elevator car (6).

5. The wireless communication apparatus according to claim 3, wherein the communication unit (10) is placed in a head room or a machine room above, beneath, or next to a hoistway (4) of the elevator system (2).

6. The wireless communication apparatus according to any of the preceding claims, wherein the wireless communication network (30) is any of Low-Power Wide-Area Network (LPWAN), Low-Range-Wide-Area-Network (LoRaWAN), Wi-Fi, and Bluetooth networks.

7. The wireless communication apparatus according to any of claims 3-6, wherein the user interface module (7b) and the communication unit (10) are configured to make at least one of a wire communication or a wireless communication.

8. A remote communication device (20) configured to carry out a wireless communication with an apparatus according to any of the preceding claims, the remote communication apparatus (20) comprising:

a user interface module (211) comprising a microphone (211a) and a speaker (211b);
a voice recognition module (207) configured to recognize voice data inputted through the microphone (211a) and to convert the recognized voice into text data;
a wireless communication module (211) configured to make a wireless connection with a communication unit (10) placed in an elevator system to transmit the text data over a wireless communication network (30);
a text-to-voice conversion module (209) configured to convert text data received from the communication unit (10) into voice data and to transfer the voice data to the speaker (211b); and
a control module (203) configured to control the wireless communication module (201) to set up the wireless connection with the communication unit (10) over the wireless communication network (30).

9. The remote communication apparatus (20) according to claim 8 or 9, wherein the remote communication device (20) is configured to be used by a person who is responsible for managing the elevator system (2).

10. The remote communication apparatus (20) according to claim 8, wherein the remote communication device (20) is configured to be placed in a management center of the elevator system (2).

11. An elevator system (2) equipped with a wireless communication apparatus according any one of claims 1 to 7.

12. A method of voice communication in an elevator system (2), the method comprising:

setting up a wireless connection between a communication unit (10) placed in the elevator system (2) and a remote communication device (20) upon receiving a passenger's input through an interface module placed in an elevator car (6) of the elevator system (10);
receiving the passenger's voice data via a microphone (7c) arranged in the elevator car (6);
performing a voice recognition process for the received voice data to produce corresponding text data; and
transmitting the text data to the remote communication device (20) over the wireless communication network (30).

13. The method according to claim 12, further comprising
receiving text data from the remote communication device (20);
performing a text-to-voice conversion process for the received text data to produce corresponding voice data; and
outputting the produced voice data through a speaker (7d) arranged in the elevator car (6).

14. The method according to claim 12 or 13, wherein the wireless communication network (30) is any one of Low-Power Wide-Area Network (LPWAN), Low-Range-Wide-Area-Network (LoRaWAN), Wi-Fi, and Bluetooth networks.

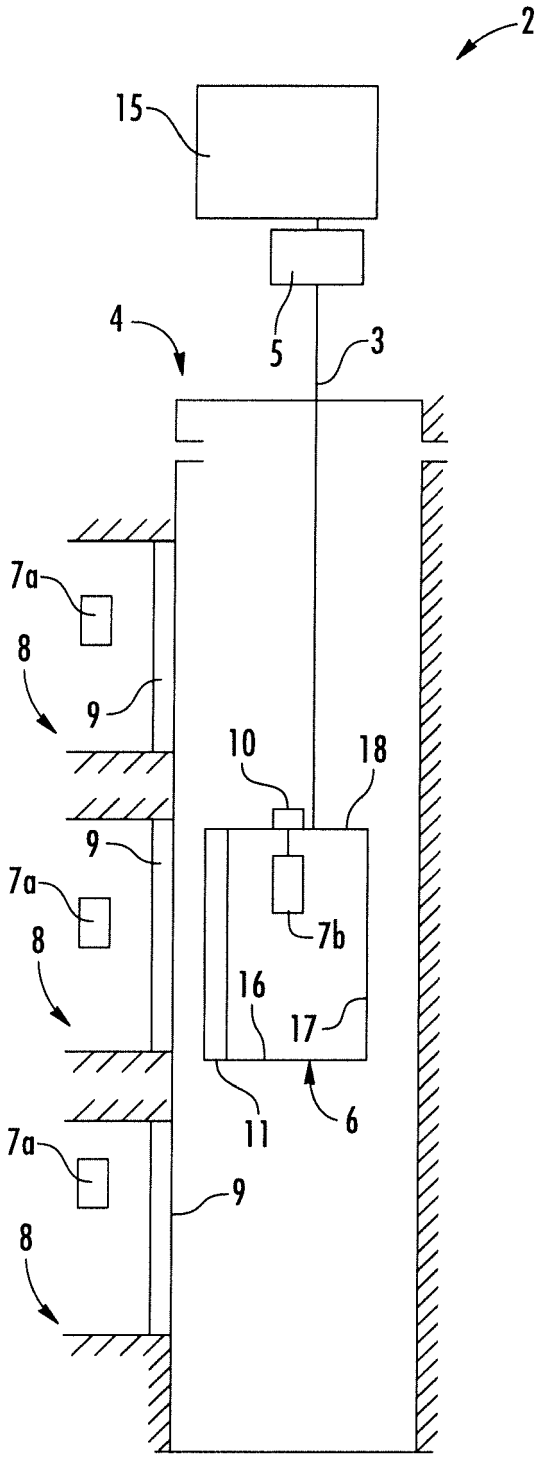


FIG. 1A

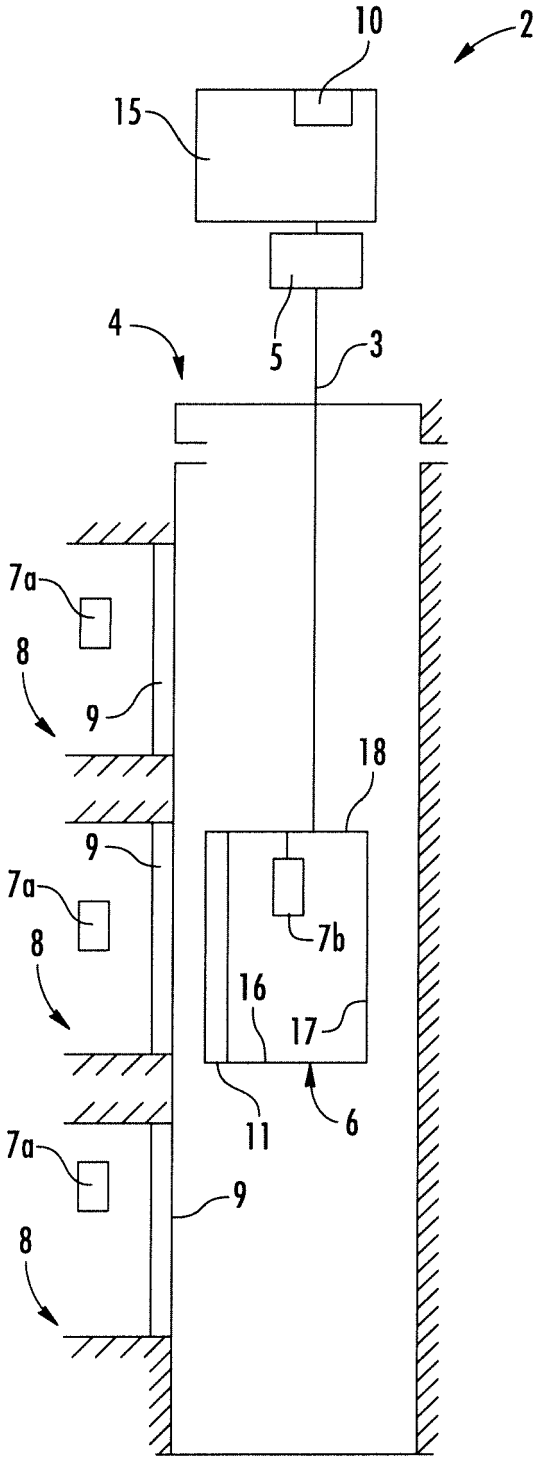


FIG. 1B

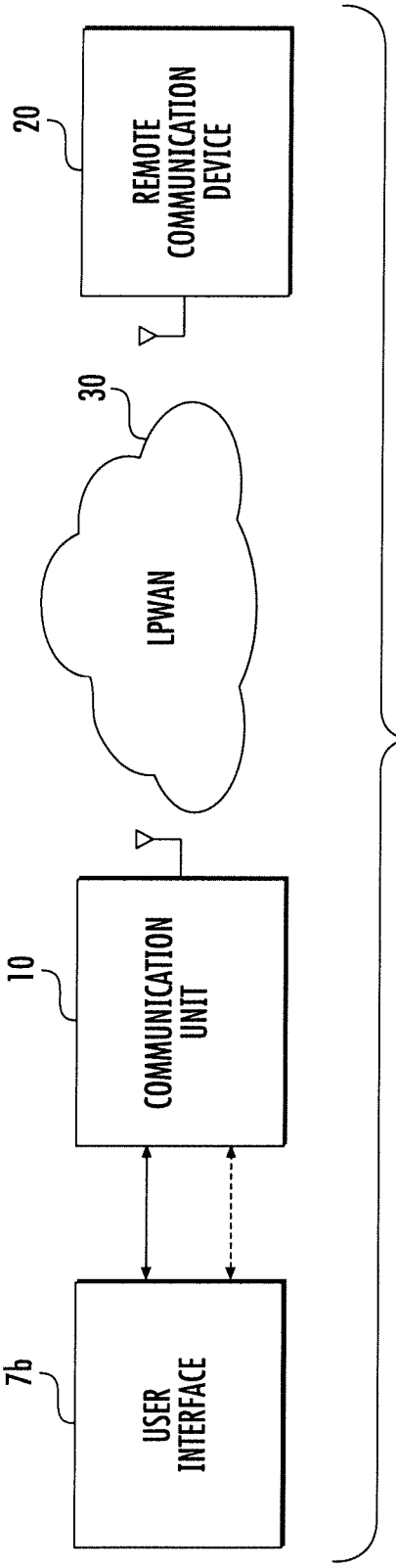

20
REMOTE COMMUNICATION DEVICE
30
LPWAN
10
COMMUNICATION UNIT
7b
USER INTERFACE

FIG. 2

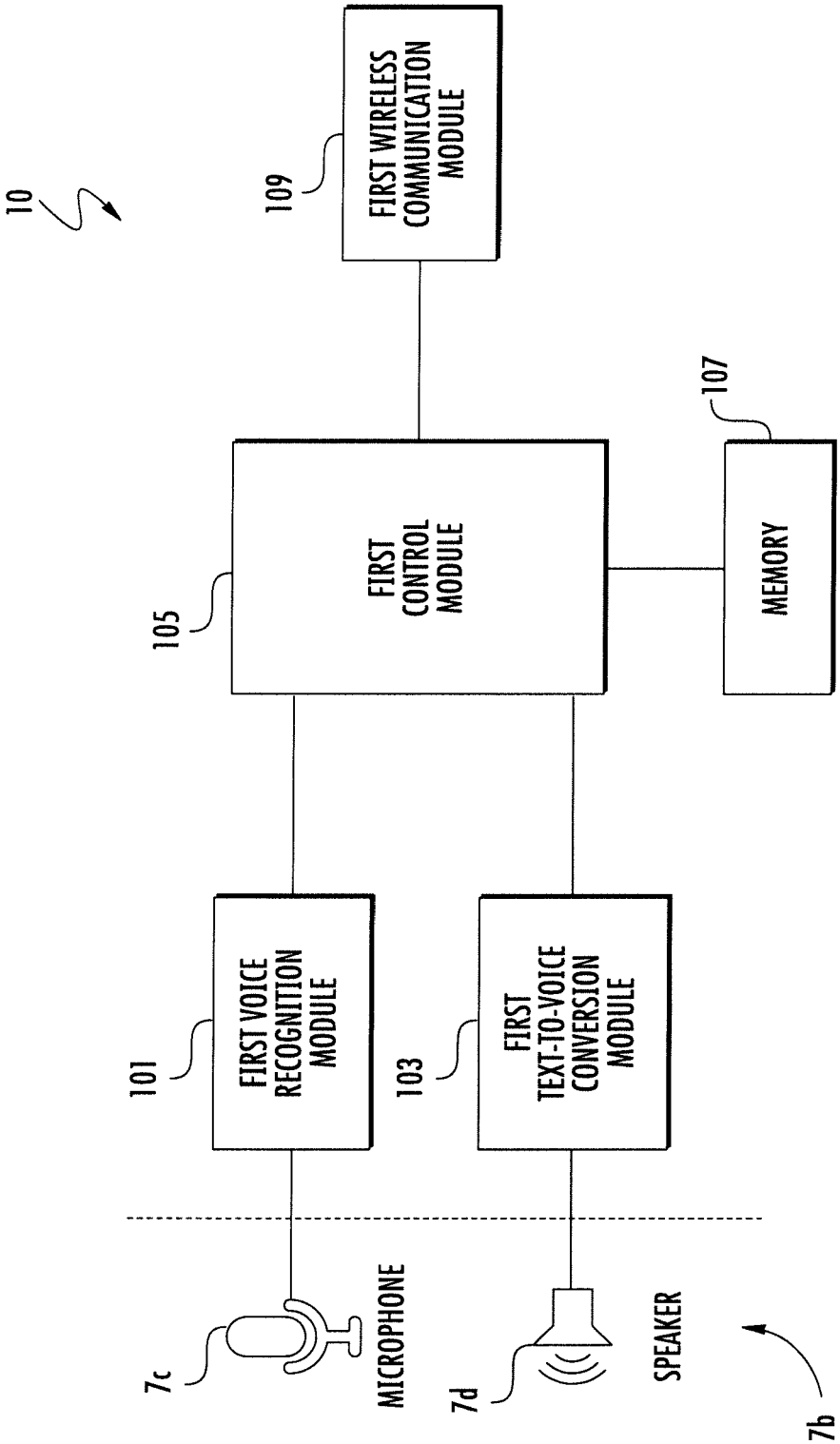

10
109
FIRST WIRELESS COMMUNICATION MODULE
105
FIRST CONTROL MODULE
107
MEMORY
101
FIRST VOICE RECOGNITION MODULE
103
FIRST TEXT-TO-VOICE CONVERSION MODULE
7c
MICROPHONE
7d
SPEAKER
7b

FIG. 3

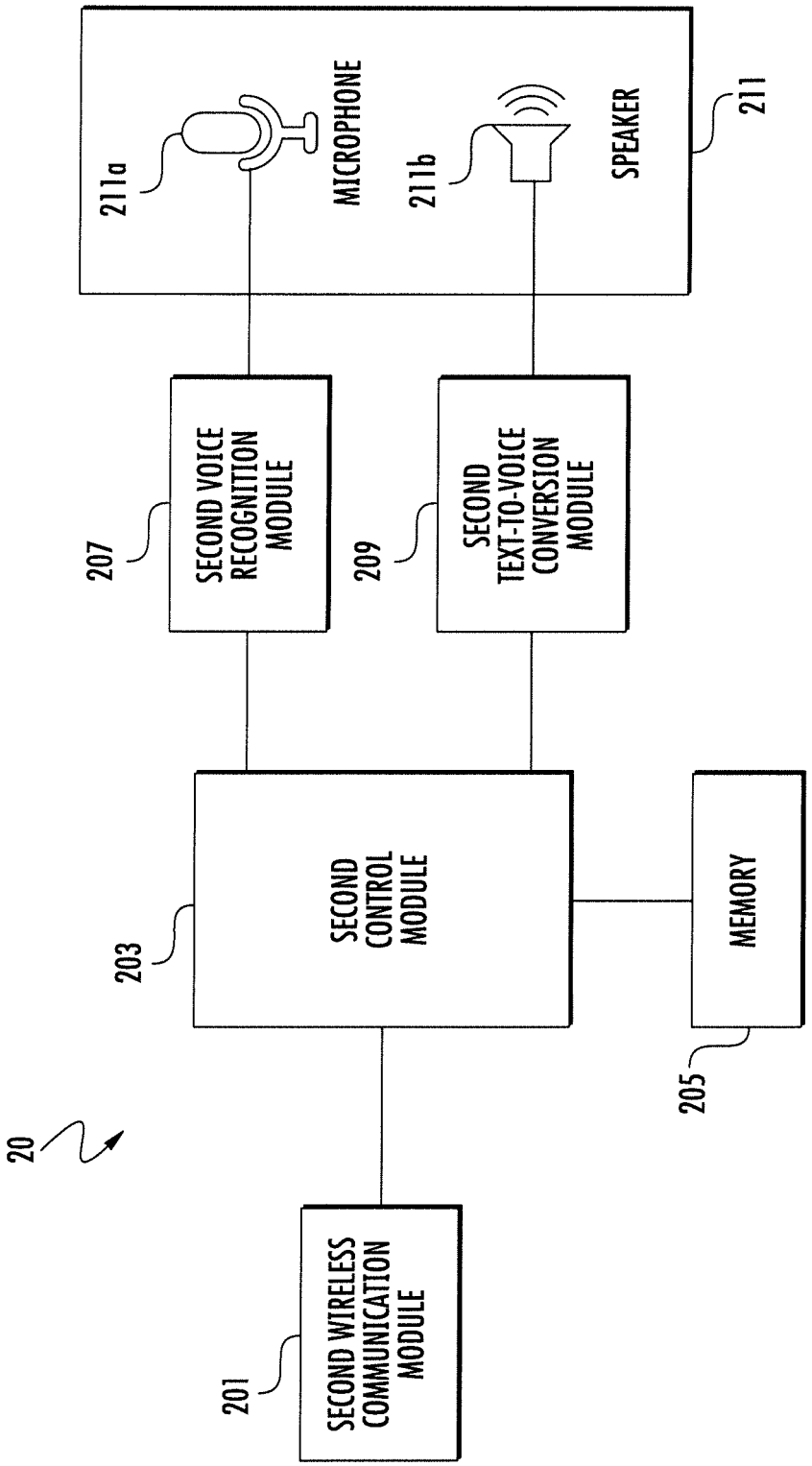
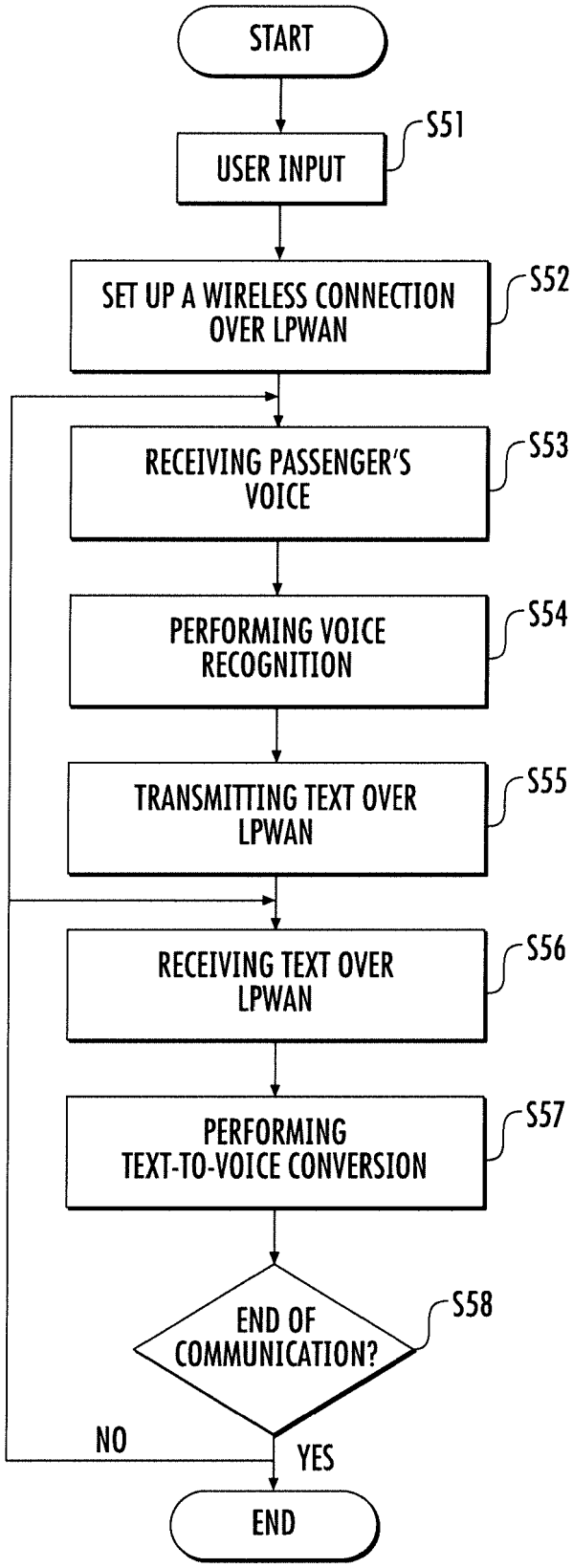

20
SECOND WIRELESS COMMUNICATION MODULE
201
SECOND CONTROL MODULE
203
MEMORY
205
SECOND VOICE RECOGNITION MODULE
207
SECOND TEXT-TO-VOICE CONVERSION MODULE
209
211
211a
MICROPHONE
211b
SPEAKER

FIG. 4

FIG. 5


START
USER INPUT
S51
SET UP A WIRELESS CONNECTION OVER LPWAN
S52
RECEIVING PASSENGER'S VOICE
S53
PERFORMING VOICE RECOGNITION
S54
TRANSMITTING TEXT OVER LPWAN
S55
RECEIVING TEXT OVER LPWAN
S56
PERFORMING TEXT-TO-VOICE CONVERSION
S57
END OF COMMUNICATION?
S58
NO
YES
END

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EUROPEAN SEARCH REPORT

Application Number
EP 18 17 2375

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	CN 107 902 517 A (SHANGHAI STEP ELECTRIC CORP) 13 April 2018 (2018-04-13) * paragraphs [0034], [0038], [0039], [0046], [0053] * -----	1-14	INV. B66B1/34
X	CN 107 673 153 A (SHANGHAI STEP ELECTRIC CORP) 9 February 2018 (2018-02-09) * paragraphs [0029] - [0031], [0033], [0041] * -----	1-14	
A	US 2006/151256 A1 (LEE JAE H [US]) 13 July 2006 (2006-07-13) * abstract * -----	1-14	
			TECHNICAL FIELDS SEARCHED (IPC) B66B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	8 November 2018	Lenoir, Xavier

CATEGORY OF CITED DOCUMENTS

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EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 18 17 2375

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82