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(19) **United States**
(12) **Reissued Patent**
Park et al.

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(54) **METHOD AND DEVICE FOR PERFORMING VOICE RECOGNITION USING GRAMMAR MODEL**

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

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Related U.S. Patent Documents

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Issued: **Mar. 30, 2021**
Appl. No.: **16/820,353**
Filed: **Mar. 16, 2020**

U.S. Applications:
(63) Continuation of application No. 16/523,263, filed on Jul. 26, 2019, now Pat. No. 10,706,838, which is a
(Continued)

(51) **Int. Cl.**
G10L 15/22 (2006.01)
G10L 15/187 (2013.01)
(Continued)

(52) **U.S. Cl.**
CPC ***G10L 15/063*** (2013.01); ***G10L 15/02*** (2013.01); ***G10L 15/14*** (2013.01); ***G10L 15/187*** (2013.01);
(Continued)

(58) **Field of Classification Search**
CPC G10L 15/187; G10L 15/30; G10L 15/197; G10L 15/063; G10L 15/14; G10L 15/02;
(Continued)

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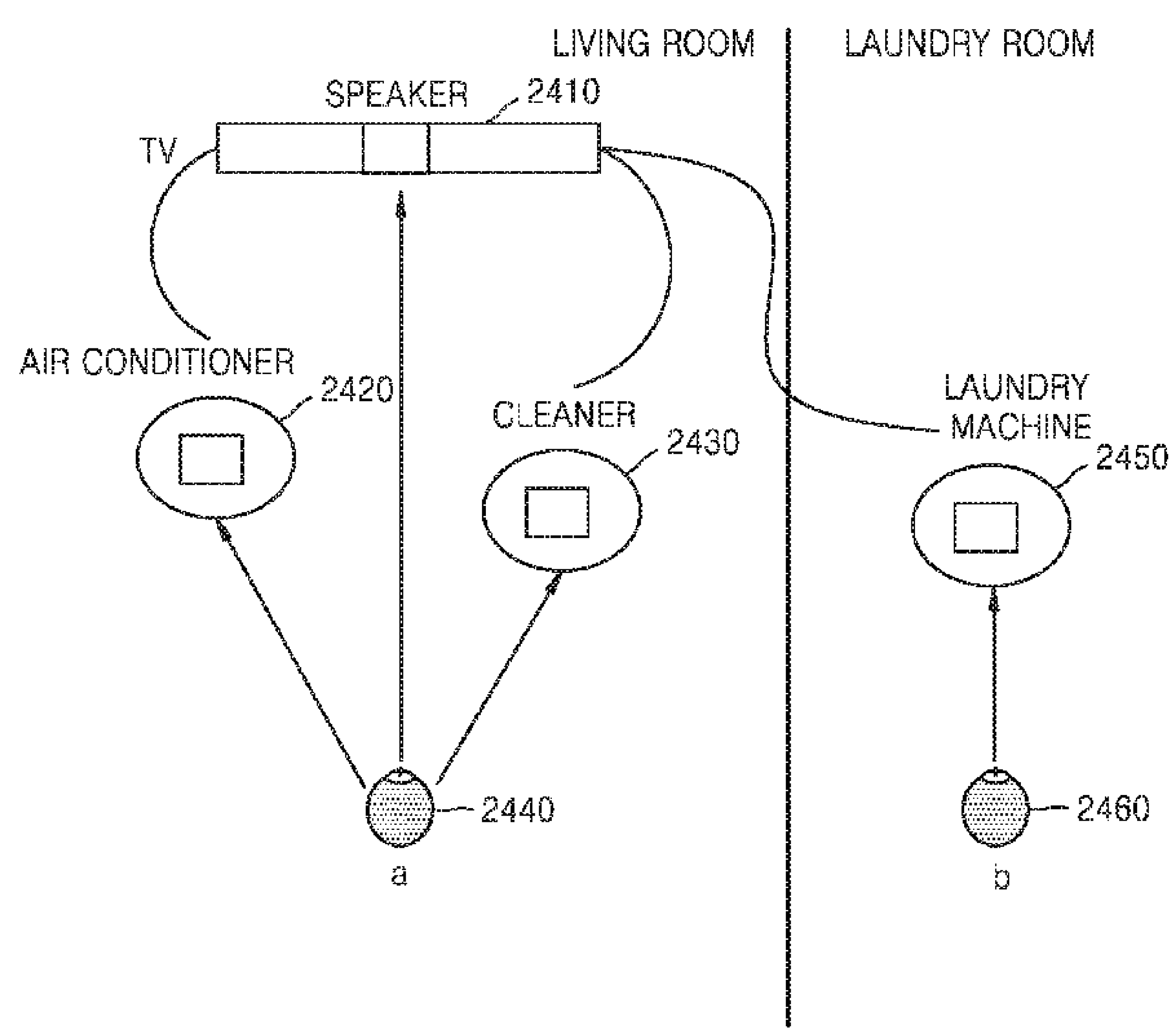
(Continued)

Primary Examiner — Luke S Wassum
(74) *Attorney, Agent, or Firm* — Sughrue Mion, PLLC

(57) **ABSTRACT**

A method of updating speech recognition data including a language model used for speech recognition, the method including obtaining language data including at least one word; detecting a word that does not exist in the language model from among the at least one word; obtaining at least one phoneme sequence regarding the detected word; obtaining components constituting the at least one phoneme sequence by dividing the at least one phoneme sequence into predetermined unit components; determining information regarding probabilities that the respective components constituting each of the at least one phoneme sequence appear during speech recognition; and updating the language model based on the determined probability information.

34 Claims, 31 Drawing Sheets



Related U.S. Application Data

continuation of application No. 15/544,198, filed as application No. PCT/KR2015/000486 on Jan. 16, 2015, now Pat. No. 10,403,267.

(51) **Int. Cl.**
G10L 15/14 (2006.01)
G10L 15/197 (2013.01)
G10L 15/06 (2013.01)
G10L 15/02 (2006.01)

(52) **U.S. Cl.**
CPC ***G10L 15/197*** (2013.01); *G10L 2015/025* (2013.01); *G10L 2015/0633* (2013.01); *G10L 2015/0635* (2013.01)

(58) **Field of Classification Search**
CPC G10L 2015/0633; G10L 2015/025; G10L 2015/0635
See application file for complete search history.

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KR	1020090004216		1/2009	
KR	10-0883657		2/2009	
KR	1020090060631		6/2009	
KR	1020100120740		11/2010	
KR	1020100130263		12/2010	
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FIG. 1

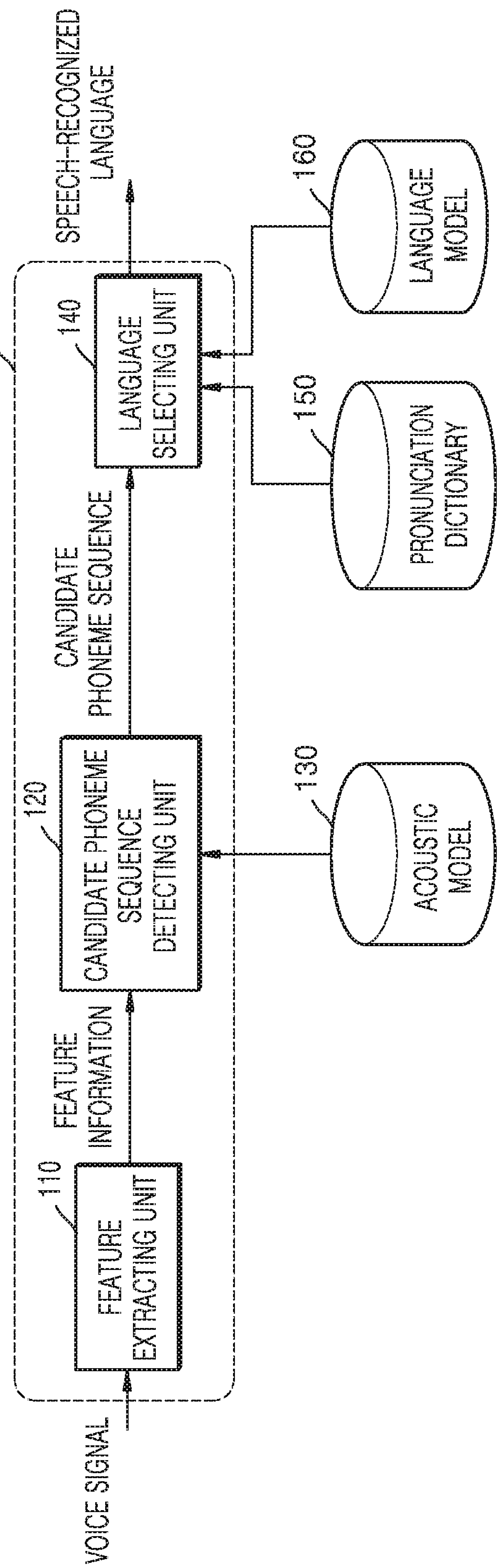

VOICE SIGNAL
100
110
FEATURE EXTRACTING UNIT
FEATURE INFORMATION
120
CANDIDATE PHONEME SEQUENCE DETECTING UNIT
130
ACOUSTIC MODEL
CANDIDATE PHONEME SEQUENCE
140
LANGUAGE SELECTING UNIT
150
PRONUNCIATION DICTIONARY
160
LANGUAGE MODEL
SPEECH-RECOGNIZED LANGUAGE

FIG. 2

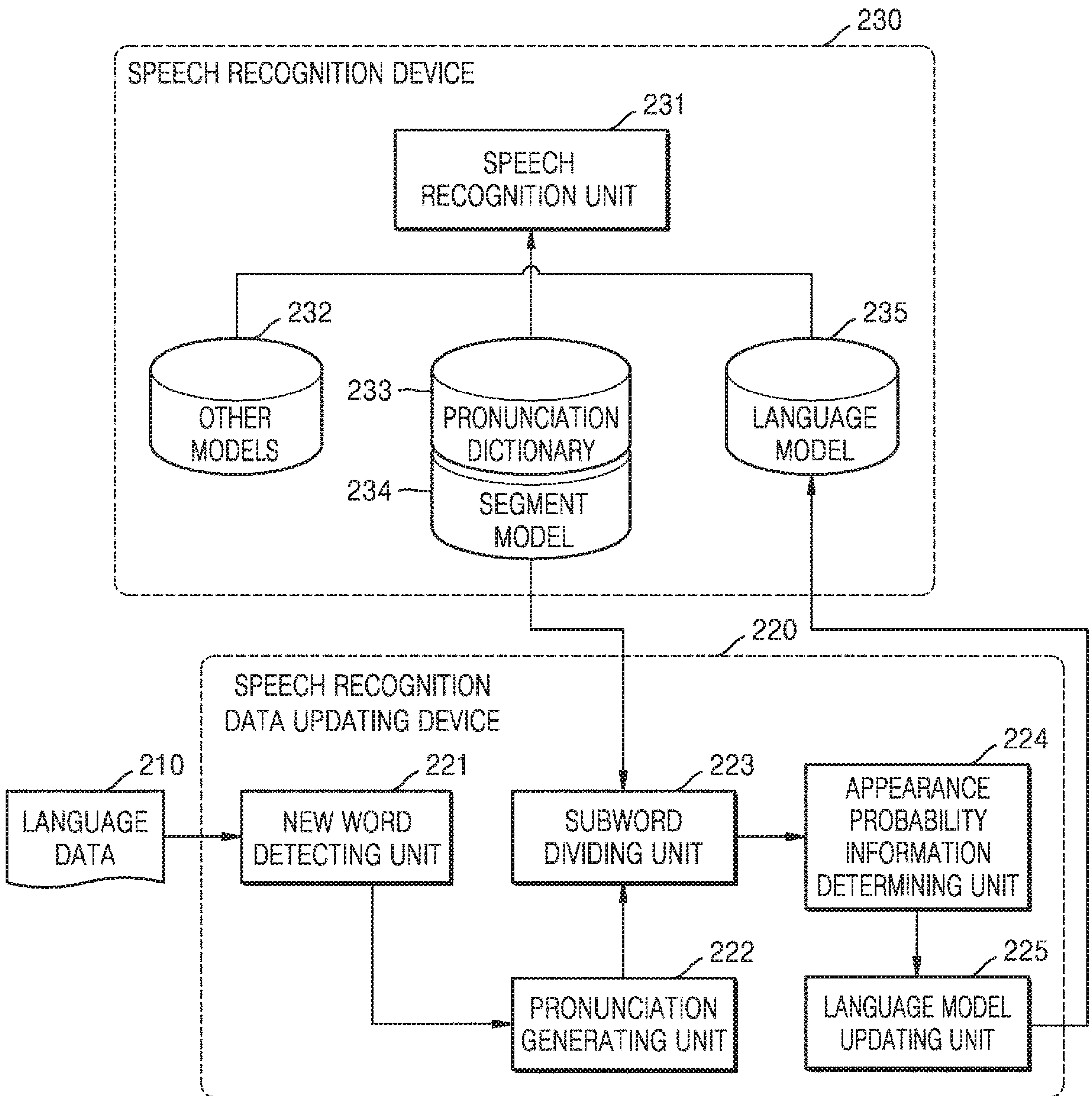

230
SPEECH RECOGNITION DEVICE
231
SPEECH RECOGNITION UNIT
232
OTHER MODELS
233
PRONUNCIATION DICTIONARY
234
SEGMENT MODEL
235
LANGUAGE MODEL
220
SPEECH RECOGNITION DATA UPDATING DEVICE
210
LANGUAGE DATA
221
NEW WORD DETECTING UNIT
223
SUBWORD DIVIDING UNIT
224
APPEARANCE PROBABILITY INFORMATION DETERMINING UNIT
222
PRONUNCIATION GENERATING UNIT
225
LANGUAGE MODEL UPDATING UNIT

FIG. 3

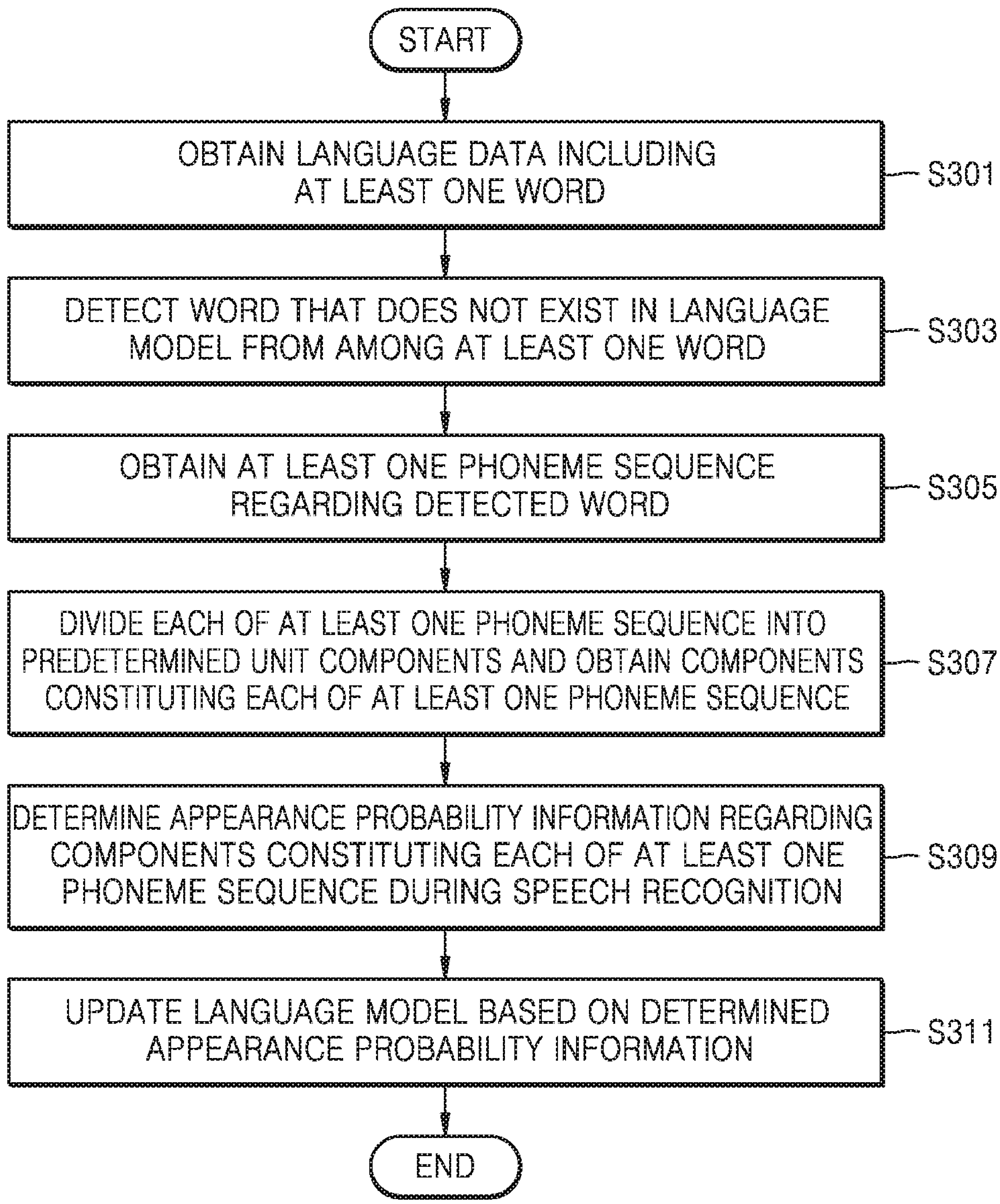

START
OBTAIN LANGUAGE DATA INCLUDING AT LEAST ONE WORD
S301
DETECT WORD THAT DOES NOT EXIST IN LANGUAGE MODEL FROM AMONG AT LEAST ONE WORD
S303
OBTAIN AT LEAST ONE PHONEME SEQUENCE REGARDING DETECTED WORD
S305
DIVIDE EACH OF AT LEAST ONE PHONEME SEQUENCE INTO PREDETERMINED UNIT COMPONENTS AND OBTAIN COMPONENTS CONSTITUTING EACH OF AT LEAST ONE PHONEME SEQUENCE
S307
DETERMINE APPEARANCE PROBABILITY INFORMATION REGARDING COMPONENTS CONSTITUTING EACH OF AT LEAST ONE PHONEME SEQUENCE DURING SPEECH RECOGNITION
S309
UPDATE LANGUAGE MODEL BASED ON DETERMINED APPEARANCE PROBABILITY INFORMATION
S311
END

FIG. 4

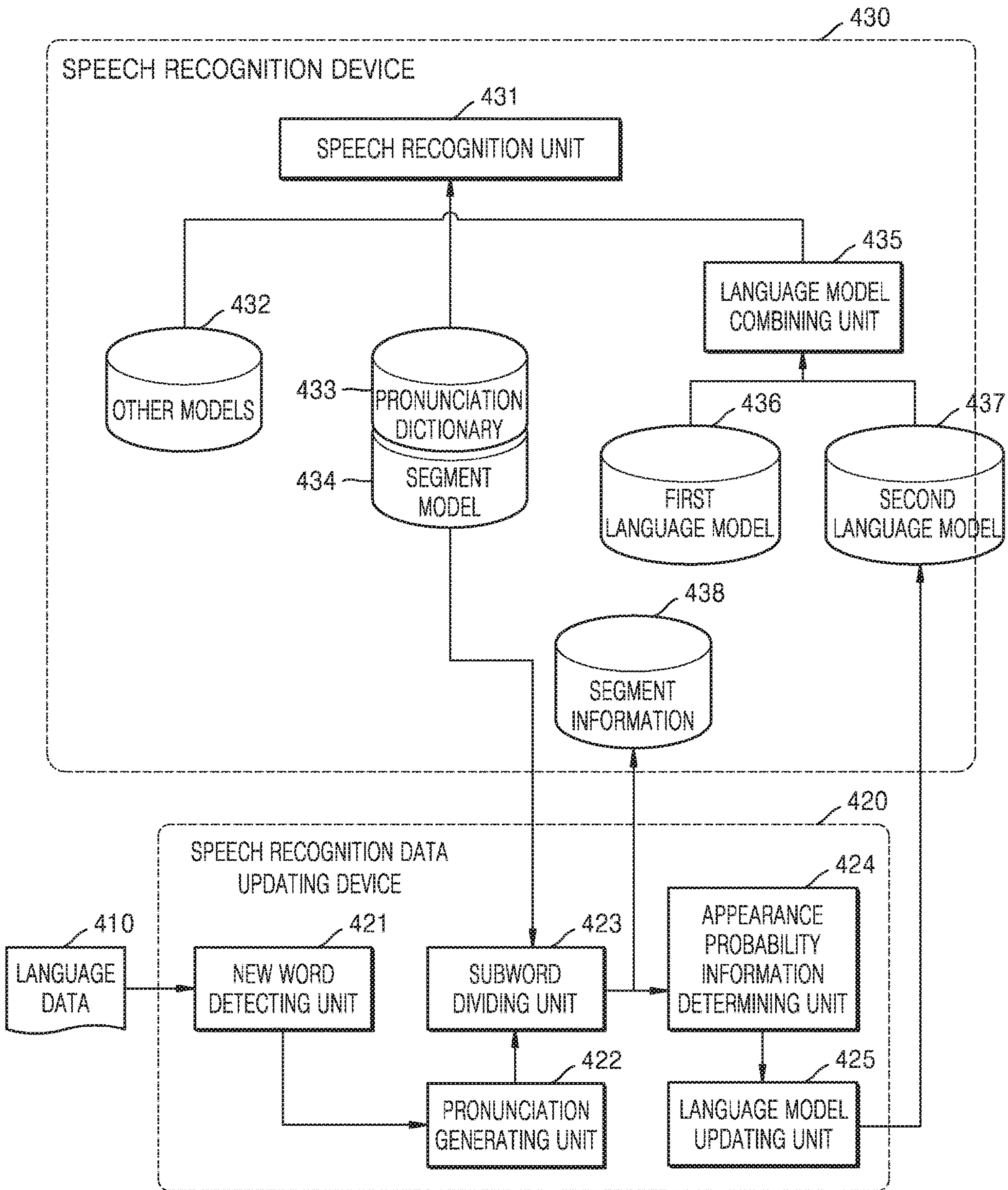
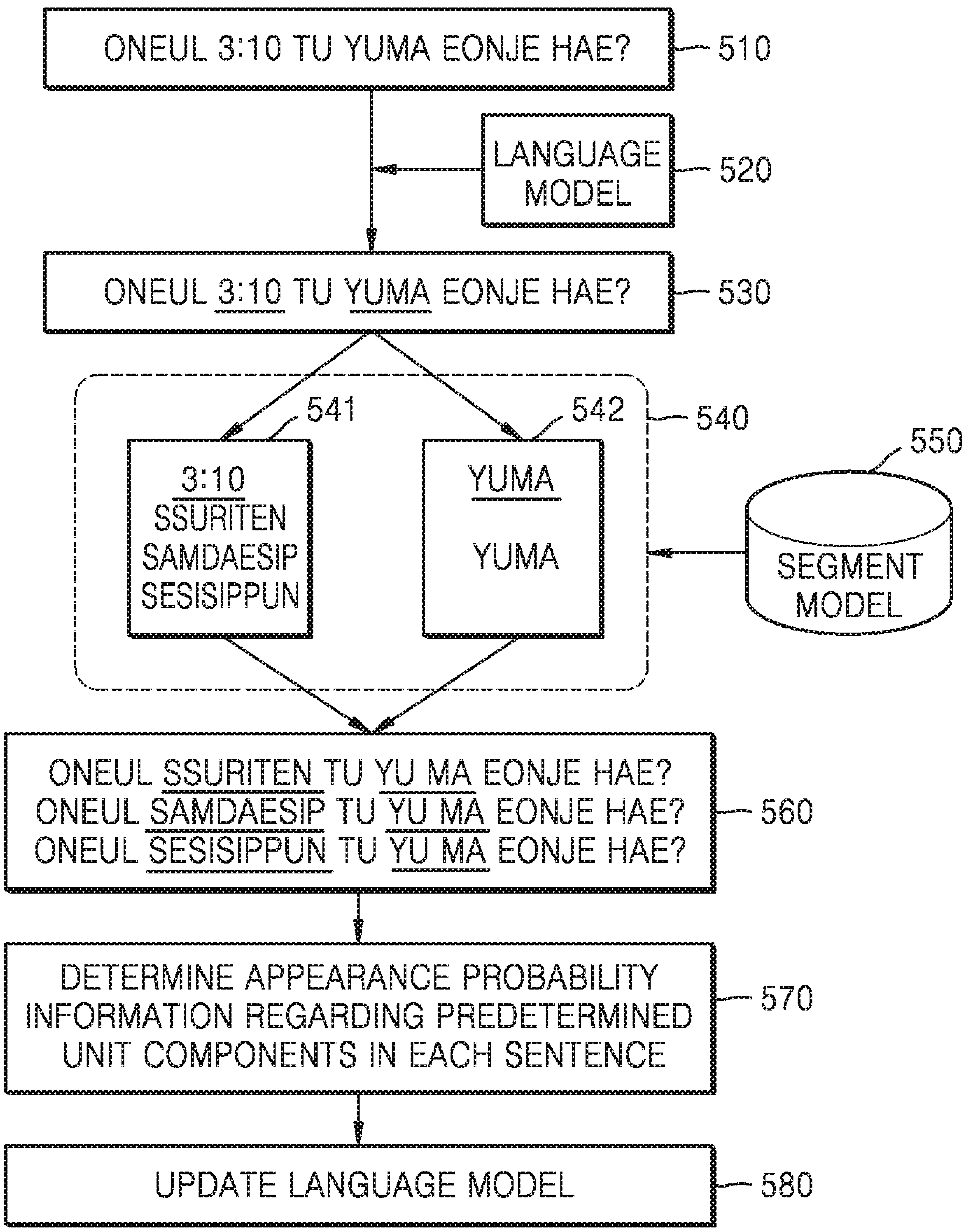
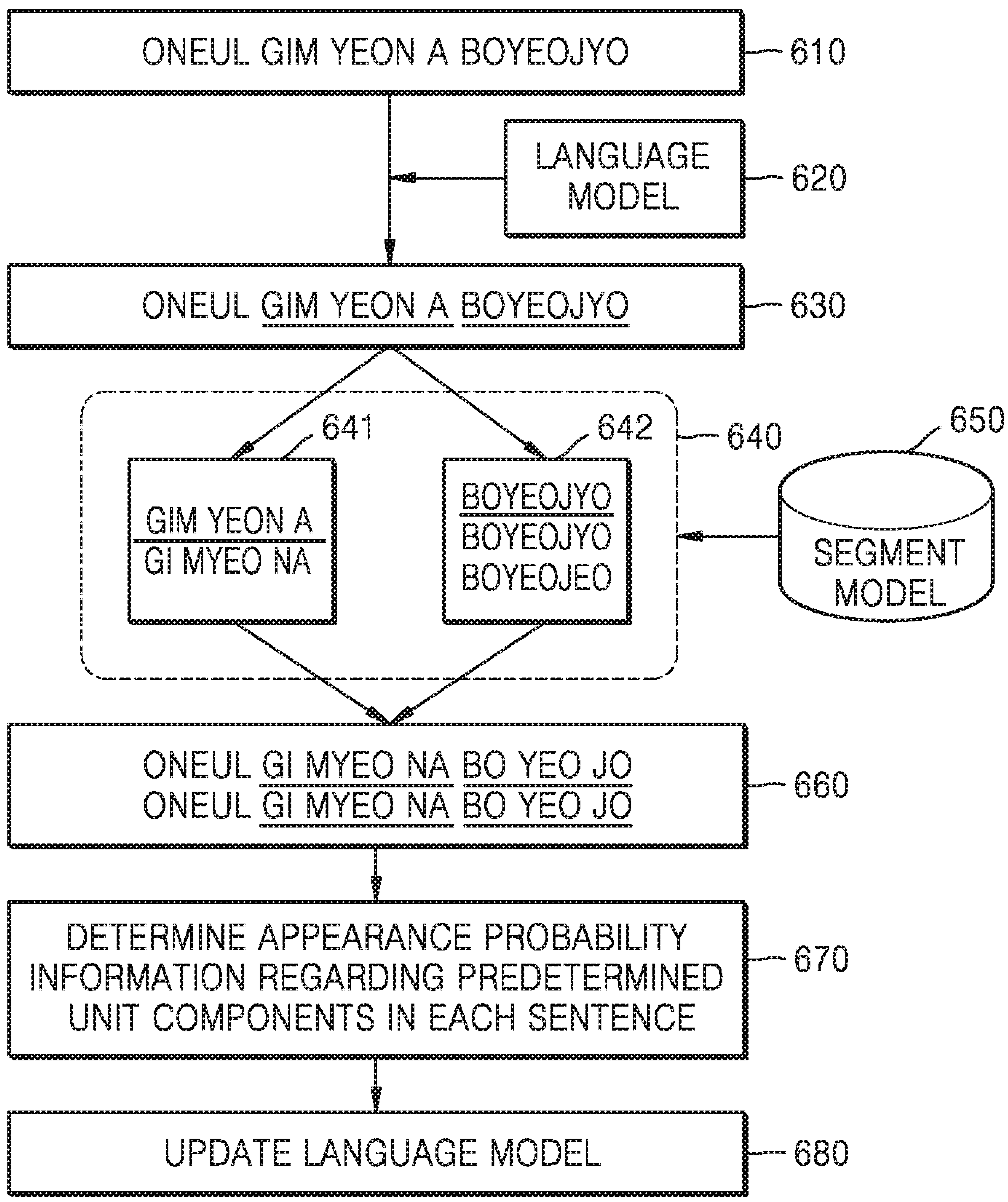

430
SPEECH RECOGNITION DEVICE
431
SPEECH RECOGNITION UNIT
432
OTHER MODELS
433
PRONUNCIATION DICTIONARY
434
SEGMENT MODEL
435
LANGUAGE MODEL COMBINING UNIT
436
FIRST LANGUAGE MODEL
437
SECOND LANGUAGE MODEL
438
SEGMENT INFORMATION
420
SPEECH RECOGNITION DATA UPDATING DEVICE
410
LANGUAGE DATA
421
NEW WORD DETECTING UNIT
422
PRONUNCIATION GENERATING UNIT
423
SUBWORD DIVIDING UNIT
424
APPEARANCE PROBABILITY INFORMATION DETERMINING UNIT
425
LANGUAGE MODEL UPDATING UNIT

FIG. 5



ONEUL 3:10 TU YUMA EONJE HAE?
510
LANGUAGE MODEL
520
ONEUL 3:10 TU YUMA EONJE HAE?
530
541
542
540
3:10
SSURITEN
SAMDAESIP
SESISIPPUN
YUMA
YUMA
550
SEGMENT MODEL
ONEUL SSURITEN TU YU MA EONJE HAE?
ONEUL SAMDAESIP TU YU MA EONJE HAE?
ONEUL SESISIPPUN TU YU MA EONJE HAE?
560
DETERMINE APPEARANCE PROBABILITY INFORMATION REGARDING PREDETERMINED UNIT COMPONENTS IN EACH SENTENCE
570
UPDATE LANGUAGE MODEL
580

FIG. 6



ONEUL GIM YEON A BOYEOJYO
610
LANGUAGE MODEL
620
ONEUL GIM YEON A BOYEOJYO
630
641
642
640
650
GIM YEON A
GI MYEO NA
BOYEOJYO
BOYEOJYO
BOYEOJEO
SEGMENT MODEL
ONEUL GI MYEO NA BO YEO JO
ONEUL GI MYEO NA BO YEO JO
660
DETERMINE APPEARANCE PROBABILITY INFORMATION REGARDING PREDETERMINED UNIT COMPONENTS IN EACH SENTENCE
670
UPDATE LANGUAGE MODEL
680

FIG. 7

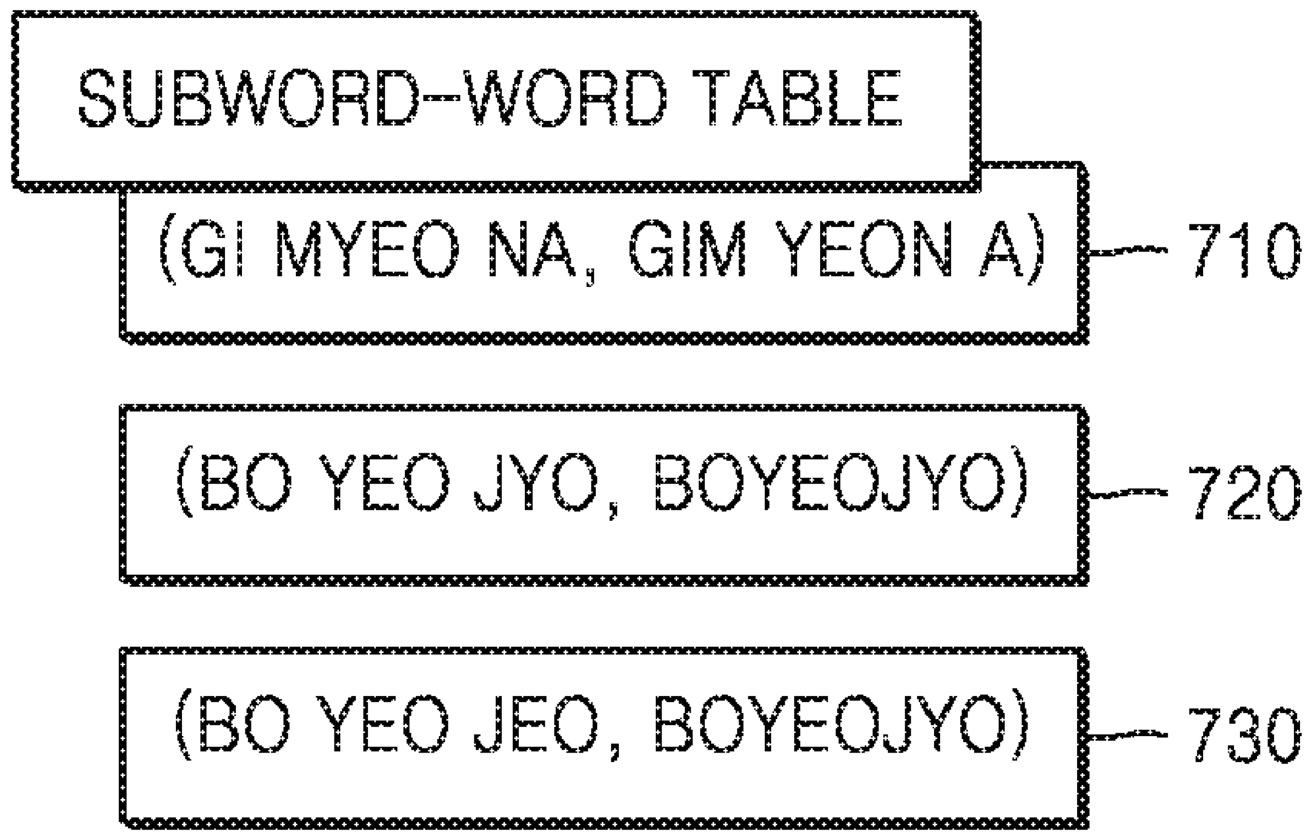


FIG. 8

WORD APPEARANCE PROBABILITY

810

ONE WORD	PROBABILITY
ONEUL	0.143
GI	0.143
JEO	0.071
–	

820

TWO WORDS	PROBABILITY
ONEUL GI	0.166
GI MYEO	0.166
YEO JYO	0.083
–	

FIG. 9

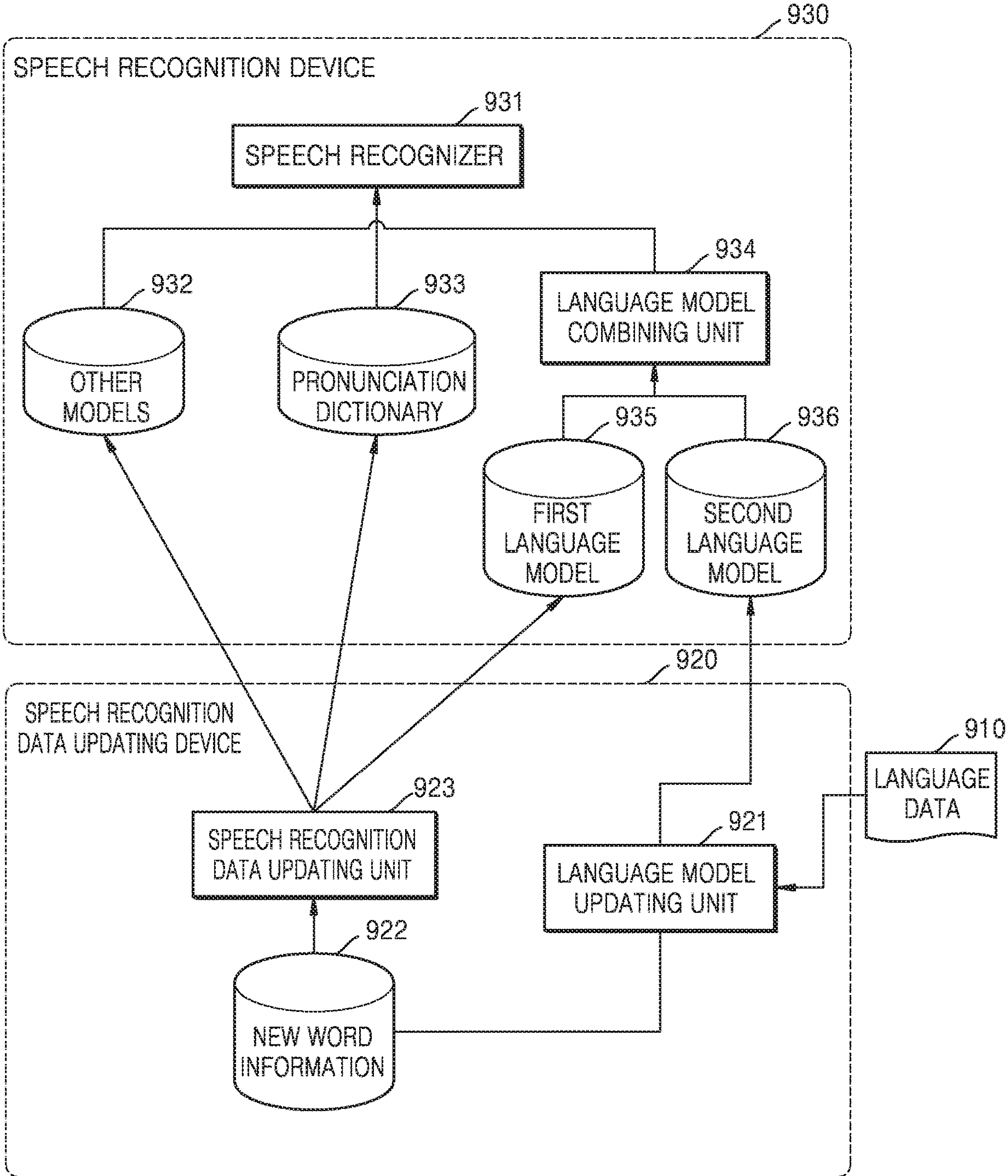

930
SPEECH RECOGNITION DEVICE
931
SPEECH RECOGNIZER
932
OTHER MODELS
933
PRONUNCIATION DICTIONARY
934
LANGUAGE MODEL COMBINING UNIT
935
FIRST LANGUAGE MODEL
936
SECOND LANGUAGE MODEL
920
SPEECH RECOGNITION DATA UPDATING DEVICE
923
SPEECH RECOGNITION DATA UPDATING UNIT
921
LANGUAGE MODEL UPDATING UNIT
910
LANGUAGE DATA
922
NEW WORD INFORMATION

FIG. 10

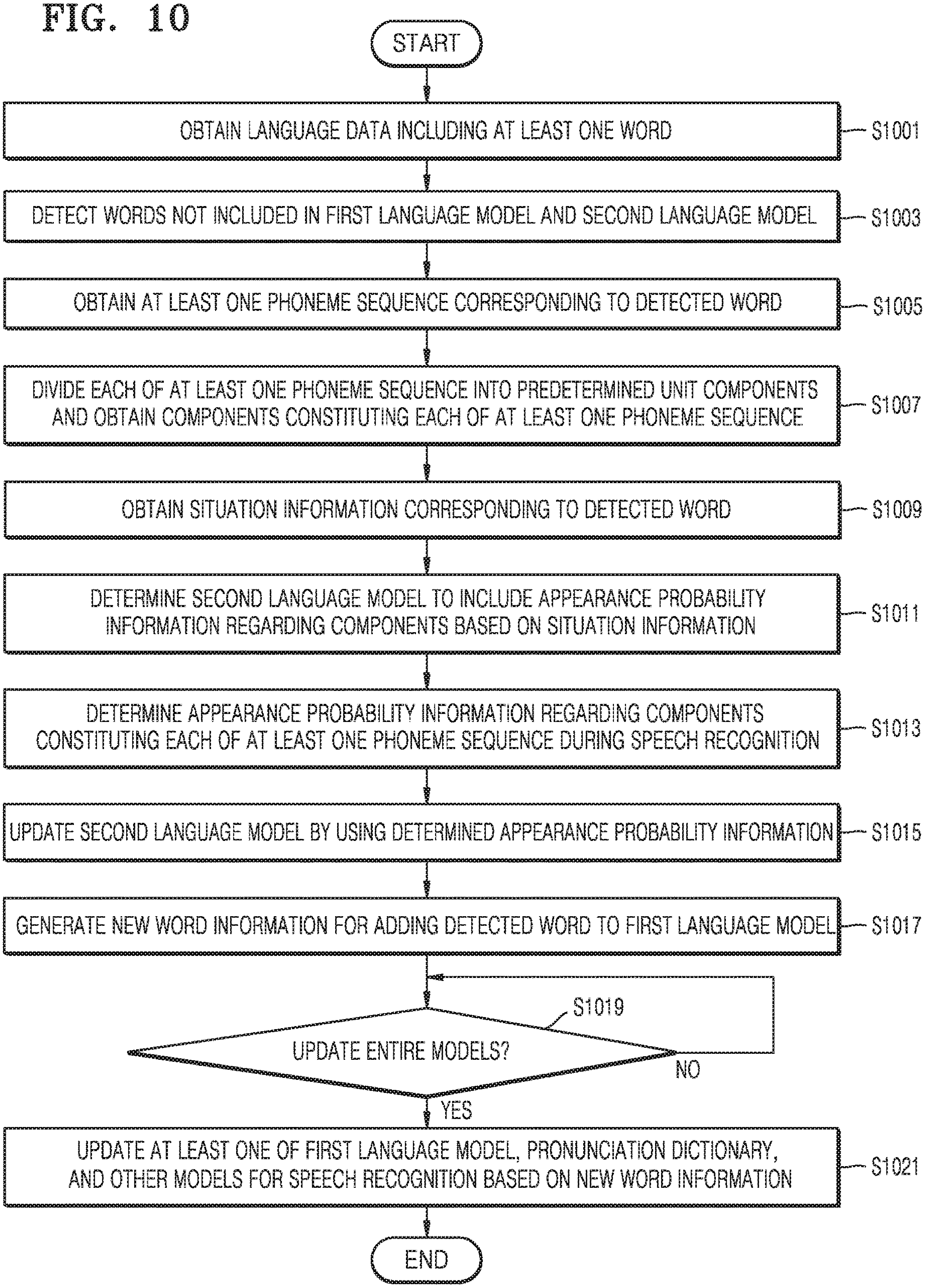

START
OBTAIN LANGUAGE DATA INCLUDING AT LEAST ONE WORD
S1001
DETECT WORDS NOT INCLUDED IN FIRST LANGUAGE MODEL AND SECOND LANGUAGE MODEL
S1003
OBTAIN AT LEAST ONE PHONEME SEQUENCE CORRESPONDING TO DETECTED WORD
S1005
DIVIDE EACH OF AT LEAST ONE PHONEME SEQUENCE INTO PREDETERMINED UNIT COMPONENTS AND OBTAIN COMPONENTS CONSTITUTING EACH OF AT LEAST ONE PHONEME SEQUENCE
S1007
OBTAIN SITUATION INFORMATION CORRESPONDING TO DETECTED WORD
S1009
DETERMINE SECOND LANGUAGE MODEL TO INCLUDE APPEARANCE PROBABILITY INFORMATION REGARDING COMPONENTS BASED ON SITUATION INFORMATION
S1011
DETERMINE APPEARANCE PROBABILITY INFORMATION REGARDING COMPONENTS CONSTITUTING EACH OF AT LEAST ONE PHONEME SEQUENCE DURING SPEECH RECOGNITION
S1013
UPDATE SECOND LANGUAGE MODEL BY USING DETERMINED APPEARANCE PROBABILITY INFORMATION
S1015
GENERATE NEW WORD INFORMATION FOR ADDING DETECTED WORD TO FIRST LANGUAGE MODEL
S1017
S1019
UPDATE ENTIRE MODELS?
NO
YES
UPDATE AT LEAST ONE OF FIRST LANGUAGE MODEL, PRONUNCIATION DICTIONARY, AND OTHER MODELS FOR SPEECH RECOGNITION BASED ON NEW WORD INFORMATION
S1021
END

FIG. 11

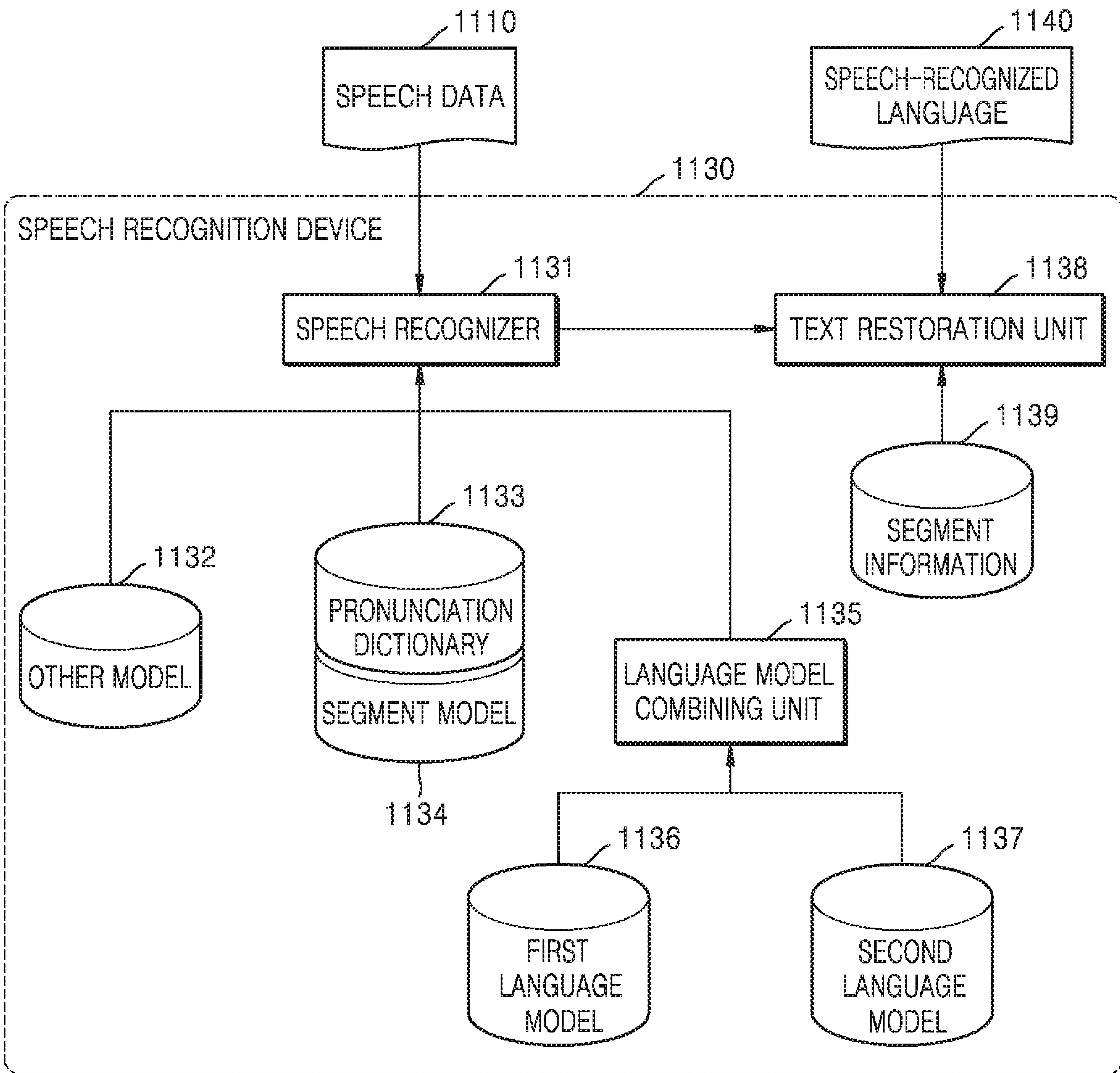

1110
SPEECH DATA
1140
SPEECH-RECOGNIZED LANGUAGE
1130
SPEECH RECOGNITION DEVICE
1131
SPEECH RECOGNIZER
1138
TEXT RESTORATION UNIT
1139
SEGMENT INFORMATION
1133
1132
PRONUNCIATION DICTIONARY
OTHER MODEL
SEGMENT MODEL
1134
1135
LANGUAGE MODEL COMBINING UNIT
1136
1137
FIRST LANGUAGE MODEL
SECOND LANGUAGE MODEL

FIG. 12

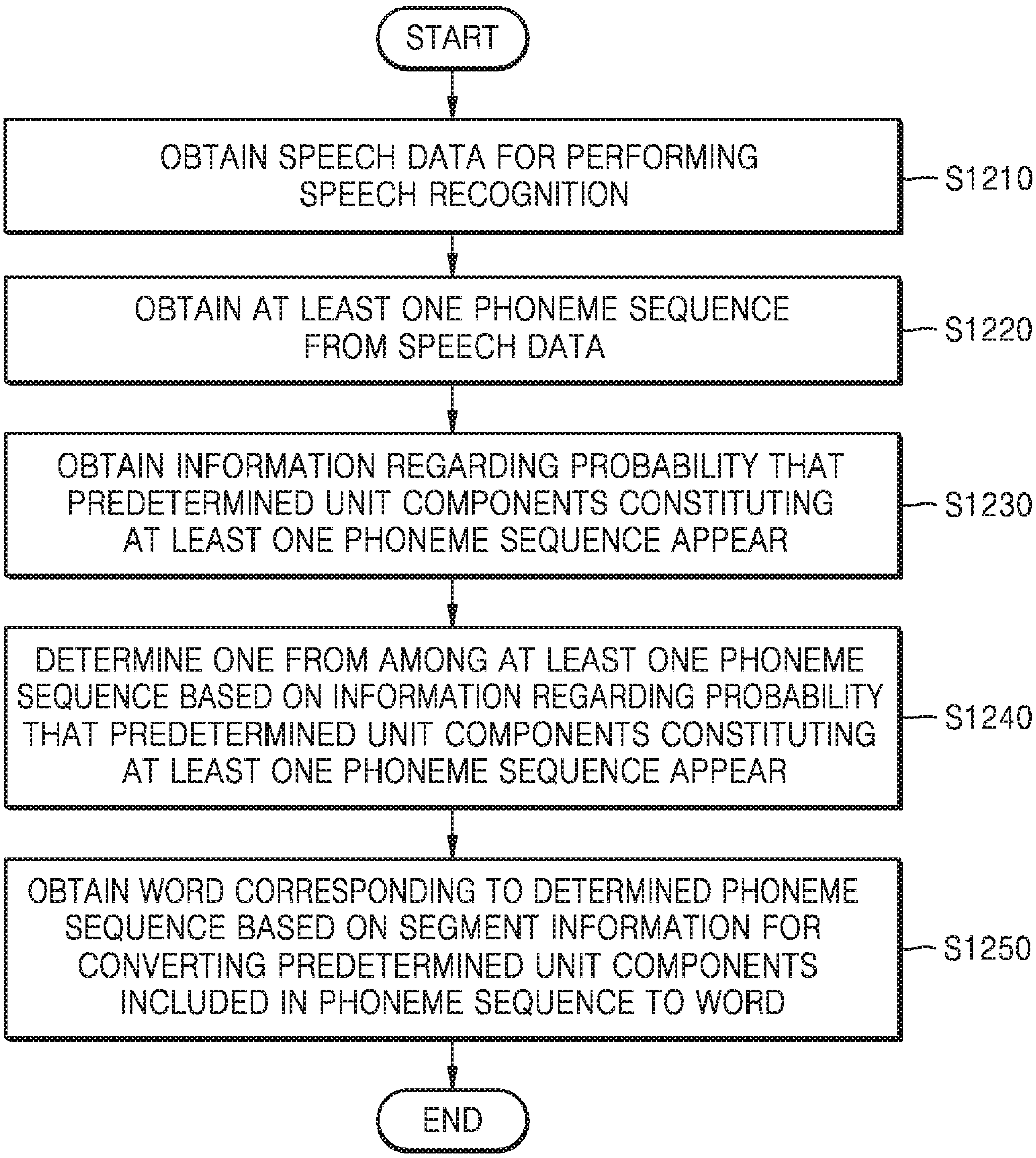

START
OBTAIN SPEECH DATA FOR PERFORMING SPEECH RECOGNITION
S1210
OBTAIN AT LEAST ONE PHONEME SEQUENCE FROM SPEECH DATA
S1220
OBTAIN INFORMATION REGARDING PROBABILITY THAT PREDETERMINED UNIT COMPONENTS CONSTITUTING AT LEAST ONE PHONEME SEQUENCE APPEAR
S1230
DETERMINE ONE FROM AMONG AT LEAST ONE PHONEME SEQUENCE BASED ON INFORMATION REGARDING PROBABILITY THAT PREDETERMINED UNIT COMPONENTS CONSTITUTING AT LEAST ONE PHONEME SEQUENCE APPEAR
S1240
OBTAIN WORD CORRESPONDING TO DETERMINED PHONEME SEQUENCE BASED ON SEGMENT INFORMATION FOR CONVERTING PREDETERMINED UNIT COMPONENTS INCLUDED IN PHONEME SEQUENCE TO WORD
S1250
END

FIG. 13

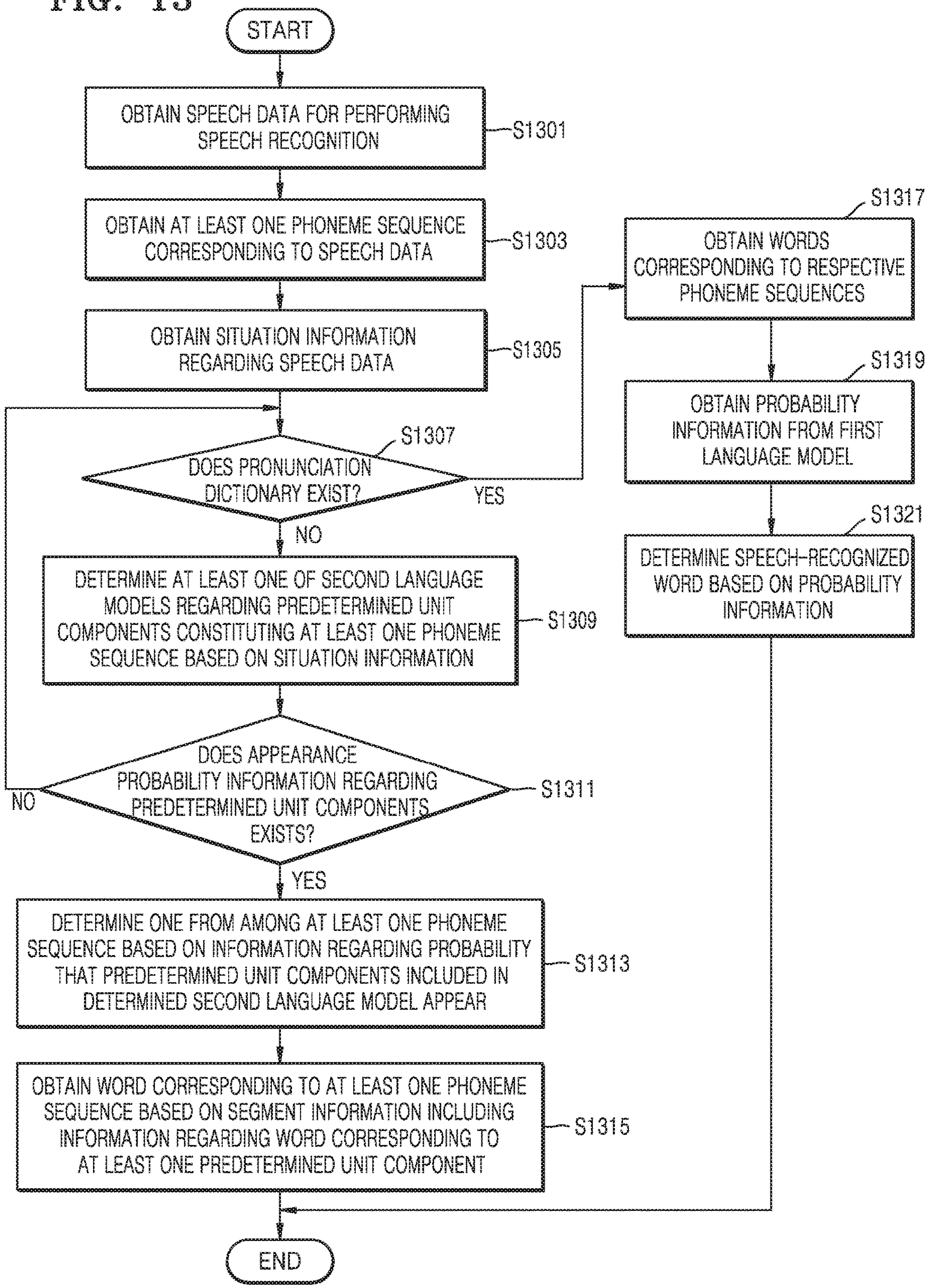

START
OBTAIN SPEECH DATA FOR PERFORMING SPEECH RECOGNITION
S1301
OBTAIN AT LEAST ONE PHONEME SEQUENCE CORRESPONDING TO SPEECH DATA
S1303
OBTAIN SITUATION INFORMATION REGARDING SPEECH DATA
S1305
DOES PRONUNCIATION DICTIONARY EXIST?
S1307
YES
NO
DETERMINE AT LEAST ONE OF SECOND LANGUAGE MODELS REGARDING PREDETERMINED UNIT COMPONENTS CONSTITUTING AT LEAST ONE PHONEME SEQUENCE BASED ON SITUATION INFORMATION
S1309
DOES APPEARANCE PROBABILITY INFORMATION REGARDING PREDETERMINED UNIT COMPONENTS EXISTS?
S1311
NO
YES
DETERMINE ONE FROM AMONG AT LEAST ONE PHONEME SEQUENCE BASED ON INFORMATION REGARDING PROBABILITY THAT PREDETERMINED UNIT COMPONENTS INCLUDED IN DETERMINED SECOND LANGUAGE MODEL APPEAR
S1313
OBTAIN WORD CORRESPONDING TO AT LEAST ONE PHONEME SEQUENCE BASED ON SEGMENT INFORMATION INCLUDING INFORMATION REGARDING WORD CORRESPONDING TO AT LEAST ONE PREDETERMINED UNIT COMPONENT
S1315
S1317
OBTAIN WORDS CORRESPONDING TO RESPECTIVE PHONEME SEQUENCES
S1319
OBTAIN PROBABILITY INFORMATION FROM FIRST LANGUAGE MODEL
S1321
DETERMINE SPEECH-RECOGNIZED WORD BASED ON PROBABILITY INFORMATION
END

FIG. 14

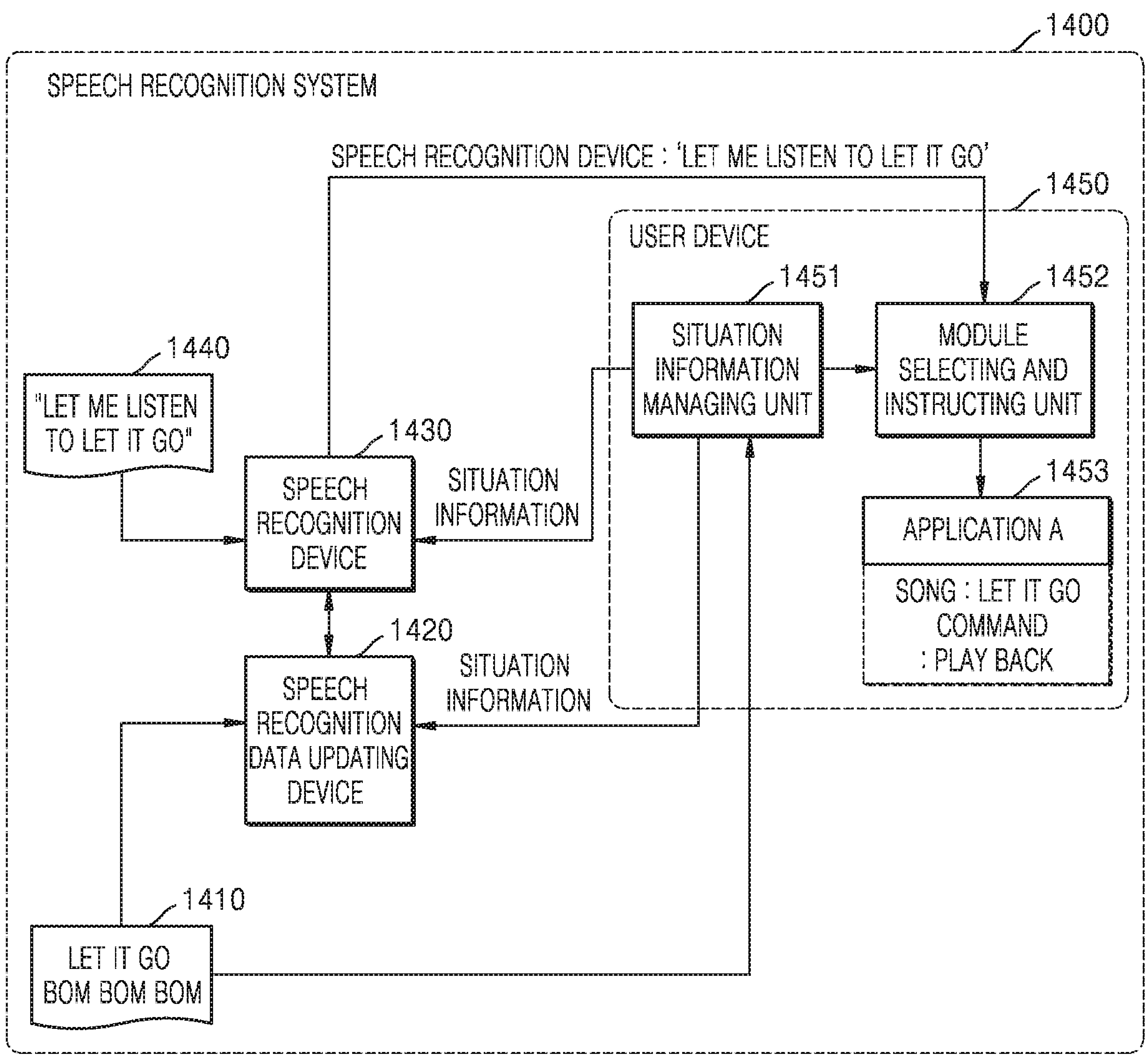

1400
SPEECH RECOGNITION SYSTEM
SPEECH RECOGNITION DEVICE : 'LET ME LISTEN TO LET IT GO'
1450
USER DEVICE
1451
SITUATION INFORMATION MANAGING UNIT
1452
MODULE SELECTING AND INSTRUCTING UNIT
1440
"LET ME LISTEN TO LET IT GO"
1430
SPEECH RECOGNITION DEVICE
SITUATION INFORMATION
1453
APPLICATION A
SONG : LET IT GO
COMMAND
: PLAY BACK
1420
SPEECH RECOGNITION DATA UPDATING DEVICE
SITUATION INFORMATION
1410
LET IT GO
BOM BOM BOM

FIG. 15

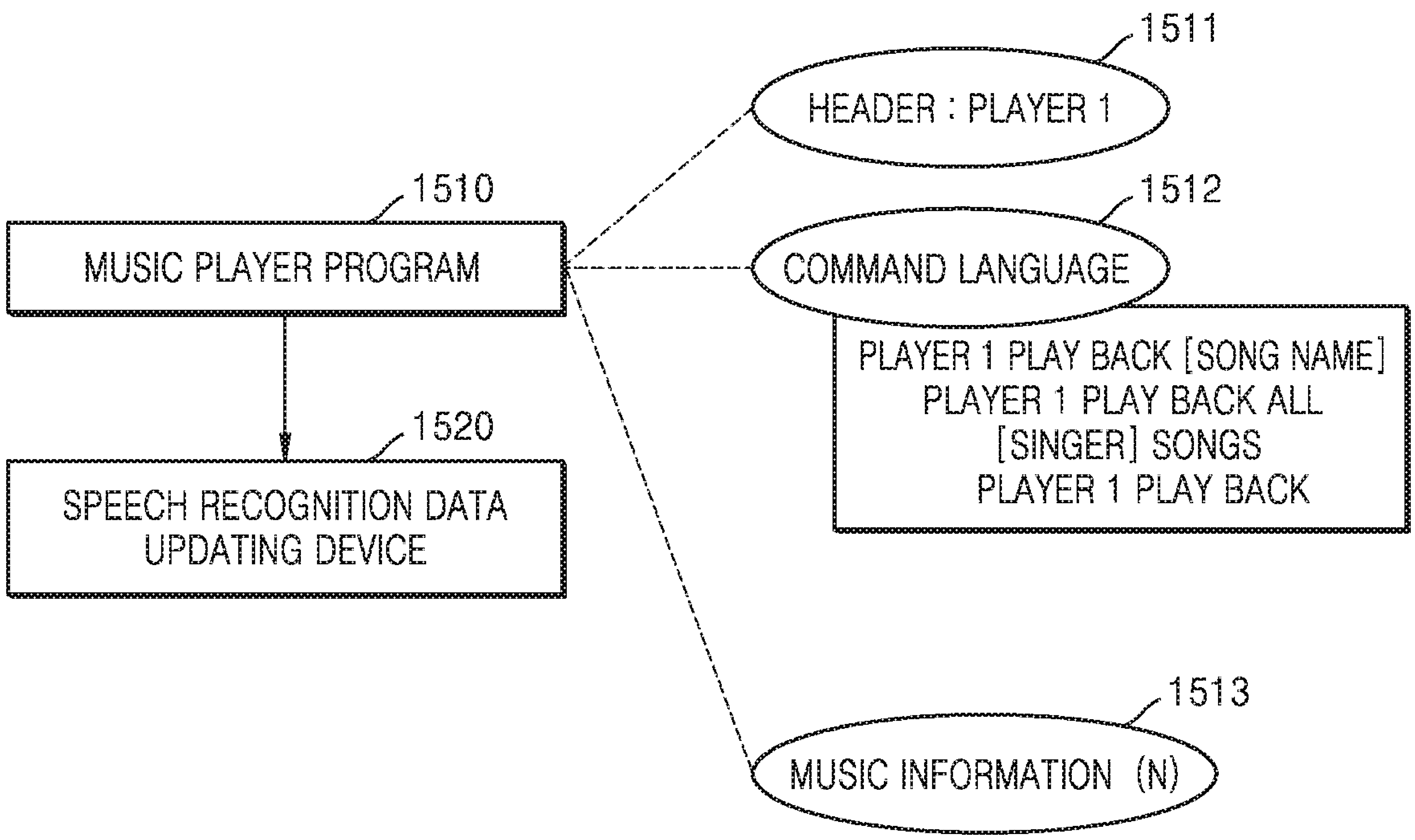

1510
MUSIC PLAYER PROGRAM
1520
SPEECH RECOGNITION DATA UPDATING DEVICE
1511
HEADER : PLAYER 1
1512
COMMAND LANGUAGE
PLAYER 1 PLAY BACK [SONG NAME]
PLAYER 1 PLAY BACK ALL [SINGER] SONGS
PLAYER 1 PLAY BACK
1513
MUSIC INFORMATION (N)

FIG. 16

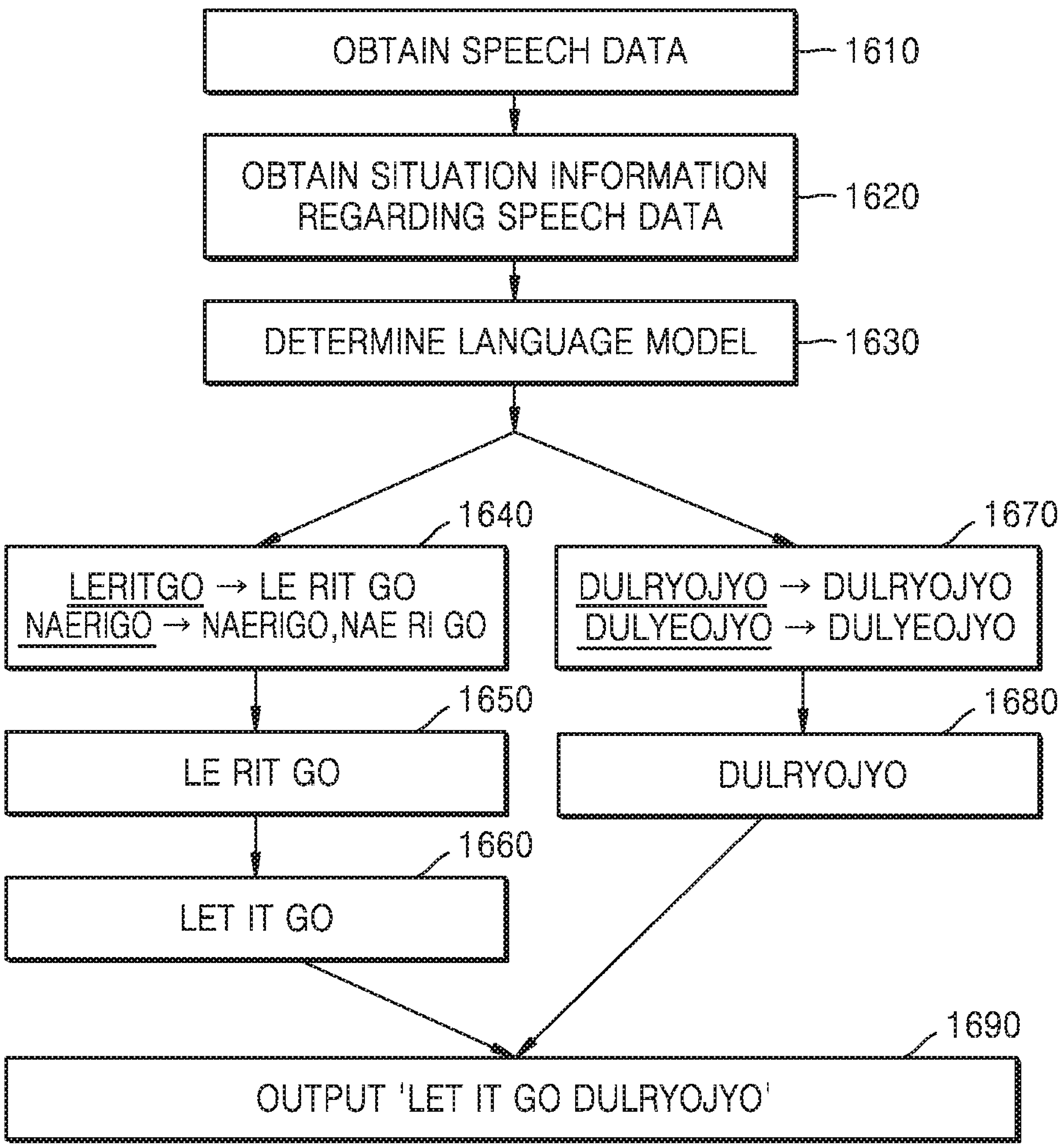

OBTAIN SPEECH DATA
1610
OBTAIN SITUATION INFORMATION REGARDING SPEECH DATA
1620
DETERMINE LANGUAGE MODEL
1630
1640
LERITGO → LE RIT GO
NAERIGO → NAERIGO,NAE RI GO
1670
DULRYOJYO → DULRYOJYO
DULYEOJYO → DULYEOJYO
1650
LE RIT GO
1680
DULRYOJYO
1660
LET IT GO
1690
OUTPUT 'LET IT GO DULRYOJYO'

FIG. 17

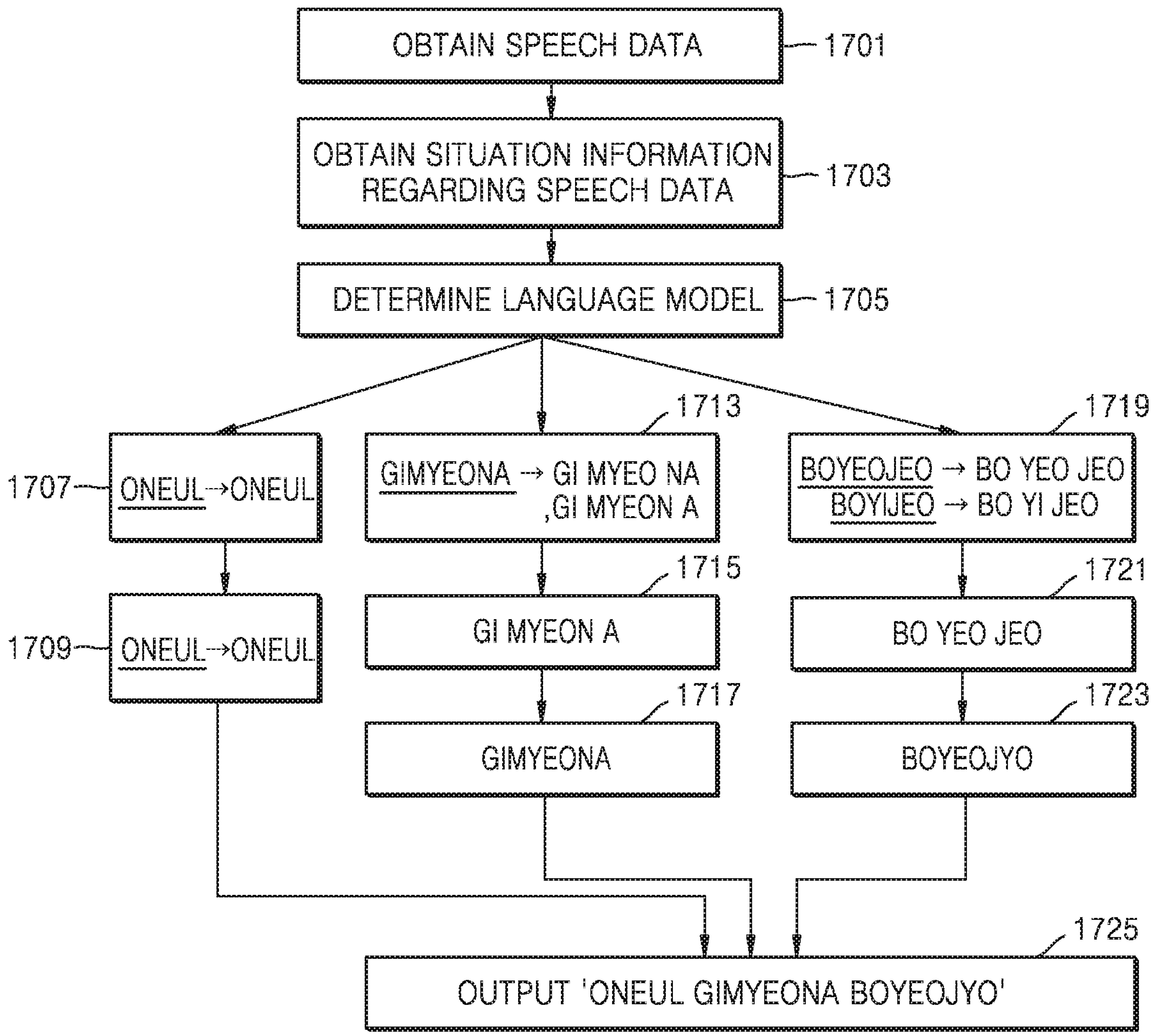

OBTAIN SPEECH DATA
1701
OBTAIN SITUATION INFORMATION REGARDING SPEECH DATA
1703
DETERMINE LANGUAGE MODEL
1705
1707
ONEUL→ONEUL
1713
GIMYEONA → GI MYEO NA ,GI MYEON A
1719
BOYEOJEO → BO YEO JEO
BOYIJEO → BO YI JEO
1709
ONEUL→ONEUL
1715
GI MYEON A
1721
BO YEO JEO
1717
GIMYEONA
1723
BOYEOJYO
1725
OUTPUT 'ONEUL GIMYEONA BOYEOJYO'

FIG. 18

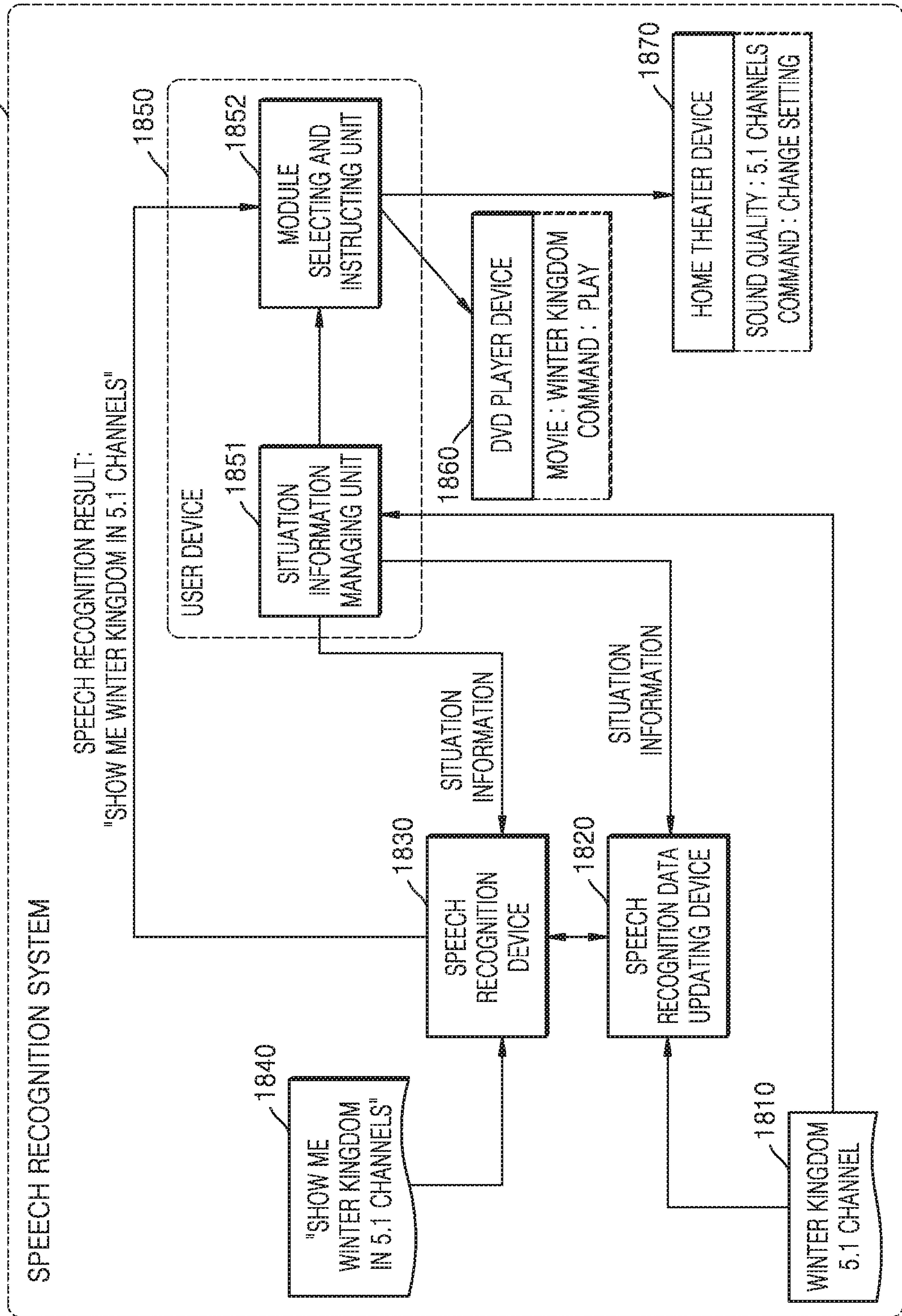

1800
SPEECH RECOGNITION SYSTEM
1840
"SHOW ME WINTER KINGDOM IN 5.1 CHANNELS"
1830
SPEECH RECOGNITION DEVICE
1820
SPEECH RECOGNITION DATA UPDATING DEVICE
1810
WINTER KINGDOM 5.1 CHANNEL
SPEECH RECOGNITION RESULT: "SHOW ME WINTER KINGDOM IN 5.1 CHANNELS"
SITUATION INFORMATION
SITUATION INFORMATION
1850
USER DEVICE
1851
SITUATION INFORMATION MANAGING UNIT
1852
MODULE SELECTING AND INSTRUCTING UNIT
1860
DVD PLAYER DEVICE
MOVIE : WINTER KINGDOM
COMMAND : PLAY
1870
HOME THEATER DEVICE
SOUND QUALITY : 5.1 CHANNELS
COMMAND : CHANGE SETTING

FIG. 19

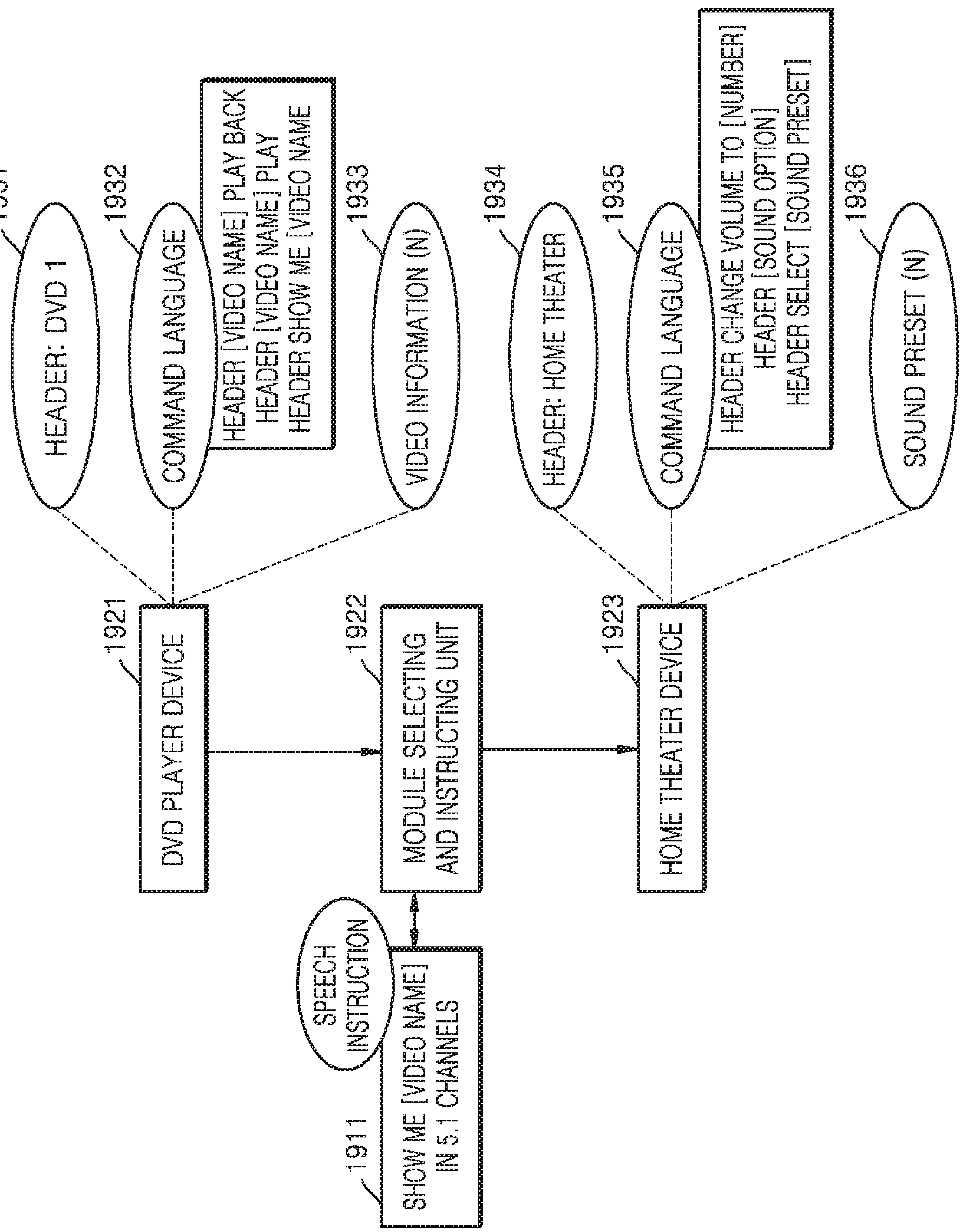

1931
HEADER: DVD 1
1932
COMMAND LANGUAGE
HEADER [VIDEO NAME] PLAY BACK
HEADER [VIDEO NAME] PLAY
HEADER SHOW ME [VIDEO NAME
1933
VIDEO INFORMATION (N)
1934
HEADER: HOME THEATER
1935
COMMAND LANGUAGE
HEADER CHANGE VOLUME TO [NUMBER]
HEADER [SOUND OPTION]
HEADER SELECT [SOUND PRESET]
1936
SOUND PRESET (N)
1921
DVD PLAYER DEVICE
1922
MODULE SELECTING AND INSTRUCTING UNIT
1923
HOME THEATER DEVICE
SPEECH INSTRUCTION
1911
SHOW ME [VIDEO NAME] IN 5.1 CHANNELS

FIG. 20

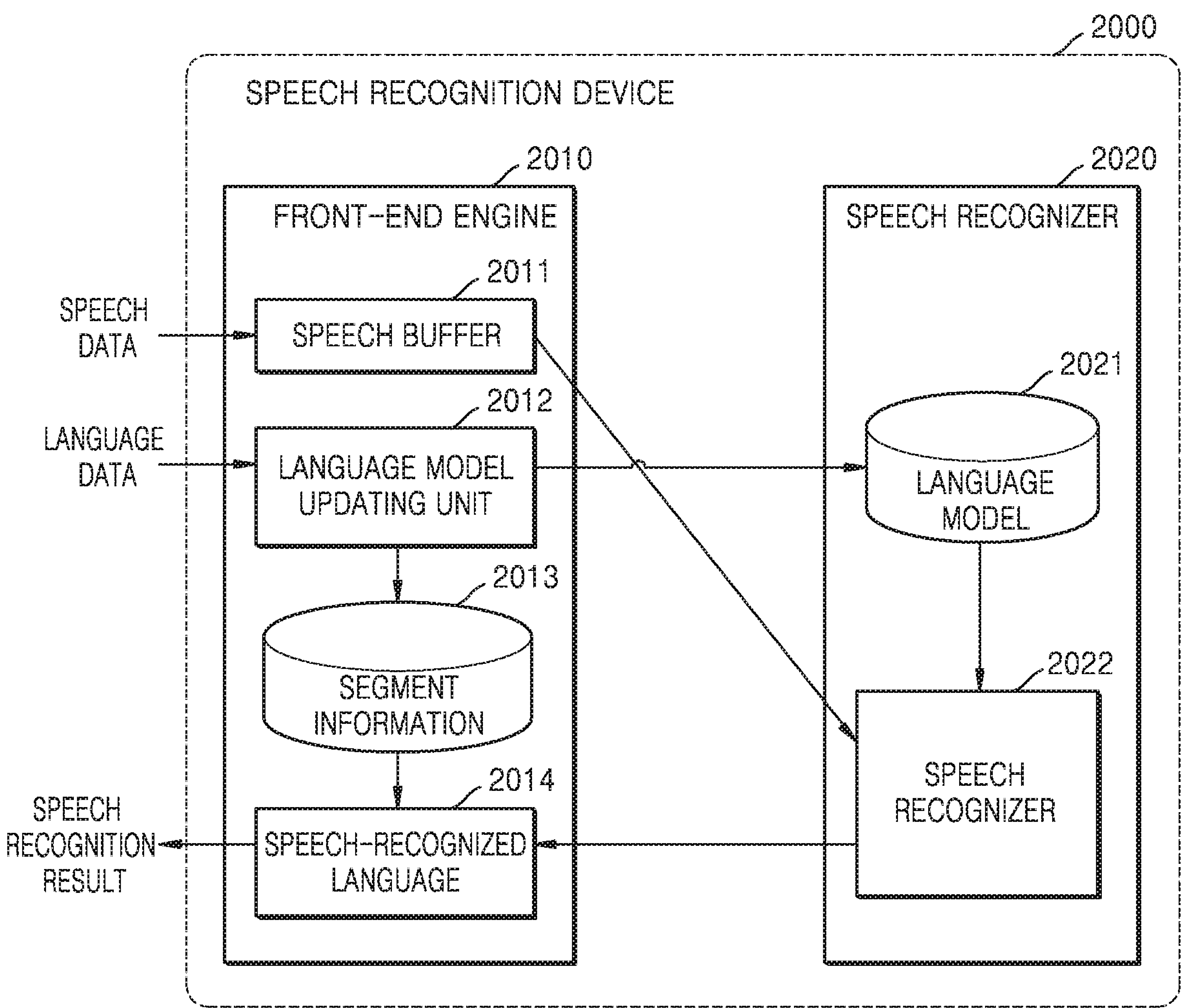

2000
SPEECH RECOGNITION DEVICE
2010
FRONT-END ENGINE
2020
SPEECH RECOGNIZER
2011
SPEECH DATA
SPEECH BUFFER
2021
2012
LANGUAGE DATA
LANGUAGE MODEL UPDATING UNIT
LANGUAGE MODEL
2013
SEGMENT INFORMATION
2022
2014
SPEECH RECOGNIZER
SPEECH RECOGNITION RESULT
SPEECH-RECOGNIZED LANGUAGE

FIG. 21

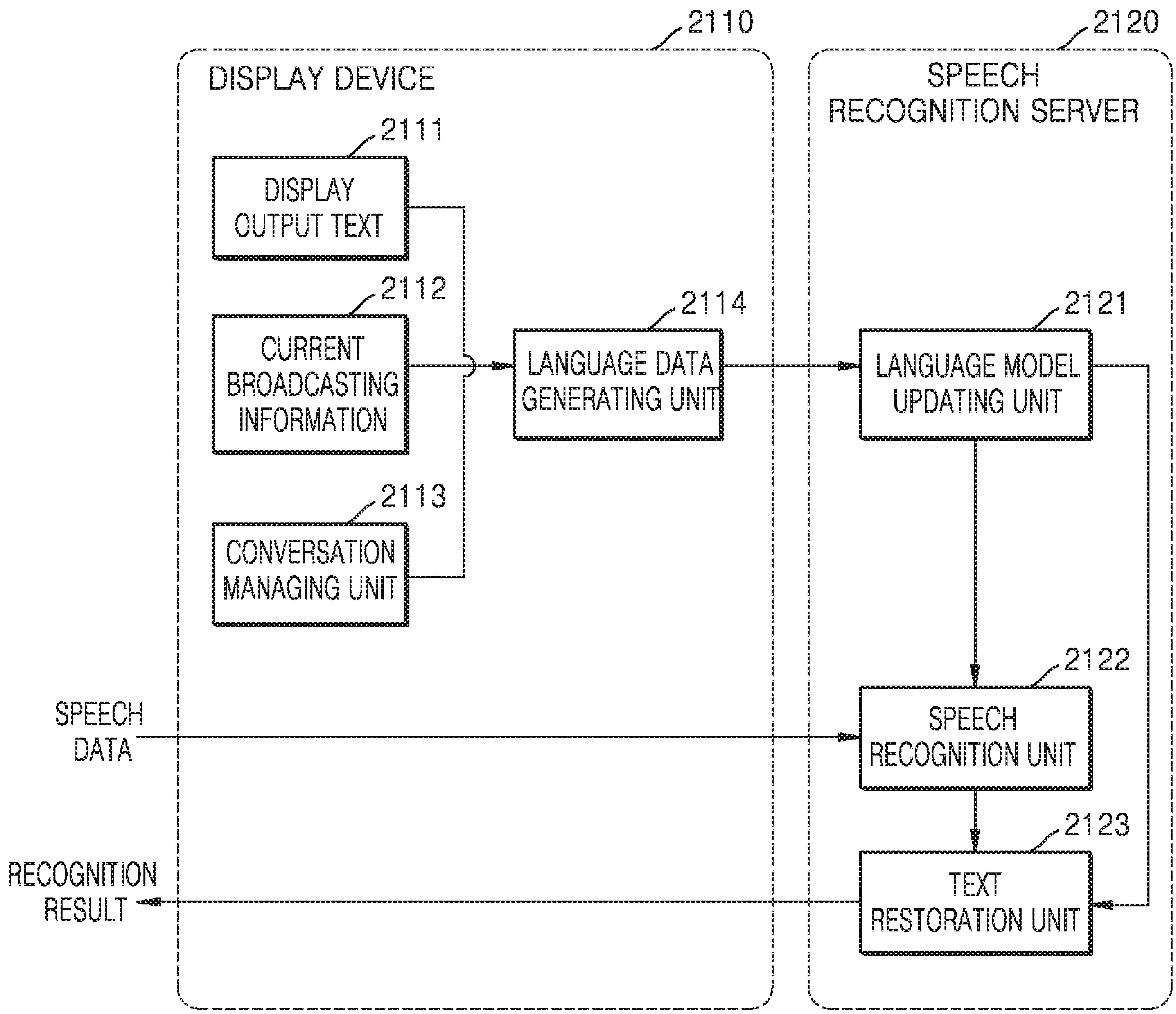

2110
DISPLAY DEVICE
2111
DISPLAY OUTPUT TEXT
2112
CURRENT BROADCASTING INFORMATION
2113
CONVERSATION MANAGING UNIT
2114
LANGUAGE DATA GENERATING UNIT
2120
SPEECH RECOGNITION SERVER
2121
LANGUAGE MODEL UPDATING UNIT
2122
SPEECH RECOGNITION UNIT
2123
TEXT RESTORATION UNIT
SPEECH DATA
RECOGNITION RESULT

FIG. 22

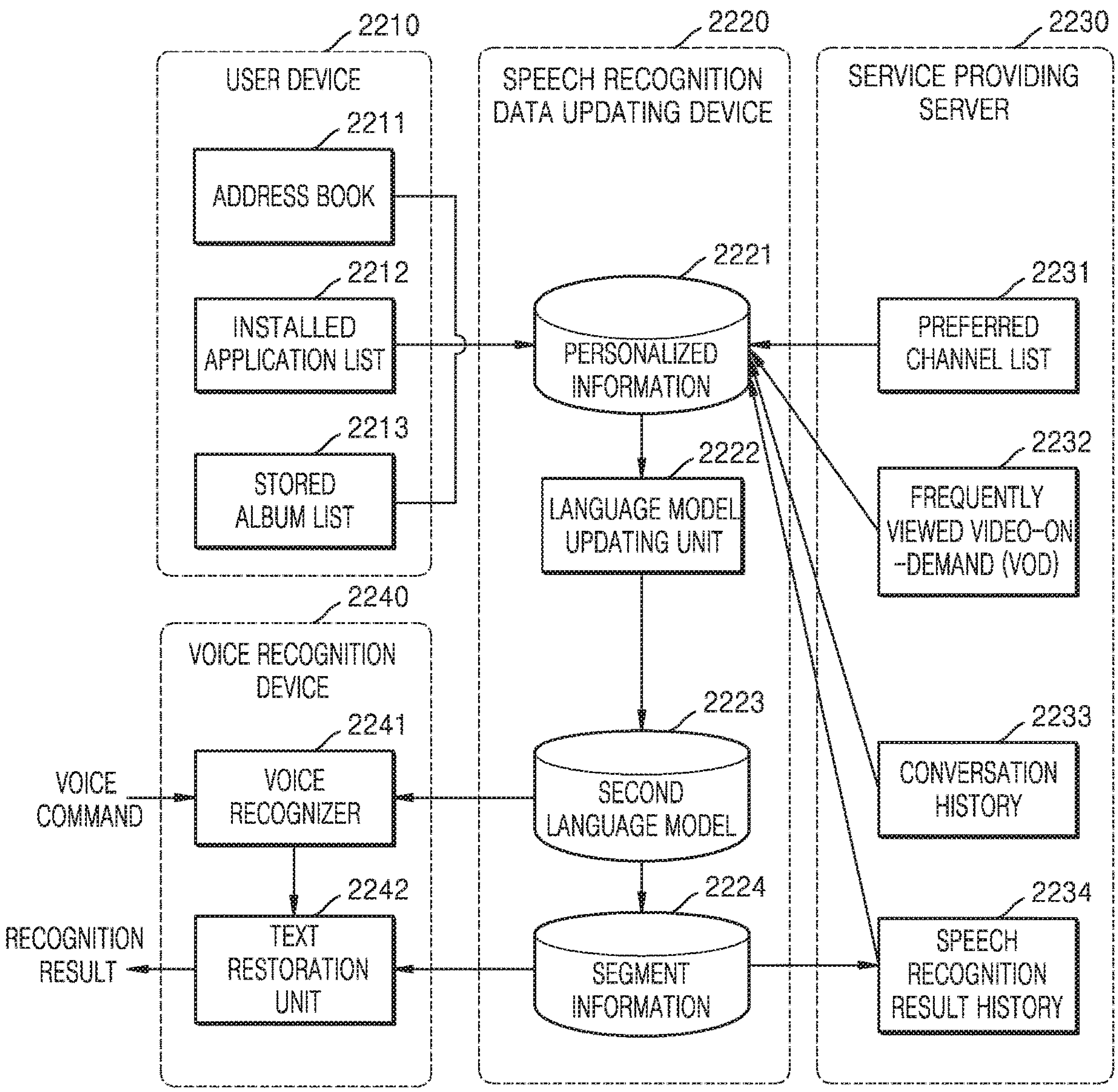

2210
USER DEVICE
2211
ADDRESS BOOK
2212
INSTALLED APPLICATION LIST
2213
STORED ALBUM LIST
2220
SPEECH RECOGNITION DATA UPDATING DEVICE
2221
PERSONALIZED INFORMATION
2222
LANGUAGE MODEL UPDATING UNIT
2223
SECOND LANGUAGE MODEL
2224
SEGMENT INFORMATION
2230
SERVICE PROVIDING SERVER
2231
PREFERRED CHANNEL LIST
2232
FREQUENTLY VIEWED VIDEO-ON -DEMAND (VOD)
2233
CONVERSATION HISTORY
2234
SPEECH RECOGNITION RESULT HISTORY
2240
VOICE RECOGNITION DEVICE
2241
VOICE RECOGNIZER
2242
TEXT RESTORATION UNIT
VOICE COMMAND
RECOGNITION RESULT

FIG. 23

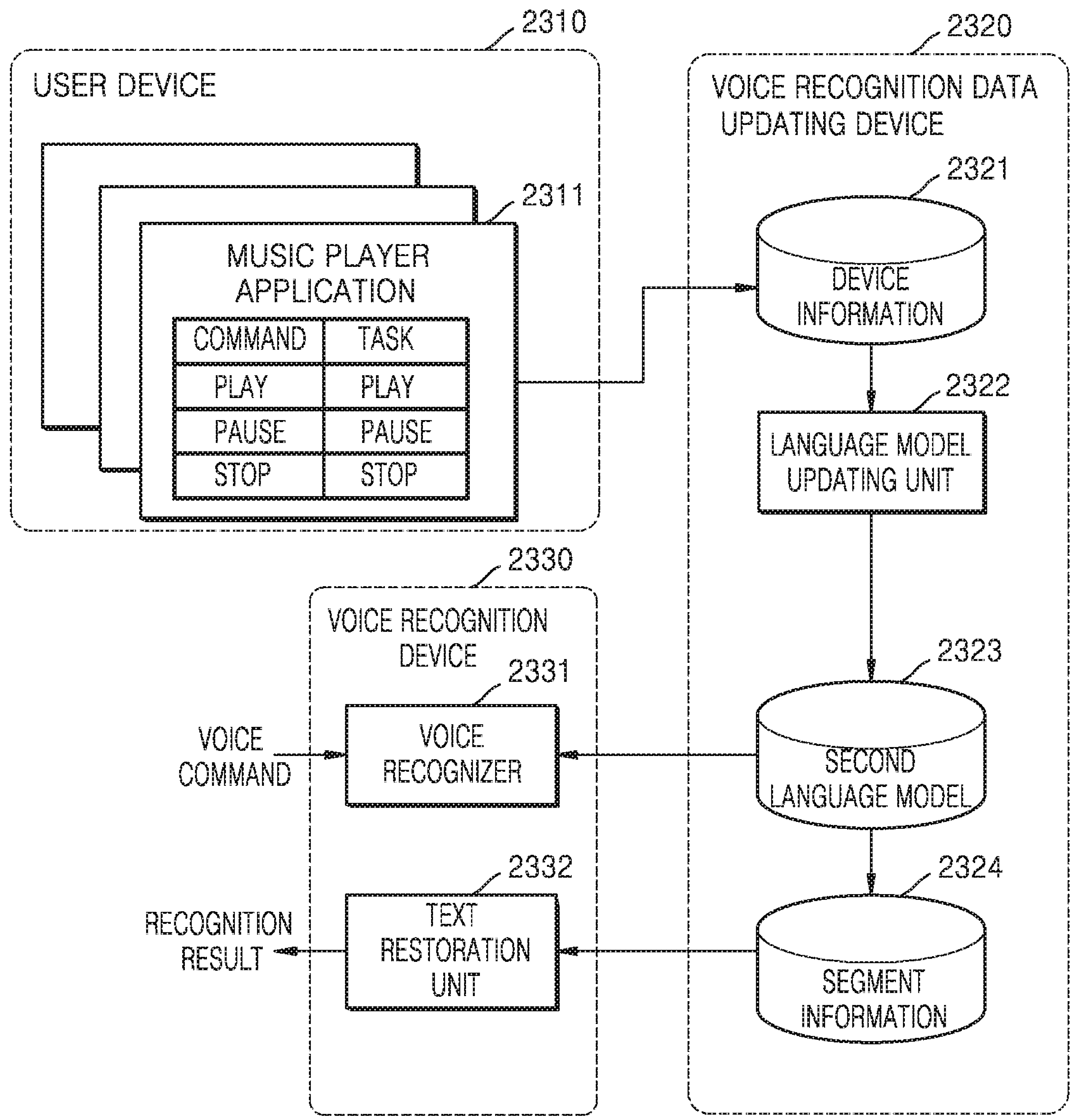

2310
USER DEVICE
2311
MUSIC PLAYER APPLICATION
COMMAND
TASK
PLAY
PLAY
PAUSE
PAUSE
STOP
STOP
2320
VOICE RECOGNITION DATA UPDATING DEVICE
2321
DEVICE INFORMATION
2322
LANGUAGE MODEL UPDATING UNIT
2323
SECOND LANGUAGE MODEL
2324
SEGMENT INFORMATION
2330
VOICE RECOGNITION DEVICE
2331
VOICE RECOGNIZER
2332
TEXT RESTORATION UNIT
VOICE COMMAND
RECOGNITION RESULT

FIG. 24

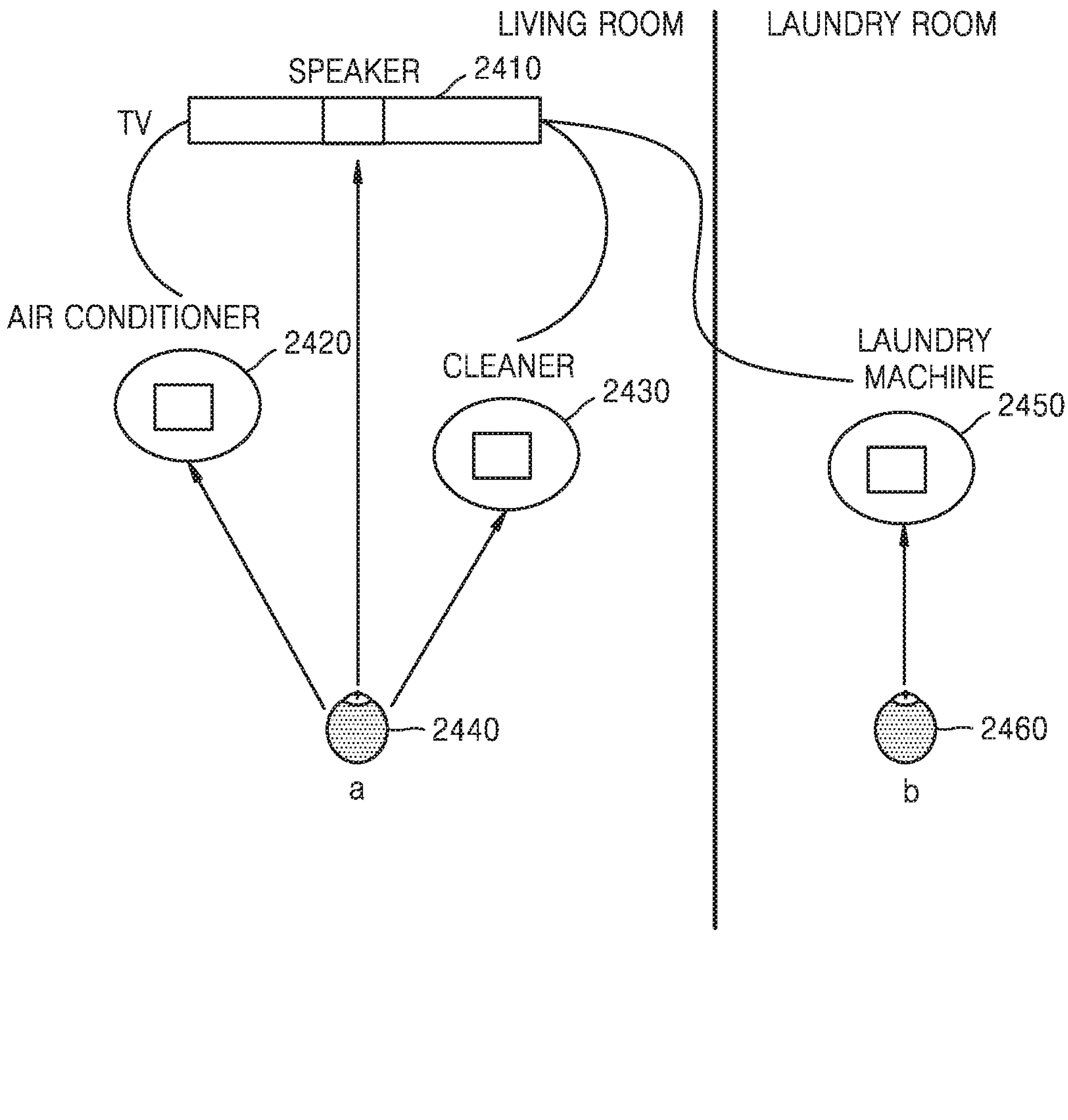

LIVING ROOM
LAUNDRY ROOM
SPEAKER
2410
TV
AIR CONDITIONER
2420
CLEANER
2430
LAUNDRY MACHINE
2450
2440
a
2460
b

FIG. 25

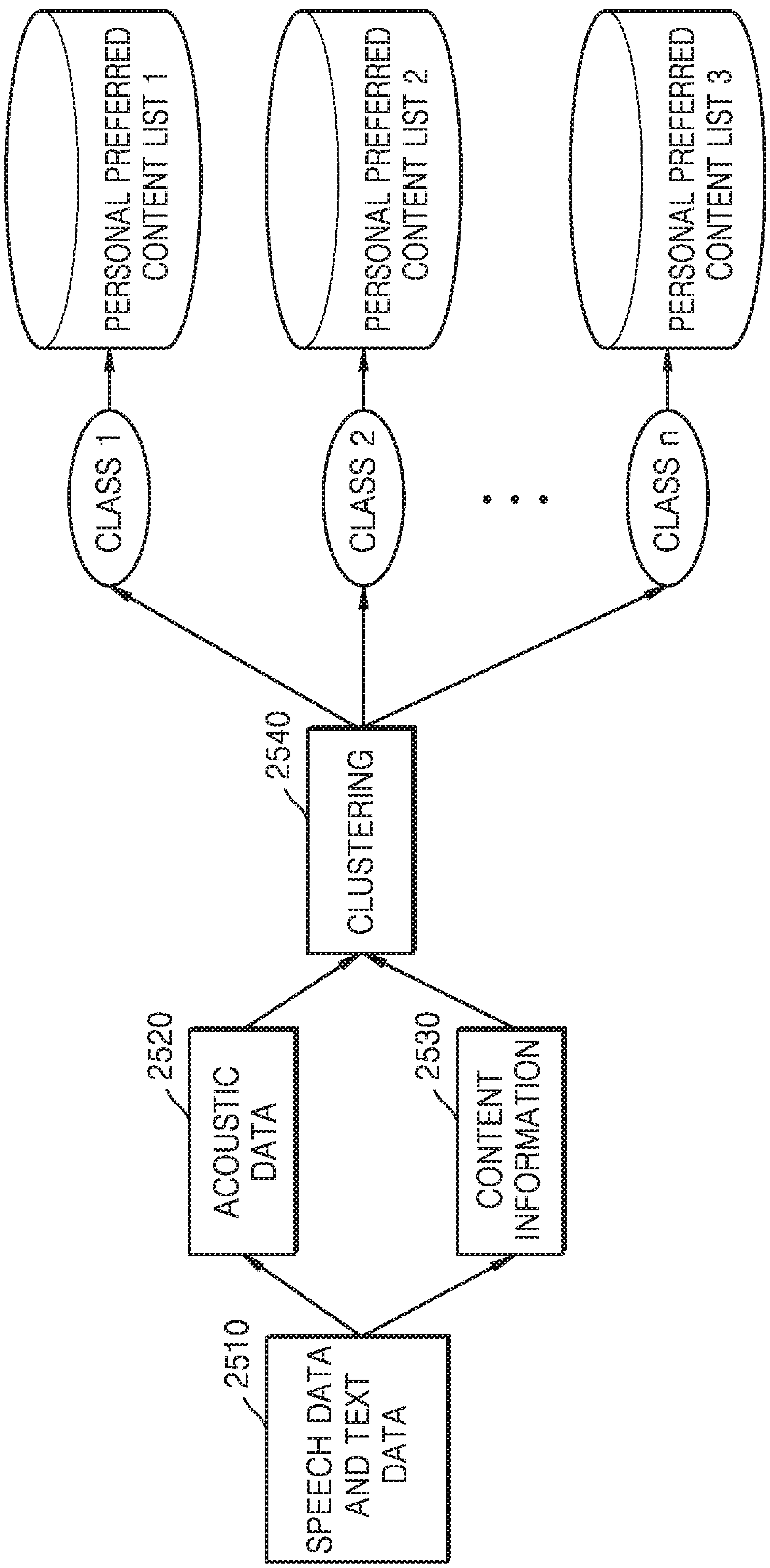

SPEECH DATA AND TEXT DATA
2510
ACOUSTIC DATA
2520
CONTENT INFORMATION
2530
CLUSTERING
2540
CLASS 1
CLASS 2
CLASS n
PERSONAL PREFERRED CONTENT LIST 1
PERSONAL PREFERRED CONTENT LIST 2
PERSONAL PREFERRED CONTENT LIST 3

FIG. 26

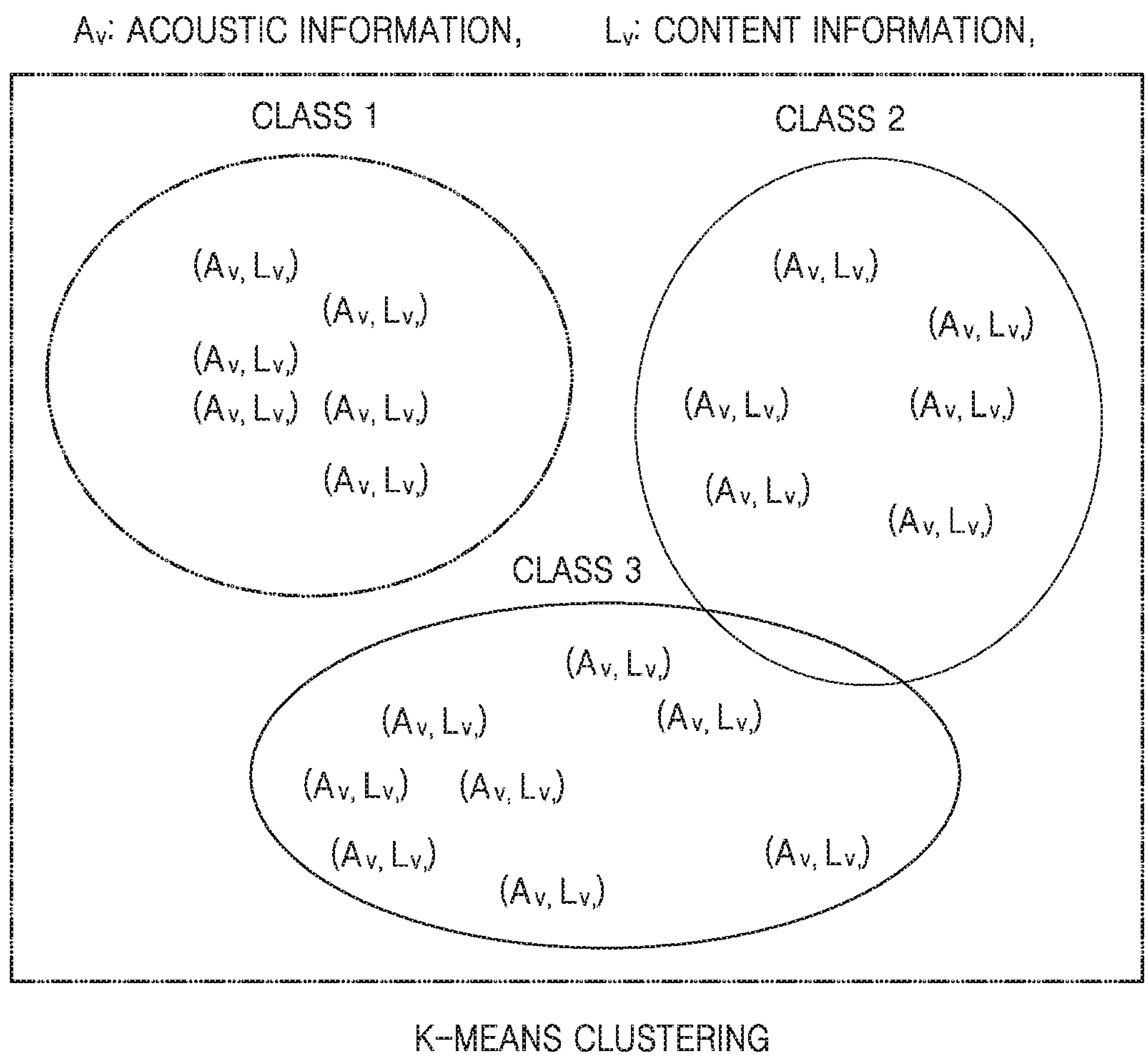

Av: ACOUSTIC INFORMATION, Lv: CONTENT INFORMATION,
CLASS 1
CLASS 2
CLASS 3
(Av, Lv,)
K-MEANS CLUSTERING

FIG. 27

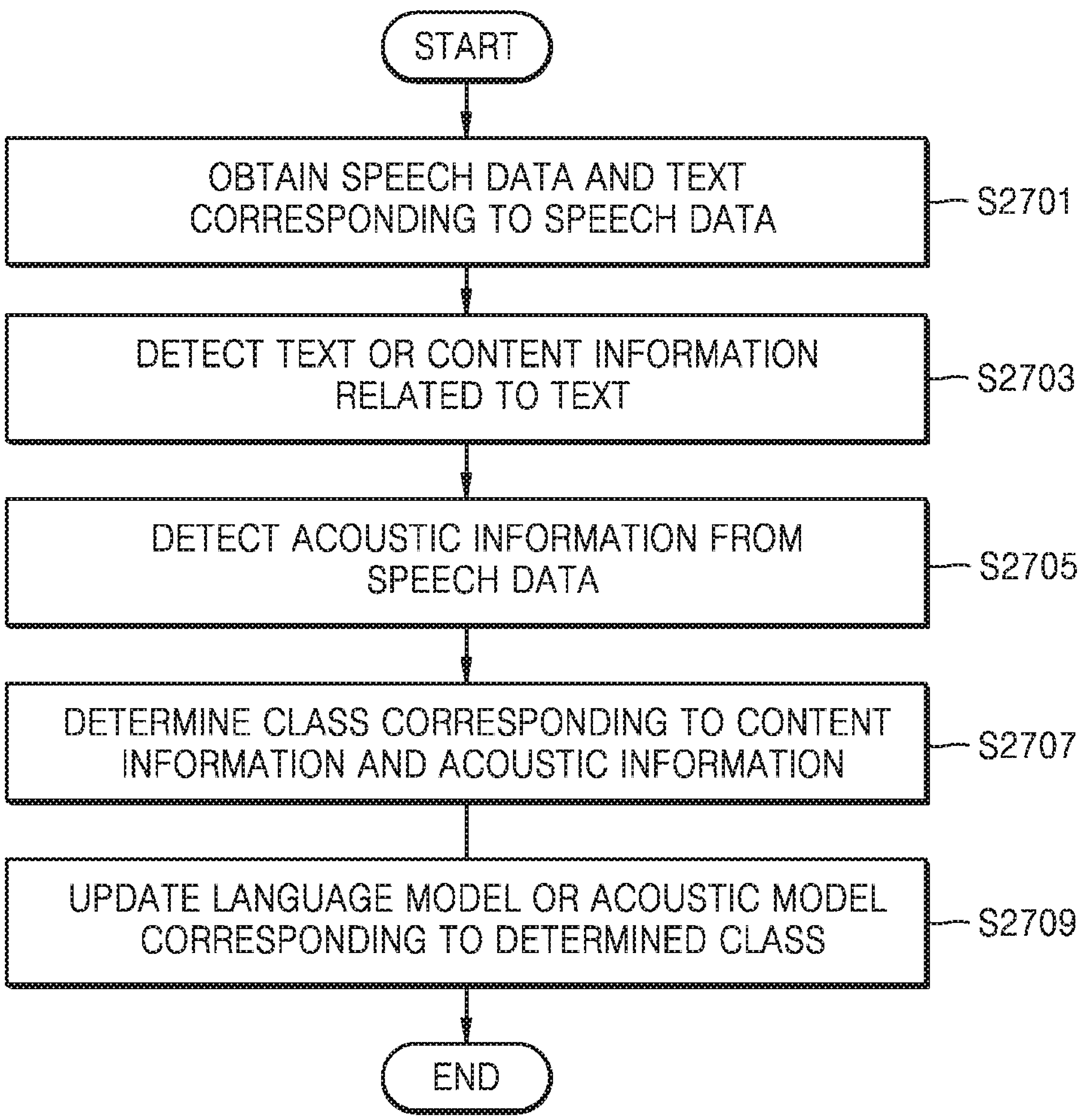

START
OBTAIN SPEECH DATA AND TEXT CORRESPONDING TO SPEECH DATA
S2701
DETECT TEXT OR CONTENT INFORMATION RELATED TO TEXT
S2703
DETECT ACOUSTIC INFORMATION FROM SPEECH DATA
S2705
DETERMINE CLASS CORRESPONDING TO CONTENT INFORMATION AND ACOUSTIC INFORMATION
S2707
UPDATE LANGUAGE MODEL OR ACOUSTIC MODEL CORRESPONDING TO DETERMINED CLASS
S2709
END

FIG. 28

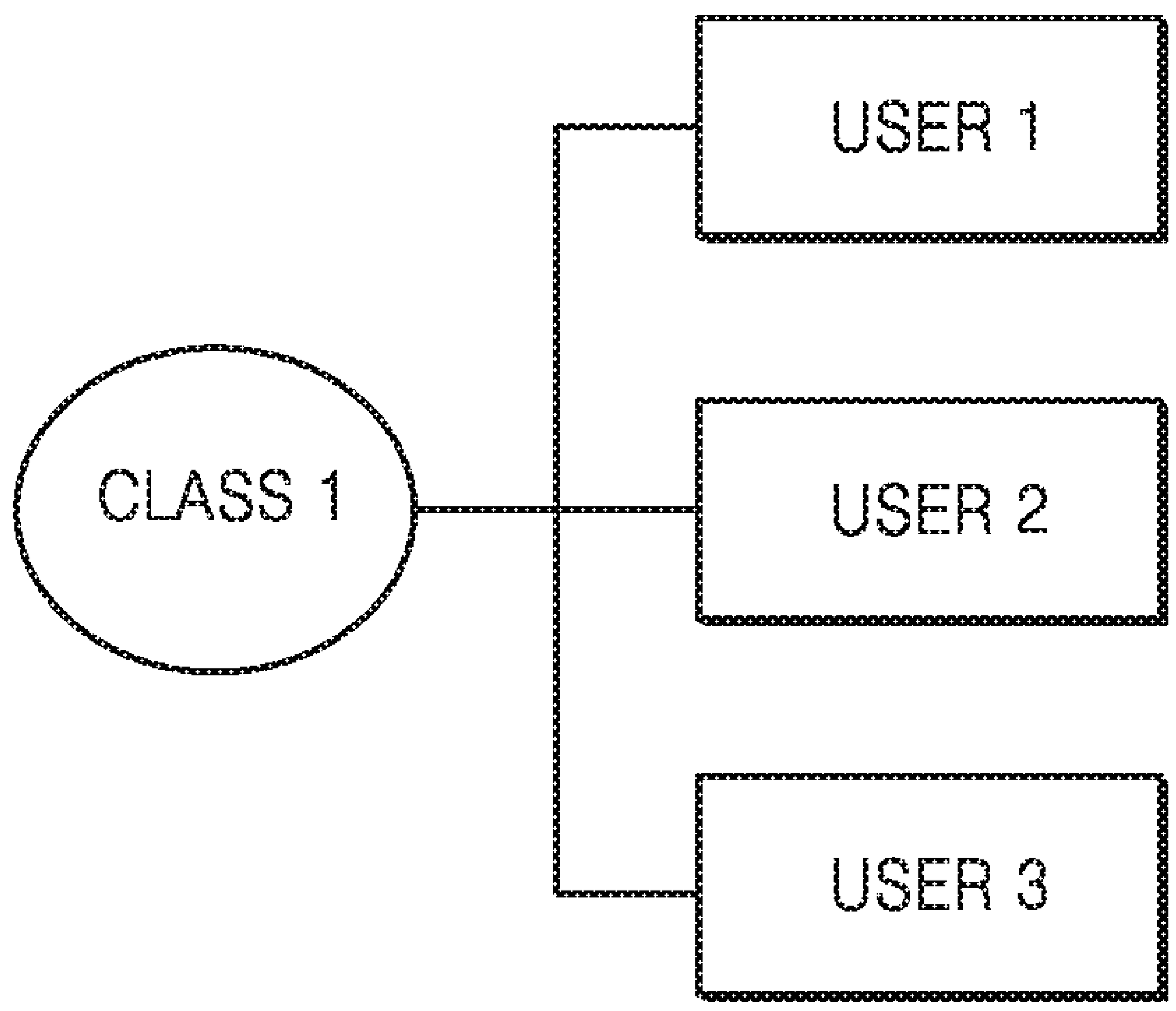

USER 1
CLASS 1
USER 2
USER 3

FIG. 29

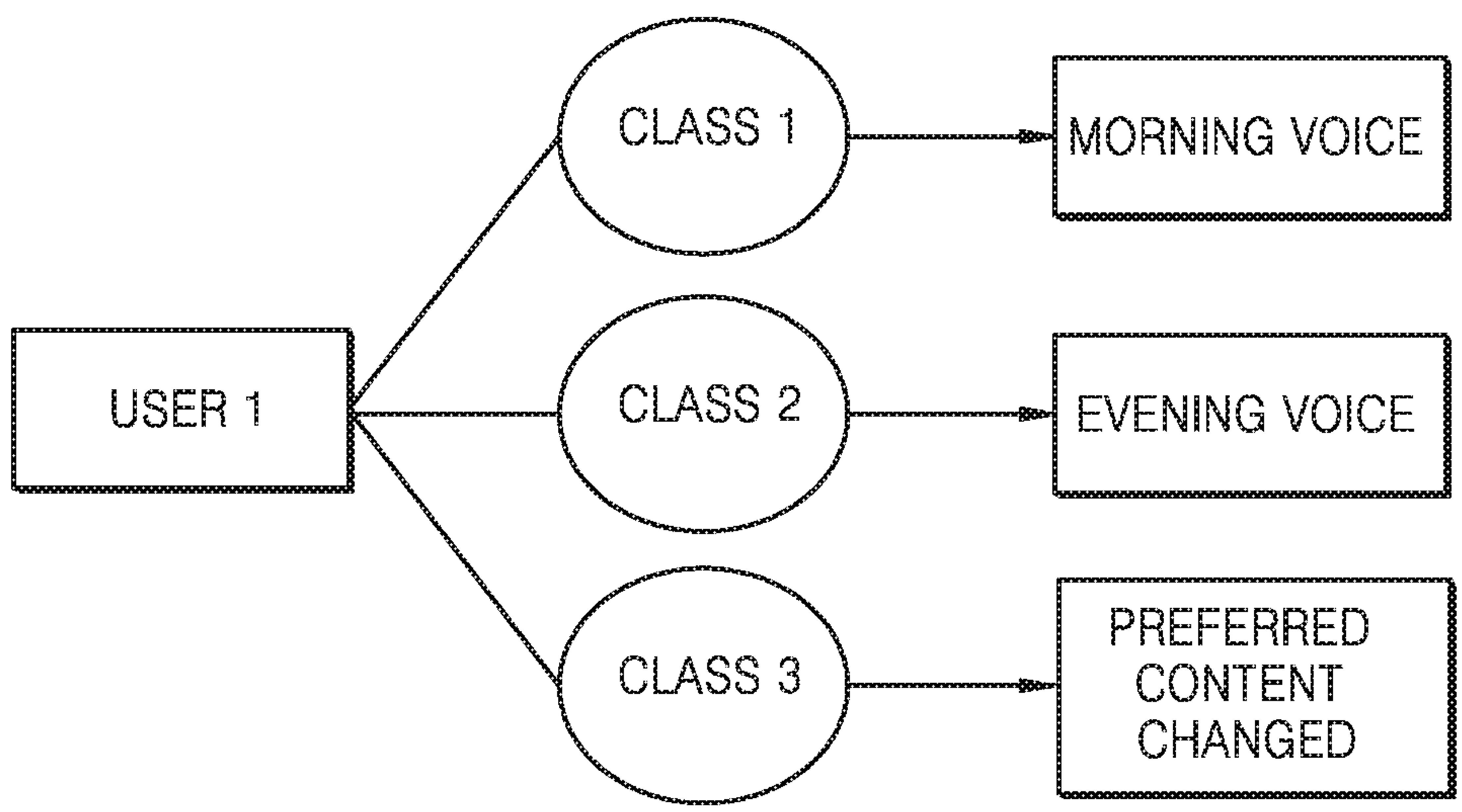

CLASS 1
MORNING VOICE
USER 1
CLASS 2
EVENING VOICE
CLASS 3
PREFERRED CONTENT CHANGED

FIG. 30

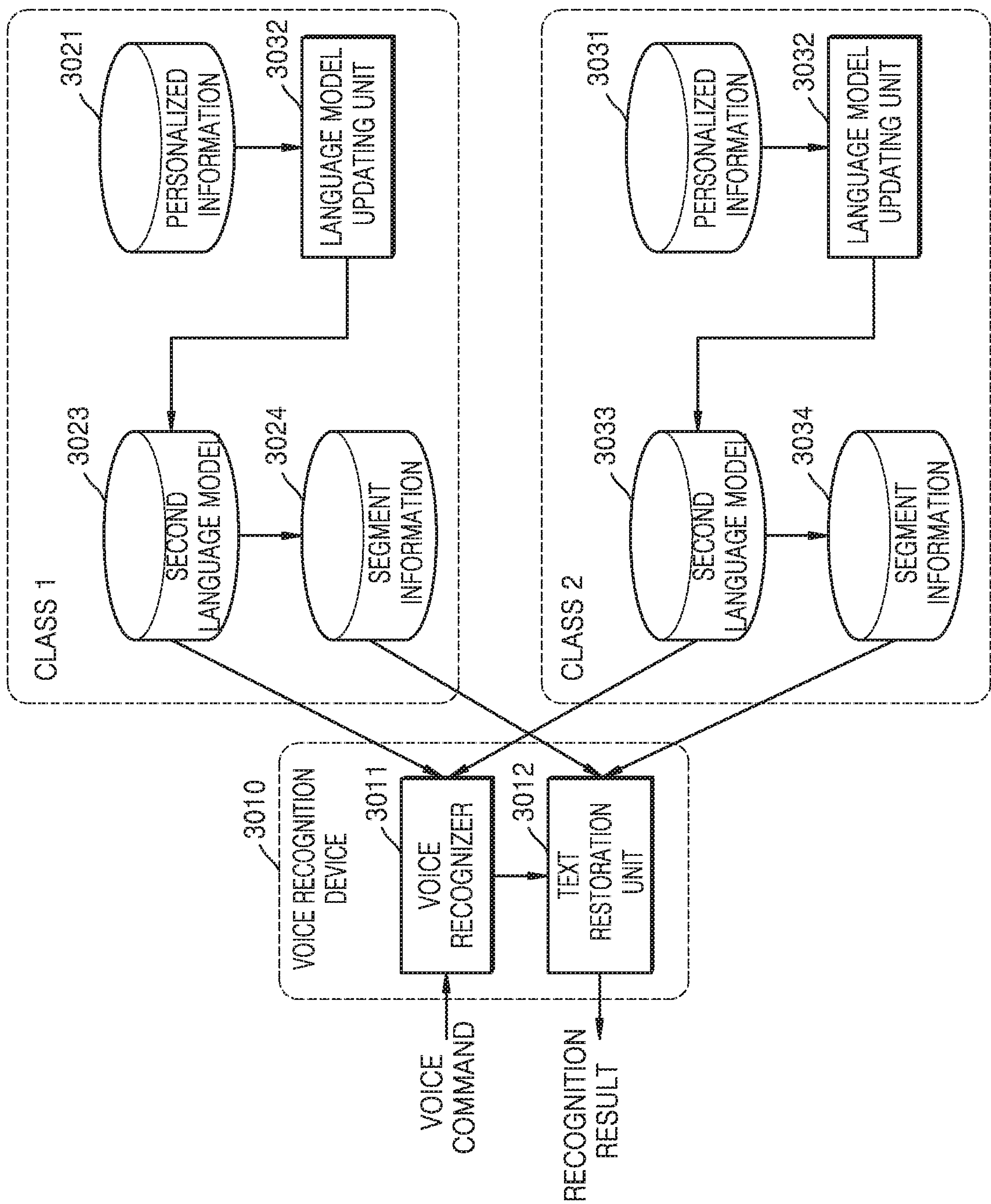

CLASS 1
3021
PERSONALIZED INFORMATION
3032
LANGUAGE MODEL UPDATING UNIT
3023
SECOND LANGUAGE MODEL
3024
SEGMENT INFORMATION
CLASS 2
3031
PERSONALIZED INFORMATION
3032
LANGUAGE MODEL UPDATING UNIT
3033
SECOND LANGUAGE MODEL
3034
SEGMENT INFORMATION
3010
VOICE RECOGNITION DEVICE
3011
VOICE RECOGNIZER
3012
TEXT RESTORATION UNIT
VOICE COMMAND
RECOGNITION RESULT

FIG. 31

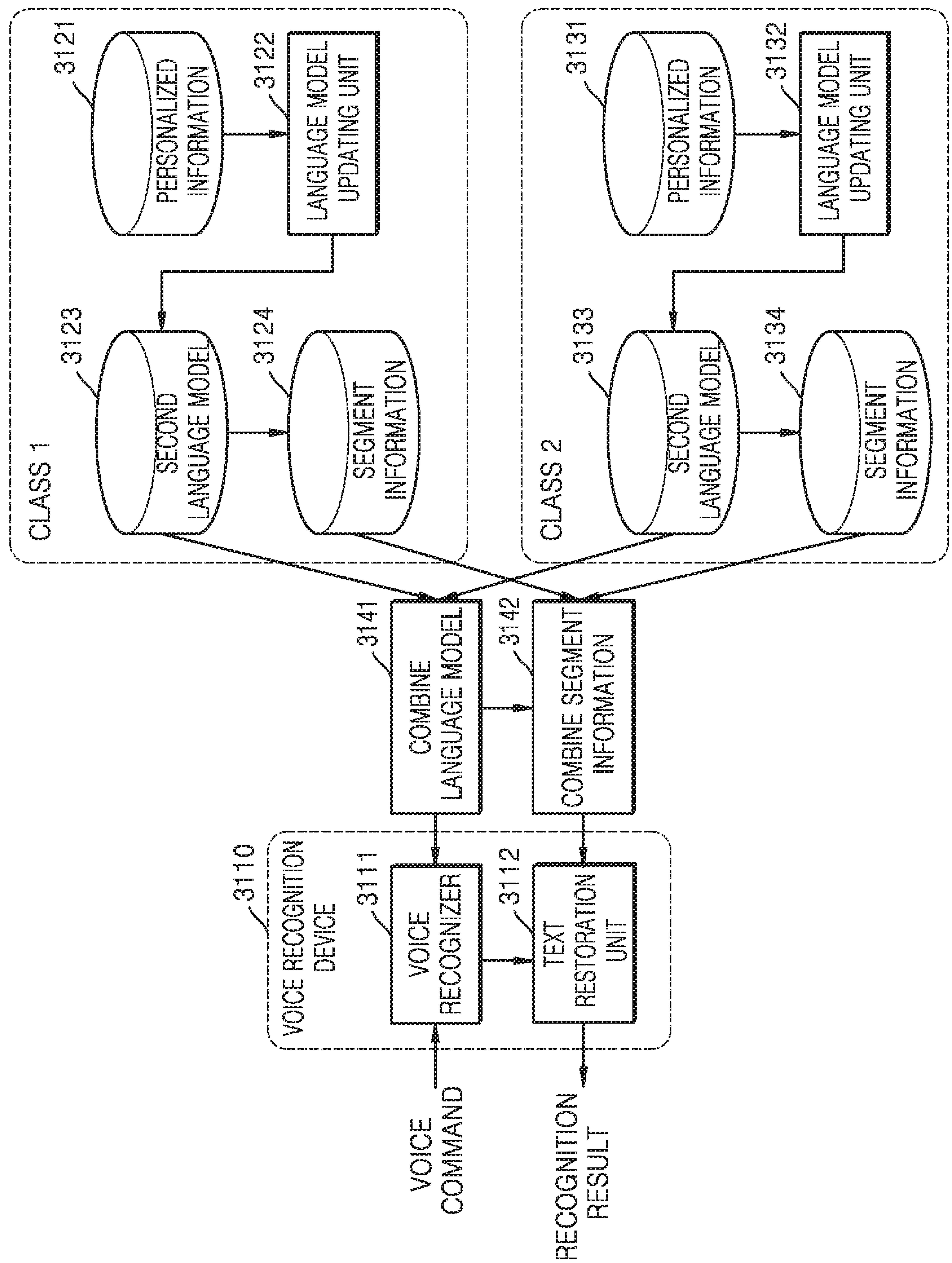

CLASS 1
3121
PERSONALIZED INFORMATION
3122
LANGUAGE MODEL UPDATING UNIT
3123
SECOND LANGUAGE MODEL
3124
SEGMENT INFORMATION
CLASS 2
3131
PERSONALIZED INFORMATION
3132
LANGUAGE MODEL UPDATING UNIT
3133
SECOND LANGUAGE MODEL
3134
SEGMENT INFORMATION
3141
COMBINE LANGUAGE MODEL
3142
COMBINE SEGMENT INFORMATION
3110
VOICE RECOGNITION DEVICE
3111
VOICE RECOGNIZER
3112
TEXT RESTORATION UNIT
VOICE COMMAND
RECOGNITION RESULT

FIG. 32

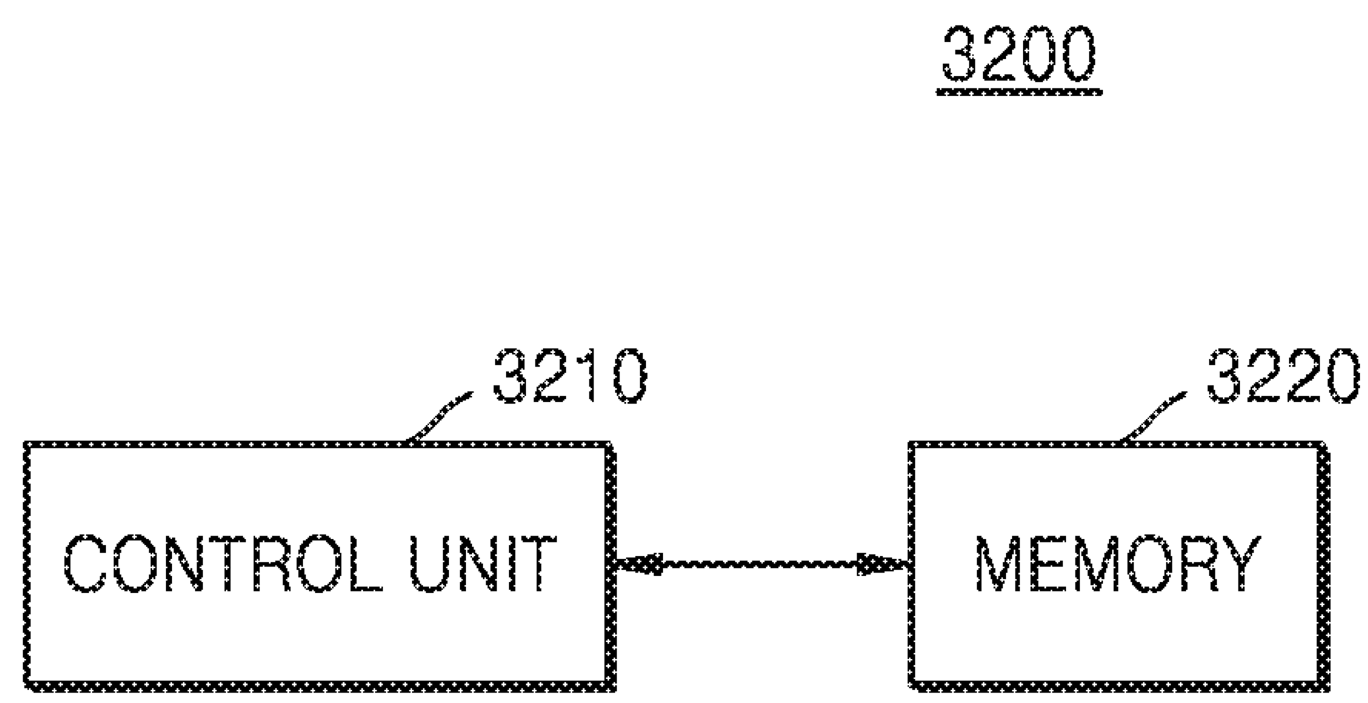

3200
3210
CONTROL UNIT
3220
MEMORY

FIG. 33

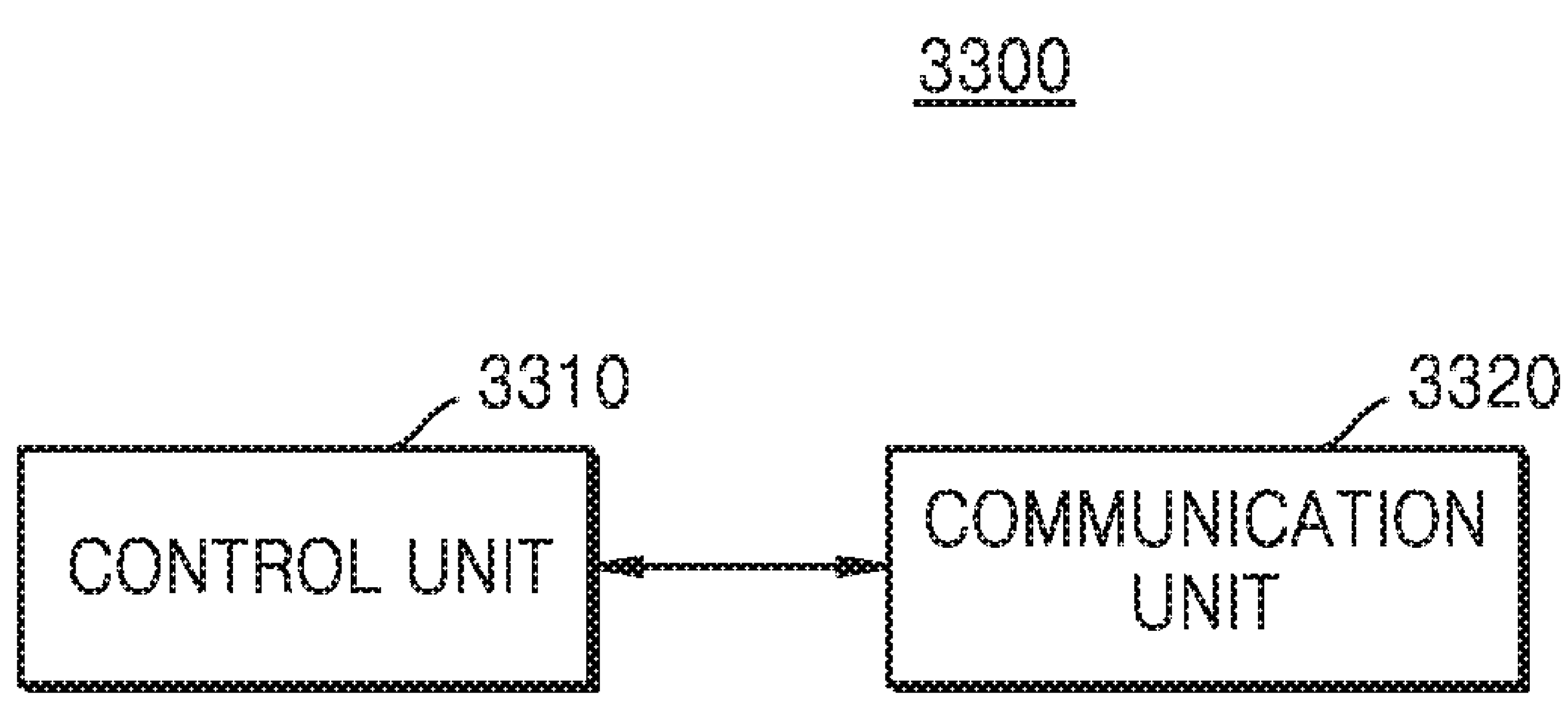
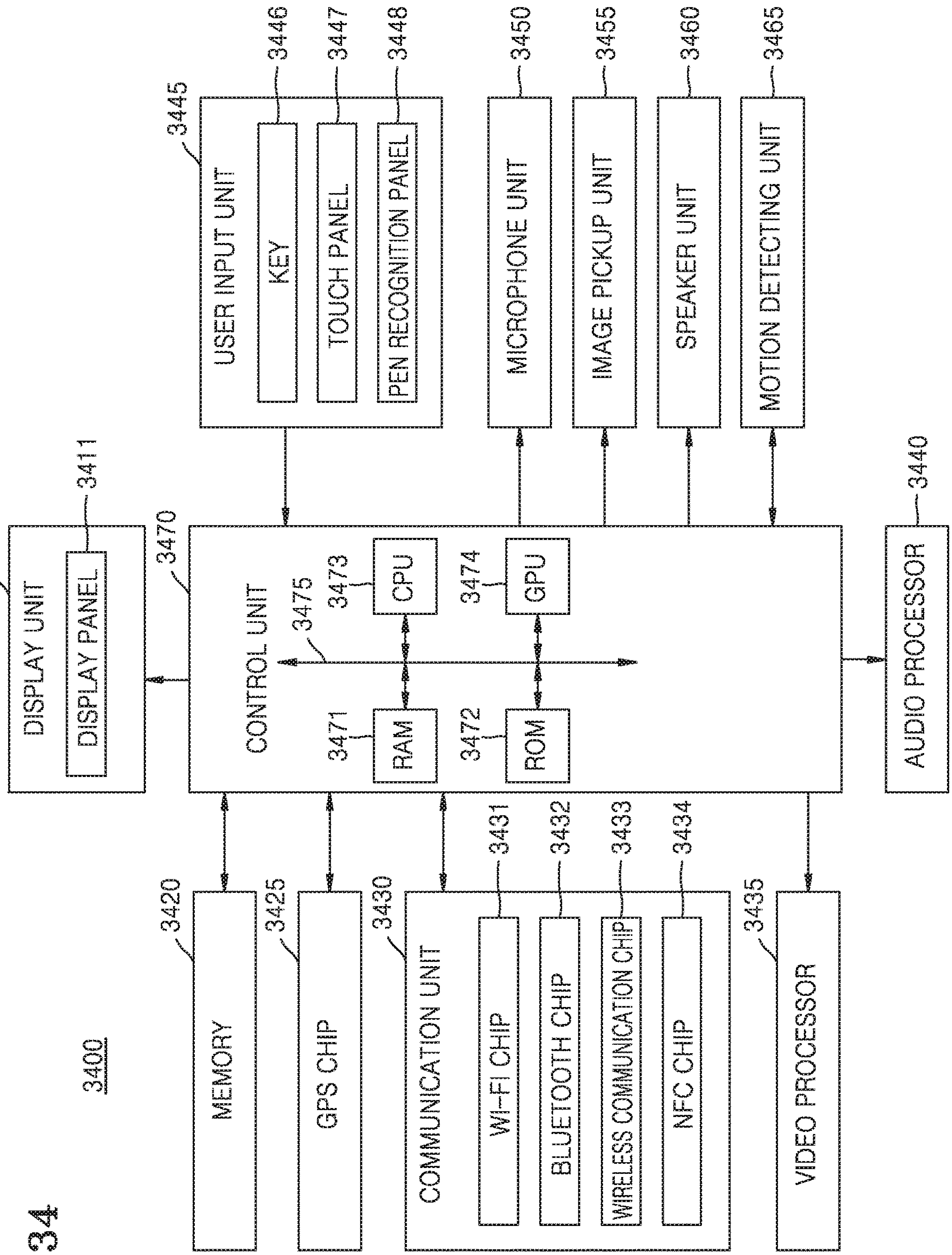

3300
3310
CONTROL UNIT
3320
COMMUNICATION UNIT

FIG. 34


3400
DISPLAY UNIT
DISPLAY PANEL
3410
3411
CONTROL UNIT
3470
3475
CPU
3473
GPU
3474
RAM
3471
ROM
3472
USER INPUT UNIT
3445
KEY
3446
TOUCH PANEL
3447
PEN RECOGNITION PANEL
3448
MICROPHONE UNIT
3450
IMAGE PICKUP UNIT
3455
SPEAKER UNIT
3460
MOTION DETECTING UNIT
3465
AUDIO PROCESSOR
3440
MEMORY
3420
GPS CHIP
3425
COMMUNICATION UNIT
3430
WI-FI CHIP
3431
BLUETOOTH CHIP
3432
WIRELESS COMMUNICATION CHIP
3433
NFC CHIP
3434
VIDEO PROCESSOR
3435

METHOD AND DEVICE FOR PERFORMING VOICE RECOGNITION USING GRAMMAR MODEL

Matter enclosed in heavy brackets [ ] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue; a claim printed with strikethrough indicates that the claim was canceled, disclaimed, or held invalid by a prior post-patent action or proceeding.

[This application is a Continuation of U.S. application Ser. No. 16/523,263 filed with the U.S. Patent and Trademark Office on Jul. 26, 2019, which is a Continuation of U.S. application Ser. No. 15/544,198 filed with the U.S. Patent and Trademark Office on Jul. 17, 2017, now U.S. Pat. No. 10,403,267 issued Sep. 3, 2019, as a National Phase Entry of PCT International Application No. PCT/KR2015/000486, which was filed on Jan. 16, 2015, the contents of each of which are herein incorporated by reference.]

This is a reissue application of U.S. Pat. No. 10,964,310, which was filed as U.S. patent application Ser. No. 16/820,353 on Mar. 16, 2020 and issued on Mar. 30, 2021, which is a continuation of U.S. patent application Ser. No. 16/523,263 filed on Jul. 26, 2019, now U.S. Pat. No. 10,706,838, issued Jul. 7, 2020, which is a continuation of U.S. patent application Ser. No. 15/544,198 filed on Jul. 17, 2017, now U.S. Pat. No. 10,403,267, issued Sep. 3, 2019, which claims benefit of a National Phase Entry of PCT International Application No. PCT/KR2015/000486, which was filed on Jan. 16, 2015, the disclosures of which are incorporated herein by reference in their entireties.

BACKGROUND

1. Field of the Disclosure

The present invention relates to a method and device for performing speech recognition using a language model.

2. Description of the Related Art

Speech recognition is a technique for receiving an input of speech from a user, automatically converting the speech into text, and recognizing the text. Recently, speech recognition is used as an interfacing technique for replacing a keyboard input for a smart phone or a TV.

A speech recognition system may include a client for receiving voice signals and an automatic speech recognition (ASR) engine for recognizing a speech from voice signals, where the client and the ASR engine may be independently designed.

Generally, a speech recognition system may perform speech recognition by using an acoustic model, a language model, and a pronunciation dictionary. It is necessary to establish a language model and a pronunciation dictionary regarding a predetermined word in advance for a speech recognition system to speech-recognize the predetermined word from voice signals.

SUMMARY

The present invention provides a method and a device for performing speech recognition using a language model, and more particularly, a method and apparatus for establishing a language model for speech recognition of new words and performing speech recognition with respect to a speech including the new words.

According to an aspect of the present invention, there is provided a method of updating speech recognition data including a language model used for speech recognition, the method including obtaining language data including at least one word; detecting a word that does not exist in the language model from among the at least one word; obtaining at least one phoneme sequence regarding the detected word; obtaining components constituting the at least one phoneme sequence by dividing the at least one phoneme sequence into predetermined unit components; determining information regarding probabilities that the respective components constituting each of the at least one phoneme sequence appear during speech recognition; and updating the language model based on the determined probability information.

Furthermore, the language model includes a first language model and a second language model including at least one language model, and the updating of the language model includes updating the second language model based on the determined probability information.

Furthermore, the method further includes updating the first language model based on at least one appearance probability information included in the second language model; and updating a pronunciation dictionary including information regarding phoneme sequences of words based on the phoneme sequence of the detected word.

Furthermore, the appearance probability information includes information regarding appearance probability of each of the components under a condition that a word or another component appears before the corresponding component.

Furthermore, the determining the appearance probability information includes obtaining situation information regarding a surrounding situation corresponding to the detected word; and selecting a language model to add appearance probability information regarding the detected word based on the situation information.

Furthermore, the updating of the language model includes updating a second language model regarding a module corresponding to the situation information based on the determined appearance probability information.

According to another aspect of the present invention, there is provided a method of performing speech recognition, the method including obtaining speech data for performing speech recognition; obtaining at least one phoneme sequence from the speech data; obtaining information regarding probabilities that predetermined unit components constituting the at least one phoneme sequence appear; determining one of the at least one phoneme sequence based on the information regarding probabilities that the predetermined unit components appear; and obtaining a word corresponding to the determined phoneme sequence based on segment information for converting predetermined unit components included in the determined phoneme sequence to a word.

Furthermore, the obtaining of the at least one phoneme sequence includes obtaining a phoneme sequence, regarding which information about a word corresponding to the phoneme sequence exists in a pronunciation dictionary including information regarding phoneme sequences of words, and a phoneme sequence, regarding which information about a word corresponding to the phoneme sequence does not exist in the pronunciation dictionary.

Furthermore, the obtaining of the appearance probability information regarding the components includes determining a plurality of language models including appearance probability information regarding the components; determining weights with respect to the plurality of determined language models; obtaining at least one appearance probability information regarding the components from the plurality of language models; and obtaining appearance probability information regarding the components by applying the determined weights to the obtained appearance probability information according to language models to which the respective appearance probability information belongs.

Furthermore, the obtaining of the appearance probability information regarding the components includes obtaining situation information regarding the speech data; determining at least one second language model based on the situation information; and obtaining appearance probability information regarding the components from the at least one determined second language model.

Furthermore, the at least one second language model corresponds to a module or a group including at least one module, and the determining of the at least one second language model includes, if the obtained situation information includes an identifier of a module, determining the at least one second language model corresponding to the identifier.

Furthermore, the situation information includes a personalized model information including at least one of acoustic information by classes and information regarding preferred languages by classes, and the determining of the second language model includes determining a class regarding the speech data based on the at least one of the acoustic information and the information regarding preferred languages by classes; and determining the second language model based on the determined class.

Furthermore, the method further includes obtaining the speech data and a text, which is a result of speech recognition of the speech data; detecting information regarding content from the text or the situation information; detecting acoustic information from the speech data; determining a class corresponding to information regarding the content and the acoustic information; and updating information regarding a language model corresponding to the determined class based on at least one of the information regarding the content and the situation information.

According to another aspect of the present invention, there is provided a device for updating a language model including appearance probability information regarding respective words during speech recognition, the device including a controller, which obtains language data including at least one word, detects a word that does not exist in the language model from among the at least one word, obtains at least one phoneme sequence regarding the detected word, obtains components constituting the at least one phoneme sequence by dividing the at least one phoneme sequence into predetermined unit components, determines information regarding probabilities that the respective components constituting each of the at least one phoneme sequence appear during speech recognition, and updates the language model based on the determined probability information; and a memory, which stores the updated language model.

According to another aspect of the present invention, there is provided a device for performing speech recognition, the device including a user inputter, which obtains speech data for performing speech recognition; and a controller, which obtains at least one phoneme sequence from the speech data, obtains information regarding probabilities that predetermined unit components constituting the at least one phoneme sequence appear, determines one of the at least one phoneme sequence based on the information regarding probabilities that the predetermined unit components appear, and obtains a word corresponding to the determined phoneme sequence based on segment information for converting predetermined unit components included in the determined phoneme sequence to a word.

Another object of the present disclosure provides a method, performed by an electronic device, of performing speech recognition, with the method including, from a first device and a second device receiving a user's voice, receiving first audio data and second audio data comprising the voice; determining sound quality of each of the first audio data and the second audio data; selecting at least one audio data from among the first audio data and the second audio data, based on the determined sound quality; performing speech recognition with respect to the voice, based on the selected audio data; determining a command corresponding to the voice, based on a result of the voice speech; selecting an application for performing the command, from among at least one application executable in the electronic device, based on the result of the speech recognition; and transmitting the command to the selected application.

A further object of the present disclosure provides an electronic device including a communication unit configured to, from a first device and a second device receive a user's voice, receive first audio data and second audio data comprising the voice; and at least one processor configured to determine sound quality of each of the first audio data and the second audio data, select at least one audio data from among the first audio data and the second audio data, based on the determined sound quality, perform speech recognition with respect to the voice, based on the selected audio data, determine a command corresponding to the voice, based on a result of the speech recognition, select an application for performing the command, from among at least one application executable in the electronic device, based on the result of the speech recognition, and transmit the command to the selected application.

BRIEF DESCRIPTION OF THE DRAWINGS

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

FIG. **1** is a block diagram exemplifying a device that performs speech recognition according to an embodiment;

FIG. **2** is a block diagram showing a speech recognition device and a speech recognition data updating device for updating speech recognition data, according to an embodiment;

FIG. **3** is a flowchart showing a method of updating speech recognition data for recognition of a new word, according to an embodiment;

FIG. **4** is a block diagram showing an example of systems for adding a new word, according to an embodiment;

FIGS. **5** and **6** are flowcharts showing an example of adding a new word according to an embodiment;

FIG. **7** is a table showing an example of correspondence relationships between new words and subwords, according to an embodiment;

FIG. **8** is a table showing an example of appearance probability information regarding new words during speech recognition, according to an embodiment;

FIG. 9 is a block diagram showing a system for updating speech recognition data for recognizing a new word, according to an embodiment;

FIG. 10 is a flowchart showing a method of updating language data for recognizing a new word, according to an embodiment;

FIG. 11 is a block diagram showing a speech recognition device that performs speech recognition according to an embodiment;

FIG. 12 is a flowchart showing a method of performing speech recognition according to an embodiment;

FIG. 13 is a flowchart showing a method of performing speech recognition according to an embodiment;

FIG. 14 is a block diagram showing a speech recognition system that executes a module based on a result of speech recognition performed based on situation information, according to an embodiment;

FIG. 15 is a diagram showing an example of situation information regarding a module, according to an embodiment;

FIG. 16 is a flowchart showing an example of methods of performing speech recognition according to an embodiment;

FIG. 17 is a flowchart showing an example of methods of performing speech recognition according to an embodiment;

FIG. 18 is a block diagram showing a speech recognition system that executes a plurality of modules according to a result of speech recognition performed based on situation information, according to an embodiment;

FIG. 19 is a diagram showing an example of a voice command with respect to a plurality of devices, according to an embodiment;

FIG. 20 is a block diagram showing an example of speech recognition devices according to an embodiment;

FIG. 21 is a block diagram showing an example of performing speech recognition at a display device, according to an embodiment;

FIG. 22 is a block diagram showing an example of updating a language model in consideration of situation information, according to an embodiment;

FIG. 23 is a block diagram showing an example of a speech recognition system including language models corresponding to respective applications, according to an embodiment;

FIG. 24 is a diagram showing an example of a user device transmitting a request to perform a task based on a result of speech recognition, according to an embodiment;

FIG. 25 is a block diagram showing a method of generating an personal preferred content list regarding classes of speech data, according to an embodiment;

FIG. 26 is a diagram showing an example of determining a class of speech data, according to an embodiment;

FIG. 27 is a flowchart showing a method of updating speech recognition data according to classes of speech data, according to an embodiment;

FIGS. 28 and 29 are diagrams showing examples of acoustic data that may be classified according to embodiments;

FIGS. 30 and 31 are block diagrams showing an example of performing a personalized speech recognition method according to an embodiment;

FIG. 32 is a block diagram showing an internal configuration of a speech recognition data updating device according to an embodiment;

FIG. 33 is a block diagram showing an internal configuration of a speech recognition device according to an embodiment;

FIG. 34 is a block diagram for describing a configuration of a user device according to an embodiment.

DETAILED DESCRIPTION

The present invention will now be described more fully with reference to the accompanying drawings, in which exemplary embodiments of the invention are shown. In the description of the present invention, certain detailed explanations of related art are omitted when it is deemed that they may unnecessarily obscure the essence of the invention. Like reference numerals in the drawings denote like elements throughout.

Preferred embodiments of the present invention are described hereafter in detail with reference to the accompanying drawings. Before describing the embodiments, the words and terminologies used in the specification and claims should not be construed with common or dictionary meanings, but construed as meanings and conception coinciding the spirit of the invention under a principle that the inventor(s) can appropriately define the conception of the terminologies to explain the invention in the optimum method. Therefore, embodiments described in the specification and the configurations shown in the drawings are not more than the most preferred embodiments of the present invention and do not fully cover the spirit of the present invention. Accordingly, it should be understood that there may be various equivalents and modifications that can replace those when this application is filed.

In the attached drawings, some elements are exaggerated, omitted, or simplified, and sizes of the respective elements do not fully represent actual sizes thereof. The present invention is not limited to relative sizes or distances shown in the attached drawings.

In addition, unless explicitly described to the contrary, the word "comprise" and variations such as "comprises" or "comprising" will be understood to imply the inclusion of stated elements but not the exclusion of any other elements. In addition, the term "units" described in the specification mean units for processing at least one function and operation and can be implemented by software components or hardware components, such as FPGA or ASIC. However, the "units" are not limited to software components or hardware components. The "units" may be embodied on a recording medium and may be configured to operate one or more processors.

Therefore, for example, the "units" may include components, such as software components, object-oriented software components, class components, and task components, processes, functions, properties, procedures, subroutines, program code segments, drivers, firmware, micro codes, circuits, data, databases, data structures, tables, arrays, and variables. Components and functions provided in the "units" may be combined to smaller numbers of components and "units" or may be further divided into larger numbers of components and "units."

The present invention will now be described more fully with reference to the accompanying drawings, in which exemplary embodiments of the invention are shown. The present invention may, however, be embodied in many different forms and should not be construed as being limited to the embodiments set forth herein; rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the concept of the present invention to those skilled in the art. In the description of the present invention, certain detailed explanations of related art are omitted when it is deemed that they may unnecessarily obscure the essence of the present invention. Like reference numerals in the drawings denote like elements, and thus their description will be omitted.

Hereinafter, the present invention will be described in detail by explaining preferred embodiments of the invention with reference to the attached drawings.

FIG. **1** is a block diagram exemplifying a device **100** that performs speech recognition according to an embodiment.

Referring to FIG. **1**, the device **100** may include a feature extracting unit **110**, a candidate phoneme sequence detecting unit **120**, and a language selecting unit **140** as components for performing speech recognition. The feature extracting unit **110** extracts feature information regarding input voice signals. The candidate phoneme sequence detecting unit **120** detects at least one candidate phoneme sequence from the extracted feature information. The word selecting unit **140** selects a final speech-recognized word based on appearance probability information regarding respective candidate phoneme sequences. Appearance probability information regarding a word refers to information indicating a probability that the word appears in a speech-recognized word during speech recognition. Hereinafter, components of the device **100** will be described in detail.

When a voice signal is received, the device **100** may detect a speech portion actually spoken by a speaker and extract information indicating features of the voice signal. Information indicating features of a voice signal may include information indicating a shape of a mouth or a location of a tongue based on a waveform corresponding to the voice signal.

The candidate phoneme sequence detecting unit **120** may detect at least one candidate phoneme sequence that may be matched with a voice signal by using the extracted feature information regarding the voice signal and an acoustic model **130**. A plurality of candidate phoneme sequences may be extracted according to voice signals. For example, since pronunciations 'jyeo' and 'jeo' are similar to each other, a plurality of candidate phoneme sequences including pronunciations 'jyeo' and 'jeo' may be detected with respect to a same voice signal. Candidate phoneme sequences may be detected word-by-word. However, the present invention is not limited thereto, and candidate phoneme sequences may be detected in any of various units, such as in units of phonemes.

The acoustic model **130** may include information for detecting candidate phoneme sequences from feature information regarding a voice signal. Furthermore, the acoustic model **130** may be generated based on a large amount of speech data by using a statistical method, may be generated based on articulation data regarding unspecified speakers, or may be generated based on articulation data regarding a particular speaker. Therefore, the acoustic model **130** may be independently applied for speech recognition according to the particular speaker. The word selecting unit **140** may obtain appearance probability information regarding respective candidate phoneme sequences detected by the candidate phoneme sequence detecting unit **120** by using a pronunciation dictionary **150** and a language model **160**. Next, the word selecting unit **140** selects a final speech-recognized word based on the appearance probability information regarding the respective candidate phoneme sequences. In detail, the word selecting unit **140** may determine words corresponding to the respective candidate phoneme sequences by using the pronunciation dictionary **150** and obtain respective appearance probabilities regarding the determined words by using the language model **160**.

The pronunciation dictionary **150** may include information for obtaining words corresponding to candidate phoneme sequences detected by the candidate phoneme sequence detecting unit **120**. The pronunciation dictionary **150** may be established based on candidate phoneme sequences obtained based on changes of phonemes of respective words.

Pronunciation of a word is not consistent, because the pronunciation of the word may vary based on words before and after the word, a location of the word in a sentence, or characteristics of a speaker. Furthermore, an appearance probability regarding a word refers to a probability that the word may appear or a probability that the word may appear together with a particular word. The device **100** may perform speech recognition in consideration of context based on appearance probabilities. The device **100** may perform speech recognition by obtaining words corresponding to candidate phoneme sequences by using the pronunciation dictionary **150** and obtaining information regarding appearance probabilities of respective words by using the language model **160**. However, the present invention is not limited thereto, and the device **100** may obtain appearance probabilities from the language model **160** by using candidate phoneme sequences without obtaining words corresponding to candidate phoneme sequences.

For example, in the case of Korean, when a candidate phoneme sequence 'hakkkcyo' is detected, the word selecting unit **140** may obtain a word 'hakgyo' as a word corresponding to the detected candidate phoneme sequence 'hakkkyo' by using the pronunciation dictionary **150**. In another example, in the case of English, when a candidate phoneme sequence 'skul' is detected, the word selecting unit **140** may obtain a word 'school' as a word corresponding to the detected candidate phoneme sequence 'skul' by using the pronunciation dictionary **150**.

The language model **160** may include appearance probability information regarding words. There may be information about an appearance probability regarding each word. The device **100** may obtain appearance probability information regarding words included in respective candidate phoneme sequences from the language model **160**.

For example, if a word A appears before a current word B appears, the language model **160** may include information regarding an appearance probability P(B|A), which is a probability that the current word B may appear. In other words, the appearance probability P(B|A) regarding the word B may be subject to appearance of the word A before appearance of the word B. In another example, the language model **160** may include an appearance probability P(B|A C) that is subject to appearance of the word A and a word C, that is, appearance of a plurality of words before appearance of the word B. In other words, the appearance probability P(B|A C) may be subject to appearance of both the words A and C before appearance of the word B. In another example, instead of a conditional probability, the language model **160** may include an appearance probability P(B) regarding the word B. The appearance probability P(B) refers to a probability that the word B may appear during speech recognition.

The device **100** may finally determine a speech-recognized word based on an appearance probability regarding words corresponding to respective candidate phoneme sequences determined by the word selecting unit **140** by using the language model **160**. In other words, the device **100** may finally determine a word corresponding to the highest appearance probability as a speech-recognized word. The word selecting unit **140** may output the speech-recognized word as text.

Although the present invention is not limited to updating a language model or performing speech recognition word-by-word and such operations may be performed sequence-by-sequence, a method of updating a language model or performing speech recognition word-by-word will be described below for convenience of explanation.

Hereinafter, referring to FIGS. **2** through **9**, a method of updating speech recognition data for speech recognition of new words will be described in detail.

FIG. **2** is a block diagram showing a speech recognition device **230** and a speech recognition data updating device **220** for updating speech recognition data, according to an embodiment.

Although FIG. **2** shows that the speech recognition data updating device **220** and the speech recognition device **230** are separate devices, it is merely an embodiment, and the speech recognition data updating device **220** and the speech recognition device **230** may be embodied as a single device, e.g., the speech recognition data updating device **220** may be included in the speech recognition device **230**. In the drawings and the embodiments described below, components included in the speech recognition data updating device **220** and the speech recognition device **230** may be physically or logically distributed or integrated with one another.

The speech recognition device **230** may be an automatic speech recognition (ASR) server that performs speech recognition by using speech data received from a device and outputs a speech-recognized word.

The speech recognition device **230** may include a speech recognition unit **231** that performs speech recognition and speech recognition data **232**, **233**, and **235** that are used for performing speech recognition. The speech recognition data **232**, **233**, and **235** may include other models **232**, a pronunciation dictionary **233**, and a language model **235**. Furthermore, the speech recognition device **230** according to an embodiment may further include a segment model **234** for updating speech recognition data **232**, **233**, and **235**.

The device **100** of FIG. **1** may correspond to the speech recognition unit **231** of FIG. **2**, and the speech recognition data **232**, **233**, and **235** of FIG. **2** may correspond to the acoustic model **130**, the pronunciation dictionary **150**, and the language model **160** of FIG. **1**, respectively.

The pronunciation dictionary **233** may include information regarding at least correspondences between a candidate phoneme sequence and at least one word. The language model **235** may include appearance probability information regarding words. The other models **232** may include other models that may be used for speech recognition. For example, the other models **232** may include an acoustic model for detecting a candidate phoneme sequence from feature information regarding a voice signal.

The speech recognition device **230** according to an embodiment may further include the segment model **234** for updating the language model **235** by reflecting new words. The segment model **234** includes information that may be used for updating speech recognition data by using a new word according to an embodiment. In detail, the segment model **234** may include information for dividing a new word included in collected language data into predetermined unit components. For example, if a new word is divided into units of subwords, the segment model **234** may include subword texts, such as 'ga gya ah re pl tam.' However, the present invention is not limited thereto, and the segment model **234** may include words divided into predetermined unit components and a new word may be divided according to the predetermined unit components. A subword refers to a voice unit that may be independently articulated.

The segment model **234** of FIG. **2** is included in the speech recognition device **230**. However, the present invention is not limited thereto, and the segment model **234** may be included in the speech recognition data updating device **220** or may be included in another external device.

The speech recognition data updating device **220** may update at least one of the speech recognition data **232**, **233**, and **235** used for speech recognition. The speech recognition data updating device **220** may include a new word detecting unit **221**, a pronunciation generating unit **222**, a subword dividing unit **223**, an appearance probability information determining unit **224**, and a language model updating unit **225** as components for updating speech recognition data.

The speech recognition data updating device **220** may collect language data **210** including at least one word and update at least one of the speech recognition data **232**, **233**, and **235** by using a new word included in the language data **210**.

The speech recognition data updating device **220** may collect the language data **210** and update speech recognition data periodically or when an event occurs. For example, when a screen image on a display unit of a user device is switched to another screen image, the speech recognition data updating device **220** may collect the language data **210** included in the switched screen image and update speech recognition data based on the collected language data **210**. The speech recognition data updating device **220** may collect the language data **210** by receiving the language data **210** included in the screen image on the display unit from the user device.

Alternatively, if the speech recognition data updating device **220** is a user device, the language data **210** included in a screen image on a display unit may be obtained according to an internal algorithm. The user device may be a device identical to the speech recognition device **230** or the speech recognition data updating device **220** or an external device.

When speech recognition data is updated by the speech recognition data updating device **220**, the speech recognition device **230** may perform speech recognition with respect to a voice signal corresponding to the new word.

The language data **210** may be collected in the form of texts. For example, the language data **210** may include text included in contents or web pages. If a text is included in an image file, the text may be obtained via optical character recognition (OCR). The language data **210** may include a text in the form of a sentence or a paragraph including a plurality of words.

The new word detecting unit **221** may detect a new word, which is not included in the language model **235**, from the collected language data **210**. Information regarding an appearance probability cannot be obtained with respect to a word not included in the language model **235** when the speech recognition device **230** performs speech recognition, and thus the word not included in the language model **235** cannot be output as a speech-recognized word. The speech recognition data updating device **220** according to an embodiment may update speech recognition data by detecting a new word not included in the language model **235** and adding appearance probability information regarding the new word to the language model **235**. Next, the speech recognition device **230** may output the new word as a speech-recognized word based on the appearance probability regarding the new word.

The speech recognition data updating device **220** may divide a new word into subwords and add appearance probability information regarding the respective subwords of the new word to the language model **235**. Since the speech recognition data updating device **220** according to an embodiment may update speech recognition data for recognizing a new word only by updating the language model **235** and without updating the pronunciation dictionary **233** and the other models **232**, speech recognition data may be quickly updated.

The pronunciation generating unit **222** may convert a new word detected by the new word detecting unit **221** into at least one phoneme sequence according to a standard pronunciation rule or a pronunciation rule reflecting characteristics of a speaker.

In another example, instead of generating a phoneme sequence via the pronunciation generating unit **222**, a phoneme sequence regarding a new word may be determined based on a user input. Furthermore, it is not limited to the pronunciation rule of the above-stated embodiment, and a phoneme sequence may be determined based on conditions corresponding to various situations, such as characteristics of a speaker regarding a new word or time and location characteristics. For example, a phoneme sequence may be determined based on the fact that a same character may be pronounced differently according to situations of a speaker, e.g., different voices in the morning and the evening or a change of language behavior of the speaker.

The subword dividing unit **223** may divide a phoneme sequence converted by the pronunciation generating unit **222** into predetermined unit components based on the segment model **234**.

For example, in the case of Korean, the pronunciation generating unit **222** may convert a new word 'gim yeon a' into a phoneme sequence 'gi myeo na.' Next, the subword dividing unit **223** may refer to subword information included in the segment model **234** and divide the phoneme sequence 'gi myeo na' into subword components 'gi,' 'myeo,' and 'na.' In detail, the subword dividing unit **223** may extract 'gi,' 'myeo,' and 'na' corresponding to subword components of the phoneme sequence 'gi myeo na' from among subwords included in the segment model **234**. The subword dividing unit **223** may divide the phoneme sequence 'gi myeo na' into the subword components 'gi,' 'myeo,' and 'na' by using the detected subwords.

In the case of English, the pronunciation generating unit **222** may convert a word 'texas' recognized as a new word into a phoneme sequence 'tekss' Next, refefring to subword information included in the segment model **234**, the subword dividing unit **223** may divide 'tekss' into subwords 'teks' and 's,' according to an embodiment, a predetermined unit for division based on the segment model **234** may include not only a subword, but also other voice units, such as a segment.

In the case of the Korean, a subword may include four types: a vowel only, a combination of a vowel and a consonant, a combination of a consonant and a vowel, and a combination of a consonant, a vowel, and a consonant. If a phoneme sequence is divided into subwords, the segment model **234** may include thousands of subword information, e.g., ga, gya, gan, gal, nam, nan, un, hu, etc.

The subword dividing unit **223** may convert a new word, which may be a Japanese word or a Chinese word, into a phoneme sequence indicated by using a phonogram (e.g., Latin Alphabet, Katakana, Hangul, etc.), and the converted phoneme sequence may be divided into subwords.

In the case of languages other than the above-stated languages, the segment model **234** may include information for dividing a new word into predetermined unit components for each of the languages. Furthermore, the subword dividing unit **223** may divide a phoneme sequence of a new word into predetermined unit components based on the segment model **234**.

The appearance probability information determining unit **224** may determine appearance probability information regarding predetermined unit components constituting a phoneme sequence of a new word. If a new word is included in a sentence of language data, the appearance probability information determining unit **224** may obtain appearance probabilities information by using words included in the sentence other than the new word.

For example, in a sentence 'oneul gim yeon a boyeojyo,' if the word 'gimyeona' is detected as a new word, the appearance probability information determining unit **224** may determine appearance probabilities regarding subwords 'myeo,' and 'na.' For example, the appearance probability information determining unit **224** may determine an appearance probability P(gi/oneul) by using appearance probability information regarding the word 'oneul' included in the sentence. Furthermore, if 'texas' is detected as a new word, appearance probability information may be determined with respect to respective subwords 'teks' and 's.'

If it is assumed that at least one particular subword or word appears before a current subword, appearance probability information regarding a subword may include information regarding a probability that the current subword may appear during speech recognition. Furthermore, appearance probability information regarding a subword may include information regarding an unconditional probability that a current subword may appear during speech recognition.

The language model updating unit **225** may update the segment model **234** by using appearance probability information determined with respect to respective subwords. The language model updating unit **225** may update the language model **235**, such that a sum of all probabilities, under a condition that a particular subword or word appears before a current word or subword, is 1.

In detail, if one of appearance probability information determined with respect to respective subwords is $P(B|A)$, the language model updating unit **225** may obtain probabilities $P(C|A)$ and $P(D|A)$ included in the language model **235** under a condition that A appears before a current word or subword. Next, the language model updating unit **225** may re-determine values of the probabilities $P(B|A)$, $P(C|A)$, and $P(D|A)$, such that $P(B|A)+P(C|A)+P(D|A)$ is 1.

When a language model is updated, the language model updating unit **225** may re-determine probabilities regarding other words or subwords included in the language model **235**, and a time period elapsed for updating the language model may increase as a number of probabilities included in the language model **235** increases. Therefore, the language model updating unit **225** according to an embodiment may minimize a time period elapsed for updating a language model by updating a language model including a relatively small number of probabilities instead of updating a language model including a relatively large number of probabilities.

In the above-described speech recognition process, the speech recognition device **230** may use an acoustic model, a pronunciation dictionary, and a language model together to recognize a single word included in a voice signal. Therefore, when speech recognition data is updated, it is necessary to update the acoustic model, the pronunciation dictionary, and the language model together, such that a new word may be speech-recognized. However, to update an acoustic model, a pronunciation dictionary, and a language model together to speech-recognize a new word, it is also necessary to update information regarding words existed together and thus a time period of 1 hour or longer is necessary. Therefore, it is difficult for the speech recognition device **230** to perform speech recognition regarding a new word immediately as the new word is collected.

It is not necessary for the speech recognition data updating device **220** according to an embodiment to update the other models **232** and the pronunciation dictionary **233** based on characteristics of a new word. The speech recognition data updating device **220** may only update the language model **235** based on appearance probability information determined with respect to respective subword components constituting a new word. Therefore, in the method of updating a language model according to an embodiment, a language model may be updated with respect to a new word within a few seconds, and the speech recognition device **230** may reflect the new word in speech recognition in real time.

FIG. **3** is a flowchart showing a method of updating speech recognition data for recognition of a new word, according to an embodiment.

Referring to FIG. **3**, in an operation S**301**, the speech recognition data updating device **220** may obtain language data including at least one word. The language data may include text included in content or a web page that is being displayed on a display screen of a device being used by a user or a module of the device.

In an operation S**303**, the speech recognition data updating device **220** may detect a word that does not exist in the language data from among at least one word. A word that does not exist in the language data is a word without information regarding an appearance probability thereof and cannot be detected as a speech-recognized word. Therefore, the speech recognition data updating device **220** may detect a word that does not exist in the language data as a new word for updating speech recognition data.

In an operation S**305**, the speech recognition data updating device **220** may obtain at least one phoneme sequence corresponding to the new word detected in the operation S**303**. A plurality of phoneme sequences corresponding to a word may exist based on various conditions including pronunciation rules or characteristics of a speaker. Furthermore, a number or a symbol may correspond to various pronunciation rules, and thus a plurality of corresponding phoneme sequences may exist with respect to a number of a symbol.

In an operation S**307**, the speech recognition data updating device **220** may divide each of at least one phoneme sequence obtained in the operation S**305** into predetermined unit components and obtain components constituting each of the at least one phoneme sequence. In detail, the speech recognition data updating device **220** may divide each of phoneme sequence into subwords based on subword information included in the segment model **234**, thereby obtaining components constituting each of phoneme sequences of a new word.

In an operation S**309**, the speech recognition data updating device **220** may determine information regarding an appearance probability of each of the components obtained in the operation S**307** during speech recognition. Information regarding an appearance probability may include a conditional probability and may include information regarding an appearance probability of a current subword under a condition that a particular subword or word appears before the current subword. However, the present invention is not limited thereto, and information regarding an appearance probability may include an unconditional appearance probability regarding a current subword.

The speech recognition data updating device **220** may determine appearance probability information regarding predetermined components by using language data obtained in the operation S**301**. The speech recognition data updating device **220** may determine appearance probabilities regarding respective components by using a sentence or a paragraph to which subword components of a phoneme sequence of a new word belong and determine appearance probability information regarding the respective components. Furthermore, the speech recognition data updating device **220** may determine appearance probability information regarding respective components by using the at least one phoneme sequence obtained in the operation S**305** together with a sentence or a paragraph to which the components belong. Detailed descriptions thereof will be given below with reference to FIGS. **16** and **17**.

Information regarding an appearance probability that may be determined in an operation S**309** may not only include a conditional probability, but also an unconditional probability.

In an operation S**311**, the speech recognition data updating device **220** may update a language model by using the appearance probability information determined in the operation S**309**. For example, the speech recognition data updating device **220** may update the language model **235** by using appearance probability information determined with respect to the respective subwords. In detail, the speech recognition data updating device **220** may update the language model **235**, such that a sum of at least one probability included in the language model **235** under a condition that a particular subword or word appears before a current word or subword is 1.

FIG. **4** is a block diagram showing an example of systems for adding a new word, according to an embodiment.

Referring to FIG. **4**, the system may include a speech recognition data updating device **420** for adding a new word and a speech recognition device **430** for performing speech recognition, according to an embodiment. Unlike the speech recognition device **230** of FIG. **2**, the speech recognition device **430** of FIG. **4** may further include segment information **438**, a language model combining unit **435**, a first language model **436**, and a second language model **437**. The speech recognition data updating device **420** and the speech recognition device **430** of FIG. **4** may correspond to the speech recognition data updating device **220** and the speech recognition device **230** of FIG. **2**, and repeated descriptions thereof will be omitted.

When speech recognition is performed, the language model combining unit **435** of FIG. **4** may determine appearance probabilities regarding respective words by combining a plurality of language models, unlike the language model **235** of FIG. **2**. In other words, the language model combining unit **435** may obtain appearance probabilities regarding a word included in a plurality of language models and obtain an appearance probability regarding the word by combining the plurality of obtained appearance probabilities regarding the word. Referring to FIG. **4**, the language model combining unit **435** may obtain appearance probabilities regarding respective words by combining the first language model **436** and the second language model **437**.

The first language model **436** is a language model included in the speech recognition device **430** in advance and may include a general-purpose language data that may be used in a general speech recognition system. The first language model **436** may include appearance probabilities regarding words or predetermined units determined based on a large amount of language data (e.g., thousands of sentences included in web pages, contents, etc.). Therefore, since the first language model **436** is obtained based on a large amount of sample data, speech recognition based on the first language model **436** may guarantee high efficiency and stability

The second language model **437** is a language model including appearance probabilities regarding new words. Unlike the first language model **436**, the second language model **437** may be selectively applied based on situations, and at least one second language model **437** that may be selectively applied based on situations may exist.

The second language model **437** is a language model that includes appearance probability information regarding a new word according to an embodiment. Unlike the first language model **436**, the second language model **437** may be selectively applied according to different situations, and there may be at least one second language model **437** that may be selectively applied according to the situation.

The second language model **437** may be updated by the speech recognition data updating device **420** in real time. When language model is updated, the speech recognition data updating device **420** may re-determine appearance probabilities included in the language model by using an appearance probability regarding a new word. Since the second language model **437** includes a relatively small number of appearance probability information, a number of appearance probability information to be considered for updating the second language model **437** is relatively small. Therefore, updating of the second language model **437** for recognizing a new word may be performed more quickly.

Detailed descriptions of a method that the language model combining unit **435** obtains an appearance probability regarding a word or a subword by combining the first language model **436** and the second language model **437** during speech recognition will be given below with reference to FIGS. **11** and **12**, in which a method of performing speech recognition according to an embodiment is shown.

Unlike the speech recognition device **230**, the speech recognition device **430** of FIG. **4** may further include the segment information **438**.

The segment information **438** may include information regarding a correspondence relationship between a new word and subword components obtained by dividing the new word. As shown in FIG. **4**, the segment information **438** may be generated by the speech recognition data updating device **420** when a phoneme sequence of a new word is divided into subwords based on the segment model **434**.

For example, if a new word is 'gim yeon a' and subwords thereof are 'gi,' 'myeo,' and 'na,' the segment information **426** may include information indicating that the new word 'gim yeon a' and the subwords 'gi,' 'myeo,' and 'na' correspond to each other. In another example, if a new word is 'texas' and subwords thereof are 'teks' and 's,' the segment information **426** may include information indicating that the new word 'texas' and the subwords 'teks' and 's' correspond to each other

In a method of performing speech recognition, a word corresponding to a phoneme sequence determined based on an acoustic model may be obtained from a pronunciation dictionary **433**. However, if the second language model **437** of the speech recognition device **430** is updated according to an embodiment, the pronunciation dictionary **433** is not updated, and thus the pronunciation dictionary **433** does not include information regarding a new word.

Therefore, the speech recognition device **430** may obtain information regarding a word corresponding to predetermined unit components divided by using the segment information **438** and output a final speech recognition result in the form of text.

Detailed descriptions of a method of performing speech recognition by using the segment information **426** will be given below with reference to FIGS. **12** through **14** related to a method of performing speech recognition.

FIGS. **5** and **6** are flowcharts showing an example of adding a new word according to an embodiment.

Referring to FIG. **5**, in an operation S**10**, the speech recognition data updating device **220** may obtain language data including a sentence 'oneul 3:10 to yuma eonj e hae?' in the form of text data.

In an operation S**30**, the speech recognition data updating device **220** may detect words '3:10' and 'yuma,' which do not exist in a language model **520**, by using the language model **520** including at least one of a first language model and a second language model.

In an operation S**40**, the speech recognition data updating device **220** may obtain phoneme sequences corresponding to the detected words by using a segment model **550** and a pronunciation generating unit **422** and divide each of the phoneme sequence into predetermined unit components. In operations **541** and **542**, the speech recognition data updating device **220** may obtain phoneme sequences 'ssuriten,' 'samdaesip,' and 'sesisippun' corresponding to the word '3:10' and a phoneme sequence 'yuma' corresponding to the word 'yuma.' Next, the speech recognition data updating device **220** may divide each of the phoneme sequences into subword components.

In an operation S**60**, the speech recognition data updating device **220** may compose sentences including the phoneme sequences obtained in the operations **541** and **542**. Since the three phoneme sequences corresponding to the word '3:10' are obtained, three sentences may be composed.

In an operation S**70**, the speech recognition data updating device **220** may determine appearance probability information regarding the predetermined unit components in each of sentences composed in the operation S**60**.

For example, a probability P(ssu|oneul) regarding 'ssu' of a first sentence may have a value of ⅓, because, when 'oneul' appears, 'ssu,' 'sam' of a second sentence, or 'se' of a third sentence may follow. In the same regard, a probability P(sam|oneul) and a probability P(se|oneul) may have a value of ⅓. Since a probability P(ri|ssu) regarding 'ri' exists only if 'ri' appears after 'ssu' appears in the three sentences, the probability P(ri|ssu) may have a value of 1. In the same regard, a probability P(ten|ri), a probability P(yu|tu), a probability P(ma|yu), a probability P(dae|sam), a probability P(sip|dae), a probability P(s|se), and a probability P(sip|si) may have a value of 1. In the case of a probability P(ppun|sip), 'tu' or 'ppun' may appear when 'sip' appears, and thus the probability P(ppun|sip) may have a value of ½.

In an operation S**80**, the speech recognition data updating device **220** may update one or more of a first language model and at least one second language model based on the appearance probability information determined in the operation S**70**. In the case of updating a language model for speech recognition of a new word, the speech recognition data updating device **220** may update the language model based on appearance probabilities regarding other words or subwords already included in the language model.

For example, in consideration of a probability already included in a language model under a condition that 'oneul' appears first, e.g. the probability P(X|oneul), a probability P(ssu|oneul), a probability P(sam|oneul), and a probability P(se|oneul) and the probability P(X|oneul), the probability P(X|oneul) that is already included in the language model may be re-determined. For example, if a probability of P(du|oneul)=P(tu-oneul)=½ exists in probabilities already included in the language model, the speech recognition data updating device **220** may re-determine the probability P(X|oneul) based on the probability already existing in the language model and the probability obtained in the operation **S70**. In detail, since there are total five cases in which 'oneul' appears, each of appearance probabilities regarding respective subwords is ⅕, and thus each of probabilities P(X|oneul) may have a value of ⅕. Therefore, the speech recognition data updating device **220** may re-determine conditional appearance probabilities based on a same condition included in a same language model, such that a sum of values of the appearance probabilities is 1.

Referring to FIG. **6**, in an operation **610**, the speech recognition data updating device **220** may obtain language data including a sentence 'oneul gim yeon a boyeojyo' in the form of text data.

In an operation **630**, the speech recognition data updating device **220** may detect words gim yeon a and 'boyeojyo,' which do not exist in a language model **620**, by using at least one of a first language model and a second language model.

In an operation **640**, the speech recognition data updating device **220** may obtain phoneme sequences corresponding to the detected words by using a segment model **650** and a pronunciation generating unit **622** and divide each of the phoneme sequence into predetermined unit components. In operations **641** and **642**, the speech recognition data updating device **220** may obtain phoneme sequences 'gi myeo na' corresponding to the word 'gim yeon a' and phoneme sequences 'boyeojyo' and 'boyeojeo' corresponding to the word 'boyeojyo.' Next, the speech recognition data updating device **220** may divide each of the phoneme sequences into subword components.

In an operation **660**, the speech recognition data updating device **220** may compose sentences including the phoneme sequences obtained in the operations **641** and **642**. Since the two phoneme sequences corresponding to the word 'boyeojyo' are obtained, two sentences may be composed.

In an operation **670**, the speech recognition data updating device **220** may determine appearance probability information regarding the predetermined unit components in each of sentences composed in the operation **660**.

For example, a probability P(gi|oneul) regarding 'gi' of a first sentence may have a value of 1, because 'gi' follows in two sentences in which 'oneul' appears. In the same regard, a probability P(myeo|gi), a probability P(na|myeo), a probability P(bo|na), and a probability P(yeo|bo) may have a value of **1**, because only once case exists in each condition. In the case of a probability P(jyo|yeo) and a probability P(jeo|yeo), 'jyo' or 'jeo' may appear when 'yeo' appears in two sentences, and thus the both probability P(jyo|yeo) and the probability P(jeo|yeo) may have a value of ½.

In an operation **680**, the speech recognition data updating device **220** may update one or more of a first language model and at least one second language model based on the appearance probability information determined in the operation **670**.

FIG. **7** is a table showing an example of correspondence relationships between new words and subwords, according to an embodiment.

Referring to FIG. **7**, if a word gim yeon a is detected as a new word, 'gi,' 'myeo,' and 'na' may be determined as subwords corresponding to the word 'grim yeon a' as shown in **710**. In the same regard, if a word 'boyeojyo' is detected as a new word, 'bo,' 'yeo,' and 'jyo', and 'bo', 'yeo', and 'jeo' may be determined as subwords corresponding to the word 'boyeojyo' as shown in **720** and **730**.

Information regarding a correspondence relationship between a new word and subwords as shown in FIG. **7** may be stored as the segment information **426** and utilized during speech recognition.

FIG. **8** is a table showing an example of appearance probability information regarding new words during speech recognition, according to an embodiment.

Referring to FIG. **8**, information regarding an appearance probability may include at least one of information regarding an unconditional appearance probability and information regarding an appearance probability under a condition of a previously appeared word.

Information regarding an unconditional appearance probability **810** may include information regarding unconditional appearance probabilities regarding words or subwords, such as a probability P(oneul), a probability P(gi), and a probability P(jeo).

Information regarding an appearance probability under a condition of a previously appeared word **820** may include appearance probability information regarding words or subwords under a condition of a previously appeared word, such as a probability P(gi|oneul), a probability P(myeo|gi), and a probability P(jyo|yeo). The appearance probabilities regarding 'oneul g,' 'gi myeo,' and 'yeo jyo' as shown in FIG. **8** may correspond to the probability P(gi|oneul), the probability P(myeo|gi), and the probability P(jyo|yeo), respectively.

FIG. **9** is a block diagram showing a system for updating speech recognition data for recognizing a new word, according to an embodiment.

A speech recognition data updating device **920** shown in FIG. **9** may include new word information **922** for updating at least one of other models **932**, a pronunciation dictionary **933**, and a first language model **935** and a speech recognition data updating unit **923**.

The speech recognition data updating device **920** and the speech recognition device **930** of FIG. **9** may correspond to the speech recognition data updating devices **220** and **420** and the speech recognition device **230** and **430** of FIGS. **2** and **4**, and repeated descriptions thereof will be omitted. Furthermore, the language model updating unit **921** of FIG. **9** may correspond to the components **221** through **225** and **421** through **425** included in the speech recognition data updating devices **220** and **420** shown in FIGS. **2** and **4**, and repeated descriptions thereof will be omitted.

The new word information **922** of FIG. **9** may include information regarding a word that is recognized by the speech recognition data updating device **920** as a new word. The new word information **922** may include information regarding a new word for updating at least one of the other models **932**, the pronunciation dictionary **933** and the first language model **935**. In detail, the new word information **922** may include information about a word corresponding to an appearance probability added to a second language model **936** by the speech recognition data updating device **920**. For example, the new word information **922** may include at least one of a phoneme sequence of a new word, information regarding predetermined unit components obtained by dividing the phoneme sequence of the new word, and appearance probability information regarding the respective components of the new word.

The speech recognition data updating unit **923** may update at least one of the other models **932**, the pronunciation dictionary **933**, and the first language model **935** of the speech recognition device **930** by using the new word information **922**. In detail, the speech recognition data updating unit **923** may update an acoustic model and the pronunciation dictionary **933** of the other models **932** by using information regarding a phoneme sequence of a new word. Furthermore, the speech recognition data updating unit **923** may update the first language model **935** by using information regarding predetermined unit components obtained by dividing the phoneme sequence of the new word and appearance probability information regarding the respective components of the new word.

Unlike information regarding an appearance probability included in the second language model **936**, appearance probability information regarding a new word included in the first language model **935** updated by the speech recognition data updating unit **923** may include appearance probability information regarding a new word that is not divided into predetermined unit components.

For example, if the new word information **922** includes information regarding 'grim yeon a,' the speech recognition data updating unit **923** may update an acoustic model and the pronunciation dictionary **933** by using a phoneme sequence 'gi myeo na' corresponding to 'gim yeon a.' The acoustic model may include feature information regarding a voice signal corresponding to 'gi myeo na.' The pronunciation dictionary **933** may include a phoneme sequence information 'gi myeo na' corresponding to 'gim yeon a.' Furthermore, the speech recognition data updating unit **923** may update the first language model **935** by re-determining appearance probability information included in the first language model **935** by using appearance probability information regarding 'gim yeon a.'

Appearance probability information included in the first language model **935** are obtained based on a large amount of information regarding sentences, thus including a large number of appearance probability information. Therefore, since it is necessary to re-determine appearance probability information included in the first language model **935** based on information regarding a new word to update the first language model **935**, it may take significantly longer to update the first language model **935** than to update the second language model **936**. The speech recognition data updating device **920** may update the second language model **936** by collecting language data in real time, whereas the speech recognition data updating device **920** may update the first language model **935** periodically at intervals of a long period of time (e.g., once a week or once a month).

If the speech recognition device **930** performs speech recognition by using the second language model **936**, it is necessary to further perform restoration of a text corresponding to a predetermined unit component by using segment information after finally selecting a speech-recognized language. The reason thereof is that, since appearance probability information regarding predetermined unit components is used, a finally selected speech-recognized language includes phoneme sequences obtained by dividing a new word into unit components. Furthermore, appearance probability information included in the second language model **936** are not obtained based on a large amount of information regarding sentences, but obtained based on a sentence including a new word or a limited amount of appearance probability information included in the second language model **936**. Therefore, appearance probability information included in the first language model **934** may be more accurate than appearance probability information included in the second language model **936**.

In other words, it may be more efficient for the speech recognition device **930** to perform a speech recognition by using the first language model **935** than by using the second language model **936** in terms of efficiency and stability. Therefore, the speech recognition data updating unit **923** according to an embodiment may periodically update the first language model **935**, the pronunciation dictionary **933**, and the acoustic model.

FIG. **10** is a flowchart showing a method of updating language data for recognizing a new word, according to an embodiment.

Unlike the method shown in FIG. **3**, the method shown in FIG. **10** may further include an operation for selecting one of at least one or more second language model based on situation information and updating the selected second language model. Furthermore, the method shown in FIG. **10** may further include an operation for updating a first language model based on information regarding a new word, which is used for updating the second language model.

Referring to FIG. **10**, in an operation S**1001**, the speech recognition data updating device **420** may obtain language data including words. The operation S**1001** may correspond to the operation S**301** of FIG. **3**. The language data may include texts included in content or a web page that is being displayed on a display screen of a device being used by a user or a module of the device.

In an operation S**1003**, the speech recognition data updating device **420** may detect a word that does not exist in the language data. In other words, the speech recognition data updating device **420** may detect a word, regarding which information regarding an appearance probability does not exist in a first language model or a second language model, from among at least one word included in the language data. The operation S**1003** may correspond to the operation S**303** of FIG. **3**.

Since the second language model includes appearance probability information regarding respective components obtained by dividing a word into predetermined unit components, the second language data according to an embodiment does not include appearance probability information regarding a whole word. The speech recognition data updating device **420** may detect a word, with respect to which information regarding an appearance probability does not exist in the second language model, by using segment information including information regarding correspondence relationships between words and respective components obtained by dividing the words into predetermined unit components.

In an operation S**1005**, the speech recognition data updating device **420** may obtain at least one phoneme sequence corresponding to the new word detected in the operation S**1003**. A plurality of phoneme sequences corresponding to a word may exist based on various conditions including pronunciation rules or characteristics of a speaker. The operation S**1005** may correspond to the operation S**305** of FIG. **3**.

In an operation S**1007**, the speech recognition data updating device **420** may divide each of at least phoneme sequence obtained in the operation S**1005** into predetermined unit components and obtain components constituting each of the at least one phoneme sequence. In detail, the speech recognition data updating device **420** may divide each of phoneme sequence into subwords based on subword information included in the segment model **434**, thereby obtaining components constituting each of phoneme sequences of a new word. The operation S**1007** may correspond to the operation S**307** of FIG. **3**.

In an operation S**1009**, the speech recognition data updating device **420** may obtain situation information corresponding to the word detected in the operation S**1003**. Situation information may include situation information regarding a detected new word.

Situation information according to an embodiment may include at least one of information regarding a user, module identification information, information regarding location of a device, and information regarding a location at which a new word is obtained. For example, when a new word is obtained at a particular module or while a module is being executed, situation information may include the particular module or information regarding the module being executed. If the new word is obtained while a particular speaker is using the speech recognition data updating device **420** or the new word is related to the particular speaker, situation information regarding the new word may include information regarding the particular speaker.

In an operation S**1011**, the speech recognition data updating device **420** may select the second language model based on the situation information obtained in the operation S**1009**. The speech recognition data updating device **420** may update the second language model by adding appearance probability information regarding components of the new word to the selected second language model.

According to an embodiment, the speech recognition device **430** may include a plurality of independent second language models. In detail, a second language model may include a plurality of independent language models that may be selectively applied based on particular modules, modules, or speakers. In the operation S**1011**, the speech recognition data updating device **420** may select a second language model corresponding to the situation information from among a plurality of independent language models. During speech recognition, the speech recognition device **430** may collect situation information and perform speech recognition by using a second language model corresponding to the situation information. Therefore, according to an embodiment, adaptive speech recognition may be performed based on situation information, and thus speech recognition efficiency may be improved.

In an operation S**1013**, the speech recognition data updating device **420** may determine information regarding an appearance probability of each of the components obtained in the operation S**1007** during speech recognition. For example, the speech recognition data updating device **420** may determine appearance probabilities regarding respective subword components by using a sentence or a paragraph to which components of a word included in the language data belong. The operation S**1013** may correspond to the operation S**309** of FIG. **3**.

In an operation S**1015**, the speech recognition data updating device **420** may update the second language model by using the appearance probability information determined in the operation S**1013**. The speech recognition data updating device **420** may simply add appearance probability information regarding components of a new word to the second language model. Alternatively, the speech recognition data updating device **420** may add appearance probability information regarding components of a new word to the language model selected in the operation S**1011** and re-determine appearance probability information included in the language model selected in the operation S**1011**, thereby updating the second language model. The operation S**1015** may correspond to the operation S**311** of FIG. **3**.

In an operation S**1017**, the speech recognition data updating device **420** may generate new word information for adding the word detected in the operation S**1003** to the first language model. In detail, new word information may include at least one of information regarding components obtained by dividing a new word used for updating the second language model, information regarding a phoneme sequence, situation information, and appearance probabilities regarding the respective components. If the second language model is repeatedly updated, new word information may include information regarding a plurality of new words.

In an operation S**1019**, the speech recognition data updating device **420** may determine whether to update at least one of other models, a pronunciation dictionary, and the first language model. Next, in the operation S**1019**, the speech recognition data updating device **420** may update at least one of the other models, the pronunciation dictionary, and the first language model by using the new word information generated in the operation S**1017**. The other models may include an acoustic model including information for obtaining phoneme sequences corresponding to voice signals. A significant time period may be elapsed for updating the at least one of the other models, the pronunciation dictionary, and the first language model, because it is necessary to re-determine data included in the respective models based on information regarding a new word. Therefore, the speech recognition data updating device **420** may update the entire model in an idle time slot or at weekly or monthly intervals.

The speech recognition data updating device **420** according to an embodiment may update a second language model in real time for speech recognition of a word that is detected as a new word. Since a small number of probability information are included in the second language model, the second language model may be updated quicker than updating the first language model, speech recognition data may be updated in real time.

However, compared to speech recognition by using a first language model, it is not preferable for performing speech recognition by using a second language model in terms of efficiency and stability of a recognition result. Therefore, the speech recognition data updating device **420** may periodically update the first language model by using appearance probability information included in the second language model, such that a new word may be recognized by using the first language model.

Hereinafter, a method of performing speech recognition based on updated speech recognition data according to an embodiment will be described in closer details.

FIG. **11** is a block diagram showing a speech recognition device that performs speech recognition according to an embodiment.

Referring to FIG. **11**, a speech recognition device **1130** according to an embodiment may include a speech recognizer **1131**, other model **1132**, a pronunciation dictionary **1133**, a language model combining unit **1135**, a first language model **1136**, a second language model **1137**, and a text restoration unit **1138**. The speech recognition device **1130** of FIG. **11** may correspond to the speech recognition devices **100**, **230**, **430**, and **930** of FIGS. **1**, **2**, **4**, and **9**, where repeated descriptions will be omitted.

Furthermore, the speech recognizer **1131**, the other model **1132**, the pronunciation dictionary **1133**, the language model combining unit **1135**, the first language model **1136**, and the second language model **1137** of FIG. **11** may correspond to the speech recognition units **100**, **231**, **431**, and **931**, the other models **232**, **432**, and **932**, the pronunciation dictionaries **150**, **233**, **433**, and **933**, the language model combining units **435** and **935**, the first language models **436** and **936**, and the second language models **437** and **937** of FIGS. **1**, **2**, **4**, and **9**, where repeated descriptions will be omitted.

Unlike the speech recognition devices **100**, **230**, **430**, and **930** of FIGS. **1**, **2**, **4**, and **9**, the speech recognition device **1130** shown in FIG. **11** further includes the text restoration unit **1138** and may perform text restoration during speech recognition.

The speech recognizer **1131** may obtain speech data **1110** for performing speech recognition. The speech recognizer **1131** may perform speech recognition by using the other model **1132**, the pronunciation dictionary **1133**, and the language model combining unit **1135**. In detail, the speech recognizer **1131** may extract feature information regarding a voice data signal and obtain a candidate phoneme sequence corresponding to the extracted feature information by using an acoustic model. Next, the speech recognizer **1131** may obtain words corresponding to respective candidate phoneme sequences from the pronunciation dictionary **1133**. The speech recognizer **1131** may finally select a word corresponding to the highest appearance probability based on appearance probabilities regarding the respective words obtained from the language model combining unit **1135** and output a speech-recognized language.

The text restoration unit **1138** may determine whether to perform text restoration based on whether appearance probabilities regarding respective components constituting a word are used for speech recognition. According to an embodiment, text restoration refers to converting characters of predetermined unit components included in a language speech-recognized by the speech recognizer **1131** to a corresponding word.

For example, it may be determined whether to perform text restoration based on information indicating that appearance probabilities are used with respect to respective subwords during speech recognition, the information generated by the speech recognizer **1131**. In another example, the text restoration unit **1138** may determine whether to perform text restoration by detecting subword components from a speech-recognized language based on segment information **1126** or the pronunciation dictionary **1133**. However, the present invention is not limited thereto, and the text restoration unit **1138** may determine whether to perform text restoration and a portion for performing text restoration with respect to a speech-recognized language.

In the case of performing text restoration, the text restoration unit **1138** may restore subword characters based on the segment information **1126**. For example, if a sentence speech-recognized by the speech recognizer **1131** is 'oneul gi myeo na bo yeo jyo,' the text restoration unit **1138** may determine whether appearance probability information is used with respect to each of subwords for speech-recognizing the sentence. Furthermore, the text restoration unit **1138** may determine portions to which appearance probabilities are used for respective subwords in a speech-recognized sentence, that is, portions for text restoration. The text restoration unit **1138** may determine 'myeo,' 'na,' 'bo,' 'yeo,' and 'jyo' as portions to which appearance probability are used for respective subwords. Furthermore, the text restoration unit **1138** may refer to correspondence relationships between subwords and words stored in the segment information **1126** and perform text restoration by converting 'gi myeo na' to 'gim yeon a' and 'bo yeo jyo' into 'boyeojyo.' The text restoration unit **1138** may finally output a speech-recognized language **1140** including the restored texts.

FIG. **12** is a flowchart showing a method of performing speech recognition according to an embodiment.

Referring to FIG. **12**, in an operation S**1210**, the speech recognition device **100** may obtain speech data for performing speech recognition.

In an operation S**1220**, the speech recognition device **100** may obtain at least one phoneme sequence included in the speech data. In detail, the speech recognition device **100** may detect feature information regarding the speech data and obtain a phoneme sequence from the feature information by using an acoustic model. At least one or more phoneme sequences may be obtained from the feature information. If a plurality of phoneme sequences are obtained from same speech data based on an acoustic model, the speech recognition device **100** may finally determine a speech-recognized word by obtaining appearance probabilities regarding words corresponding to the plurality of phoneme sequences.

In an operation S**1230**, the speech recognition device **100** may obtain appearance probability information regarding predetermined unit components constituting at least one phoneme sequence. In detail, the speech recognition device **100** may obtain appearance probability information regarding predetermined unit components included in a language model.

If appearance probability information regarding predetermined unit components constituting a phoneme sequence cannot be obtained from a language model, the speech recognition device **100** is unable to obtain information regarding a word corresponding to the corresponding phoneme sequence. Therefore, the speech recognition device **100** may determine that the corresponding phoneme sequence cannot be speech-recognized and perform speech recognition with respect to other phoneme sequences regarding the same speech data obtained in the operation S**1220**. If speech recognition cannot be performed with respect to the other phoneme sequences, the speech recognition device **100** may determine that the speech data cannot be speech-recognized.

In an operation S**1240**, the speech recognition device **100** may select at least one of at least one phoneme sequence based on appearance probability information regarding predetermined unit components constituting phoneme sequences. For example, the speech recognition device **100** may select a phoneme sequence corresponding to the highest probability from among the at least one candidate phoneme sequences based on appearance probability information corresponding to subword components constituting the candidate phoneme sequences.

In an operation S**1250**, the speech recognition device **100** may obtain a word corresponding to the phoneme sequence selected in the operation S**1240** based on segment information including information regarding a word corresponding to at least one predetermined unit component. Segment information according to an embodiment may include information regarding predetermined unit components corresponding to a word. Therefore, the speech recognition device **100** may convert subword components constituting a phoneme sequence to a corresponding word based on the segment information. The speech recognition device **100** may output a word converted based on the segment information as a speech-recognized result.

FIG. **13** is a flowchart showing a method of performing speech recognition according to an embodiment. Unlike the method shown in FIG. **12**, the method of performing speech recognition shown in FIG. **13** may be used to perform speech recognition based on situation information regarding speech data. Some of operations of the method shown in

FIG. **13** may correspond to some of the operations of the method shown in FIG. **12**, where repeated descriptions will be omitted.

Referring to FIG. **13**, in an operation S**1301**, the speech recognition device **430** may obtain speech data for performing speech recognition. The operation S**1301** may correspond to the operation S**1210** of FIG. **12**.

In an operation S**1303**, the speech recognition device **430** may obtain at least one phoneme sequence corresponding to the speech data. In detail, the speech recognition device **430** may detect feature information regarding the speech data and obtain a phoneme sequence from the feature information by using an acoustic model. If a plurality of phoneme sequences are obtained, the speech recognition device **430** may perform speech recognition by finally determining one subword or word based on appearance probabilities regarding subwords or words corresponding to respective phoneme sequences.

In an operation S**1305**, the speech recognition device **430** may obtain situation information regarding the speech data. The speech recognition device **430** may perform speech recognition in consideration of the situation information regarding the speech data by selecting a language model to be applied during the speech recognition based on the situation information regarding the speech data.

According to an embodiment, situation information regarding speechd data may include at least one of information regarding a user, module identification information, and information regarding location of a device. A language model that may be selected during speech recognition may include appearance probability information regarding words or subwords and may correspond to at least one situation information.

In an operation S**1307**, the speech recognition device **430** may determine whether information regarding a word corresponding to the respective phoneme sequences obtained in the operation S**1303** exists in a pronunciation dictionary. In the case where information regarding a word corresponding to a phoneme sequence exists in the pronunciation dictionary, the speech recognition device **430** may perform speech recognition with respect to the corresponding phoneme sequence based on the word corresponding to the corresponding phoneme sequence. In the case where information regarding a word corresponding to a phoneme sequence does not exist in the pronunciation dictionary, the speech recognition device **430** may perform with respect to the corresponding phoneme sequence based on subword components constituting the corresponding phoneme sequence. A word that does not exist in the pronunciation dictionary may be either a word that cannot be speech-recognized or a new word added to a language model when speech recognition data is updated according to an embodiment.

In the case of a phoneme sequence corresponding to information existing in the pronunciation dictionary, the speech recognition device **100** may obtain a word corresponding to the phoneme sequence by using the pronunciation dictionary and finally determine a speech-recognized word based on appearance probability information regarding the word.

In the case of a phoneme sequence corresponding to information existing in the pronunciation dictionary, the speech recognition device **100** may also divide the phoneme sequence into predetermined unit components and determine appearance probability information regarding the components. In other words, all of the operations S**1307** through S**1311** and the operation S**1317** through S**1319** may be performed with respect to a phoneme sequence corresponding to information existing in the pronunciation dictionary. If a plurality of appearance probability information are obtained with respect to a phoneme sequence, the speech recognition device **100** may obtain an appearance probability regarding the phoneme sequence by combining appearance probabilities obtained from a plurality of language models as described below.

A method of performing speech recognition with respect to phoneme sequences in a case where a pronunciation dictionary includes information regarding words corresponding to the phoneme sequence will be described below in detail in descriptions of operations S**1317** through S**1321**. Furthermore, a method of performing speech recognition with respect to phoneme sequences in a case where a pronunciation dictionary does not include information regarding words corresponding to the phoneme sequence will be described below in detail in descriptions of operations S**1309** through S**1315**.

In the case of phoneme sequences where a pronunciation dictionary includes information regarding words corresponding to the phoneme sequence, the speech recognition device **430** may obtain words corresponding to the respective phoneme sequences from the pronunciation dictionary in the operation S**1317**. The pronunciation dictionary may include information regarding at least one phoneme sequence that may correspond to a word. A plurality of phoneme sequences corresponding to a word may exist. On the other hand, a plurality of words corresponding to a phoneme sequence may exist. Information regarding phoneme sequences that may correspond to words may be generally determined based on pronunciation rules. However, the present invention is not limited thereto, and information regarding phoneme sequences that may correspond to words may also be determined based on a user input or a result of learning a plurality of speech data.

In an operation S**1319**, the speech recognition device **430** may obtain appearance probability information regarding the words obtained in the operation S**1317** from a first language model. The first language model may include a general-purpose language model that may be used for general speech recognition. Furthermore, the first language model may include appearance probability information regarding words included in the pronunciation dictionary.

If the first language model includes at least one language model corresponding to situation information, the speech recognition device **430** may determine at least one language model included in the first language model based on the situation information obtained in the operation S**1305**. Next, the speech recognition device **430** may obtain appearance probability information regarding the words obtained in the operation S**1317** from the determined language model. Therefore, even in the case of applying a first language model, the speech recognition device **430** may perform adaptive speech recognition based on situation information by selecting a language model corresponding to the situation information.

If a plurality of language models are determined and appearance probability information regarding a word is included in two or more of the determined language models, the speech recognition device **430** may obtain appearance probability information regarding the word by combining the language models. Detailed descriptions thereof will be given below in the description of the operation S**1313**.

In an operation S**1321**, the speech recognition device **430** may finally determine a speech-recognized word based on the information regarding an appearance probability obtained in the operation S**1319**. If a plurality of words that may correspond to same speech data exist, the speech recognition device **430** may finally determine and output a speech-recognized word based on appearance probabilities regarding the respective words.

In the case of phoneme sequences where a pronunciation dictionary does not include information regarding words corresponding to the phoneme sequence, in the operation S**1309**, the speech recognition device **430** may determine at least one of second language models based on the situation information obtained in the operation S**1305**. The speech recognition device **430** may include at least one independent second language model that may be applied during speech recognition based on situation information. The speech recognition device **430** may determine a plurality of language models based on situation information. Furthermore, the second language model that may be determined in the operation S**1309** may include appearance probability information regarding predetermined unit components constituting phoneme sequences.

In the operation S**1311**, the speech recognition device **430** may determine whether the second language model determined in the operation S**1309** includes appearance probability information regarding predetermined unit components constituting phoneme sequences. If the second language model does not include the appearance probability information regarding the components, appearance probability information regarding phoneme sequences cannot be obtained, and thus speech recognition can no longer be performed. If a plurality of phoneme sequences corresponding to same speech data exist, the speech recognition device **430** may determine whether words corresponding to phoneme sequences other than the phoneme sequence, regarding which information regarding an appearance probability thereof cannot be obtained, exist in a pronunciation dictionary in the operation S**1307**.

In the operation S**1313**, the speech recognition device **430** may determine one of at least one phoneme sequence based on appearance probability information regarding predetermined unit components included in the second language model determined in the operation S**1309**. In detail, the speech recognition device **430** may obtain appearance probability information regarding predetermined unit components constituting phoneme sequences from the second language model. Next, the speech recognition device **430** may determine a phoneme sequence corresponding to the highest appearance probability based on the appearance probability information regarding the predetermined unit components.

When a plurality of language models are selected in the operation S**1309** or the operation S**1319**, appearance probability information regarding a predetermined unit component or word may be included in two or more language models. The plurality of language models that may be selected may include at least one of a first language model and a second language model.

For example, if a new word is added to two or more language models based on situation information when speech recognition data is updated, appearance probability information regarding a same word or subword may be added to two or more language models. In another example, if a word that existed only in a second language model is added to a first language model when speech recognition data is periodically updated, appearance probability information regarding a same word or subword may be included in the first language model and the second language model. The speech recognition device **430** may obtain an appearance probability regarding a predetermined unit component or word by combining the language models.

When there are a plurality of appearance probability information regarding a single word or component as a plurality of language models are selected, the language model combining unit **435** of the speech recognition device **430** may obtain a single appearance probability.

For example, as shown in Equation 1 below, the language model combining unit **435** may obtain a single appearance probability by obtaining a sum of weights regarding respective appearance probabilities.

$$P(a|b)=\omega_1 P_1(a|b)+\omega_2 P_2(a|b)(\omega_1+\omega_2=1) \quad \text{Equation 1}$$

In Equation 1, P(a|b) denotes an appearance probability regarding a under a condition that b appears before a. **P1** and **P2** denote an appearance probability regarding a included in a first language model and a second language model, respectively ω**1** and ω**2** denotes weights that may be applied to **P1** and P**2**, respectively. A number of right-side components of Equation 1 may increase according to a number of language models including appearance probability information regarding a.

Weights that may be applied to respective appearance probabilities may be determined based on situation information or various other conditions, e.g., information regarding a user, a region, a command history, a module being executed, etc.

According to Equation 1, an appearance probability may increase as information regarding the appearance probability is included in more language models. On the contrary, an appearance probability may decrease as information regarding the appearance probability is included in less language models. Therefore, a preferable appearance probability may not be determined in the case of determining an appearance probability according to Equation 1.

The language model combining unit **435** may obtain an appearance probability regarding a word or a subword according to Equation 2 based on the Bayesian interpolation. In the case of determining an appearance probability according to Equation 2, the appearance probability may not increase or decrease according to a number of language models including appearance probability information. In the case of an appearance probability included only in a first language model or a second language model, the appearance probability may not decrease and may be maintained according to Equation 2.

$$P(a \mid b) = \frac{\omega_1 P_1((b)P_1(a|b) + \omega_2 P_2((b)P_2(a|b)}{\omega_1 P_1(b) + \omega_2 P_2(b)}(\omega_1 + \omega_2 = 1) \quad \text{Equation 2}$$

Furthermore, the language model combining unit **435** may obtain an appearance probability according to Equation 3. According to Equation 3, an appearance probability may be the largest one from among appearance probabilities included in the respective language models

$$P(a|b)=\max\{P_1(a|b),P_2(a|b)\} \quad \text{Equation 3:}$$

In the case of determining an appearance probability according to Equation 3, the appearance probability may be the largest one from among the appearance probabilities, and thus an appearance probability regarding a word or subword included one or more times in each of the language models may have a relatively large value. Therefore, according to Equation 3, an appearance probability regarding a word added to language models as a new word according to an embodiment may be falsely reduced.

In the operation S1315, the speech recognition device **430** may obtain a word corresponding to the phoneme sequence determine in the operation S1313 based on segment information. The segment information may include information regarding a correspondence relationship between at least one unit component constituting a phoneme sequence and a word. If a new word is detected according to a method of updating speech recognition data according to an embodiment, segment information regarding each word may be generated as information regarding a new word. If a phoneme sequence is determined as a result of speech recognition based on probability information, the speech recognition device **430** may convert a phoneme sequence to a word based on the segment information, and thus a result of the speech recognition may be output as the word.

FIG. **14** is a block diagram showing a speech recognition system that executes a module based on a result of speech recognition performed based on situation information, according to an embodiment.

Referring to FIG. **14**, a speech recognition system **1400** may include a speech recognition data updating device **1420**, a speech recognition device **1430**, and a user device **1450**. The speech recognition data updating device **1420**, the speech recognition device **1430**, and the user device **1450** may exist as independent deices as shown in FIG. **14**. However, the present invention is not limited thereto, and the speech recognition data updating device **1420**, the speech recognition device **1430**, and the user device **1450** may be included in a single device as components of the device. The speech recognition data updating device **1420** and the speech recognition device **1430** of FIG. **14** may correspond to the speech recognition data updating devices **220** and **420** and the speech recognition devices **230** and **430** described above with reference to FIG. **13**, where repeated descriptions will be omitted.

First, a method of updating speech recognition data in consideration of situation information by using the speech recognition system **1400** shown in FIG. **14** will be described.

The speech recognition data updating device **1420** may obtain language data **1410** for updating speech recognition data. The language data **1410** may be obtained from various devices and transmitted to the speech recognition data updating device **1420**. For example, the language data **1410** may be obtained by the user device **1450** and transmitted to the speech recognition data updating device **1420**.

Furthermore, a situation information managing unit **1451** of the user device **1450** may obtain situation information corresponding to the language data **1410** and transmit the obtained situation information to the speech recognition data updating device **1420**. The speech recognition data updating device **1420** may determine a language model to add a new word included in the language data **1410** based on the situation information received from the situation information managing unit **1451**. If no language model corresponding to the situation information exists, the speech recognition data updating device **1420** may generate a new language model and add appearance probability information regarding a new word to the newly generated language model.

The speech recognition data updating device **1420** may detect new words 'Let it go,' and 'born born born' included in the language data **1410**. Situation information corresponding to the language data **1410** may include an application A for music playback. Situation information may be determined with respect to the language data **1410** or may also be determined with respect to each of new words included in the language data **1410**.

The speech recognition data updating device **1420** may add appearance probability information regarding 'Let it go' and 'born born born' to at least one language model corresponding to the application A. The speech recognition data updating device **1420** may update speech recognition data by adding appearance probability information regarding a new word to a language model corresponding to situation information. The speech recognition data updating device **1420** may update speech recognition data by re-determining appearance probability information included in the language model to which appearance probability information regarding a new word is added. A language model to which appearance probability information may be added may correspond to one application or a group including at least one application.

The speech recognition data updating device **1420** may update a language model in real time based on a user input. In relation to the speech recognition device **1430** according to an embodiment, a user may issue a voice command to an application or an application group according to a language defined by the user. If only an appearance probability regarding a command 'Play [Song]' exists in a language model, appearance probability information regarding a command 'Let me listen to [Song]' may be added to the language model based on a user definition.

However, if a language can be determined based on a user definition, an unexpected voice command may be performed as a language defined by another user is applied. Therefore, the speech recognition data updating device **1420** may set an application or a time for application of a language model as a range for applying a language model determined based on a user definition.

The speech recognition data updating device **1420** may update speech recognition data in real time based on situation information received from the situation information managing unit **1451** of the user device **1450**. If the user device **1450** is located nearby a movie theater, the user device **1450** may transmit information regarding the corresponding movie theater to the speech recognition data updating device **1420** as situation information. Information regarding a movie theater may include information regarding movies being played at the corresponding movie theater, information regarding restaurants nearby the movie theater, traffic information, etc. The speech recognition data updating device **1420** may collect information regarding the corresponding movie theater via web crawling or from a content provider. Next, the speech recognition data updating device **1420** may update speech recognition data based on the collected information. Therefore, since the speech recognition device **1430** may perform speech recognition in consideration of location of the user device **1450**, speech recognition efficiency may be further improved.

Second, a method of performing speech recognition and executing a module based on a result of the speech recognition at the speech recognition system **1400** will be described.

The user device **1450** may include various types of terminal devices that may be used by a user. For example, the user device **1450** may be a mobile phone, a smart phone, a laptop computer, a tablet PC, an e-book terminal, a digital broadcasting device, a personal digital assistant (PDA), a portable multimedia player (PMP), a navigation device, a MP3 player, a digital camera, or a wearable device (e.g., eyeglasses, a wristwatch, a ring, etc.). However, the present invention is not limited thereto.

The user device **1450** according to an embodiment may collect at least one of situation information related to speech data **1440** and the user device **1450** and perform a determined task based on a speech-recognized word that is speech-recognized based on the situation information.

The user device **1450** may include the situation information managing unit **1451**, the module selecting and instructing unit **1452**, and an application A **1453** for performing a task based on a result of speech recognition.

The situation information managing unit **1451** may collect situation information for selecting a language model during speech recognition at the speech recognition device **1430** and transmit the situation information to the speech recognition device **1430**.

Situation information may include information regarding a module being currently executed on the user device **1450**, a history of using modules, a history of voice commands, information regarding an application that may be executed on the user device **1450** and corresponds to an existing language model, information regarding a user currently using the user device **1450**, etc. The history of using modules and the history of voice commands may include information regarding time points at which the respective modules are used and time points at which the respective voice commands are received, respectively.

Situation information according to an embodiment may be configured as shown in Table 1 below.

TABLE 1

	Situation Information
Currently Used Module	Movie Player Module 1
History of Module Usage	Music Player Module 1/1 Day Ago Cable Broadcasting/1 Hour Ago Music Player Module 1/30 Minutes Ago
History of Voice Command	Home Theater Play [Singer 1] Song/10 Minutes Ago Music Player Module 1/30 Minutes Ago
Application with Language	Broadcasting Music Player Module 1 Movie Player Module 1 Music Player Module 2

The speech recognition device **1430** may select at least one language model to be used during speech recognition based on situation information. If situation information indicates that the speech data **1440** is obtained from the user device **1450** while the application A is being executed, the speech recognition device **1430** may select a language model corresponding to at least one of the application A and the user device **1450**.

The module selecting and instructing unit **1452** may select a module based on a result of speech recognition performed by the speech recognition device **1430** and transmit a command to perform a task to the selected module. First, the module selecting and instructing unit **1452** may determine whether the result of speech recognition includes an identifier of a module and a keyword for a command. A keyword for a command may include identifiers indicating commands for requesting a module to perform respective tasks, e.g., play, pause, next, etc.

If a module identifier is included in the result of speech recognition, the module selecting and instructing unit **1452** may select a module corresponding to the module identifier and transmit a command to the selected module.

If a module identifier is not included in the result of speech recognition, the module selecting and instructing unit **1452** may obtain at least one of a keyword for a command included in the result of speech recognition and situation information corresponding to the result of speech recognition. Based on at least one of the keyword for a command and the situation information, the module selecting and instructing unit **1452** may determine a module for performing a task according to the result of speech recognition.

In detail, the module selecting and instructing unit **1452** may determine a module for performing a task based on a keyword for a command Furthermore, the module selecting and instructing unit **1452** may determine a module that is the most suitable for performing the task based on situation information. For example, the module selecting and instructing unit **1452** may determine a module based on an execution frequency or whether the corresponding module is the most recently executed module.

Situation information that may be collected by the module selecting and instructing unit **1452** may include information regarding a module currently being executed on the user device **1450**, a history of using modules, a history of voice commands, information regarding an application that corresponding to an existing language model, etc. The history of using modules and the history of voice commands may include information regarding time points at which the modules are used and time points at which the voice commands are received.

Even if a result of speech recognition includes a module identifier, the corresponding module may not be able to perform a task according to a command The module selecting and instructing unit **1452** may determine a module to perform a task as in the case where a result of speech recognition does not include a module identifier.

Referring to FIG. **14**, the module selecting and instructing unit **1452** may receive 'let me listen to Let it go' from the speech recognition device **1430** as a result of speech recognition. Since the result of speech recognition does not include an application identifier, an application A for performing a task based on the result of speech recognition may be determined based on situation information or a keyword for a command The module selecting and instructing unit **1452** may request the application A to play back a song 'Let it go.'

FIG. **15** is a diagram showing an example of situation information regarding a module, according to an embodiment.

Referring to FIG. **15**, an example of commands of a music player program **1510** for performing a task based on a voice command is shown. The speech recognition data updating device **1520** may correspond to the speech recognition data updating device **1420** of FIG. **14**.

The speech recognition data updating device **1520** may receive situation information regarding the music player [2]**5** program **1510** from the user device **1450** and update speech recognition data based on the received situation information.

The situation information regarding the music player program **1510** may include a header **1511**, a command language **1512**, and music information **1513** as shown in FIG. **15**.

The header **1511** may include information for identifying the music player program **1510** and may include information regarding type, storage location, and name of the music player program **1510**.

The command language **1512** may include an example of commands regarding the music player program **1510**. The music player program **1510** may perform a task when a speech-recognized sentence like the command language **1512** is received. A command of the command language **1512** may also be set by a user.

The music information **1513** may include information regarding music that may be played back by the music player program **1510**. For example, the music information **1513** may include identification information regarding music files that may be played back by the music player program **1510** and classification information thereof, such as information regarding albums and singers.

The speech recognition data updating device **1520** may update a second language model regarding the music player program **1510** by using a sentence of the command language **1512** and words included in the music information **1513**. For example, the speech recognition data updating device **1520** may obtain appearance probability information by including words included in the music information **1513** in a sentence of the command language **1512**.

When a new application is installed, the user device **1450** according to an embodiment may transmit information regarding the application, which includes the header **1511**, the command language **1512**, and the music information **1513**, to the speech recognition data updating device **1520**. Furthermore, when a new event regarding an application occurs, the user device **1450** may update information regarding the application, which includes the header **1511**, the command language **1512**, and the music information **1513**, and transmit the updated information to the speech recognition data updating device **1520**. Therfore, the speech recognition data updating device **1520** may update a language model based on the latest information regarding the application.

When the speech recognition device **1430** performs speech recognition, the user device **1450** may transmit situation information for performing speech recognition to the speech recognition device **1430**. The situation information may include information regarding the music player program shown in FIG. **5**.

The situation information may be configured as shown in Table 2.

TABLE 2

	Situation Information
Currently Used Module	Memo
Command History	Music Player Module 3 Play [Song Title] 1/10 Minutes Ago Music Player Module 3 Play [Singer 1] Song/15 Minutes Ago
History of Simultaneous Module Usage	Memo - Music Player Module 3/1 Day Ago Memo - Music Player Module 3/2 Days Ago
Module Information	Music Player Module 1 [Singers 1-3] N Songs Music Player Module 2 [Singers 3-6] N Songs Music Player Module 3 [Singers 6-8] N Songs
SNS History	Music Player Module 1 Stated Once Music Player Module 2 Stated Four Times Music Player Module N Stated Twice

The speech recognition device **1430** may determine weights applicable to language models corresponding to respective music player programs based on a history of simultaneous module usages from among situation information shown in Table 2 If a memo program is currently being executed, the speech recognition device **1430** may perform speech recognition by applying a weight to a language model corresponding to a music player program that has been simultaneously used with the memo program. As a voice input is received from a user, if a result of speech recognition performed by the speech recognition device **1430** is output as 'Play all [Singer 3] songs,' the module selecting and instructing unit **1432** may determine a module to perform a corresponding task. Since a speech-recognized command does not include a module identifier, the module selecting and instructing unit **1432** may determine a module to perform a corresponding task based on the command and the situation information. In detail, the module selecting and instructing unit **1432** may select a module to play back music according to a command in consideration of various information including a history of simultaneous module usages, a history of recent module usages, and a history of SNS usages included in the situation information. Referring to Table 1, from between music player modules 1 and 2 capable of play back songs of [Singer 3], a number of times that the music player module 2 is mentioned on SNS is greater than the music player module 1, the module selecting and instructing unit **1432** may select the music player module 2. Since the command does not include a module identifier, the module selecting and instructing unit **1432** may finally decide whether to play music by using the selected music player module 2 based on a user input.

The module selecting and instructing unit **1432** may request to perform a plurality of tasks with respect to a plurality of modules according to a speech-recognized command. It is assumed that situation information is configured as shown in Table 3 below.

TABLE 3

	Situation Information
Currently Used Module	Home Screen
Command History	Music Player Module 3 Play [Song]/10 Minutes Ago I Will Write Memo/20 Minutes Ago
History of Using Settings for Using Modules	Movie Player Module - Volume 1/1 Day Ago Movie Player Module - Increase Brightness/1 Day Ago

If a speech-recognized command is 'show me [Movie],' the module selecting and instructing unit **1432** may select a movie player module capable of playing back the [Movie] as a module to perform a corresponding task. The module selecting and instructing unit **1432** may determine a plurality of modules to perform a command, other than the movie player module, based on information regarding a history of using settings for using modules from among situation information.

In detail, the module selecting and instructing unit **1432** may select a volume adjusting is module and an, illumination adjusting module for adjusting volume and illumination based on the information regarding the history of using settings for using modules. Next, the module selecting and instructing unit **1432** may transmit requests for adjusting volume and illumination to a module selected based on the information regarding the history of using settings for using modules.

FIG. **16** is a flowchart showing an example of methods of performing speech recognition according to an embodiment.

Referring to FIG. **16**, in an operation **1610**, the speech recognition device **1430** may obtain speech data to perform speech recognition.

In an operation **1620**, the speech recognition device **1430** may obtain situation information regarding the speech data. If an application A for music playback is being executed on the user device **1450** at which the speech data is obtained, the situation information may include situation information indicating that the application A is being executed.

In an operation **1630**, the speech recognition device **1430** may determine at least one language model based on the situation information obtained in the operation **1620**.

In operations **1640** and **1670**, the speech recognition device **1430** may obtain phoneme sequences corresponding to the speech data. Phoneme sequences corresponding to speech data including a speech 'Let it go' may include phoneme sequences 'leritgo' and 'naerigo.' Furthermore, phoneme sequences corresponding to speech data including a speech 'dulryojyo' may include phoneme sequences 'dulryojyo' and 'dulyeojyo.'

If a word corresponding to a pronunciation dictionary exists in the obtained phoneme sequences, the speech recognition device **1430** may convert the phoneme sequences to words. Furthermore, a phoneme sequence without a word corresponding to the pronunciation dictionary may be divided into predetermined unit components.

From among the phoneme sequences, since a word corresponding the phoneme sequence 'leritgo' does not exist in the pronunciation dictionary, the phoneme sequence 'leritgo' may be divided into predetermined unit components. Furthermore, regarding the phoneme sequence 'naerigo' from among the phoneme sequences, a correspond word 'naerigo' in the pronunciation dictionary and predetermined unit components 'nae ri go' may be obtained.

Since words corresponding to the phoneme sequences 'dulryojyo' and 'dulyeojyo' exist in the pronunciation dictionary, the phoneme sequences 'dulryojyo' and 'dulyeojyo' may be obtained.

In an operation **1650**, the speech recognition device **1430** may determine 'le rit go' from among 'le rit go,' 'naerigo,' and 'nae ri go' based on appearance probability information. Furthermore, in an operation **1680**, the speech recognition device **1430** may determine "dulryojyo' from between 'dulryojyo' and 'dulyeojyo' based on appearance probability information.

From among the phoneme sequences, there are two appearance probability information regarding the phoneme sequence 'naerigo,' and thus an appearance probability regarding the phoneme sequence 'naerigo' may be determined by combining language models as described above.

In an operation **1660**, the speech recognition device **1430** may restore 'le rit go' to the original word 'Let it go' based on segment information. Since 'dulryojyo' is not a divided word and segment information does not include information regarding 'dulryojyo,' an operation like the operation **1660** may not be performed thereon.

In an operation **1690**, the speech recognition device **1430** may output 'Let it go dulryojyo' as a final result of speech recognition.

FIG. **17** is a flowchart showing an example of methods of performing speech recognition according to an embodiment.

Referring to FIG. **17**, in an operation **1710**, the speech recognition device **1430** may obtain speech data to perform speech recognition.

In an operation **1703**, the speech recognition device **1430** may obtain situation information regarding the speech data. In an operation **1730**, the speech recognition device **1430** may determine at least one language model based on the situation information obtained in the operation **1720**.

In operations **1707**, **1713**, and **1719**, the speech recognition device **1430** may obtain phoneme sequences corresponding to the speech data. Phoneme sequences corresponding to speech data including speeches 'oneul' and 'gim yeon a' may include 'oneul' and 'gi myeo na,' respectively. Furthermore, phoneme sequences corresponding to speech data including a speech 'toyeojyo' may include 'boyeojeo' and 'toyeojyo.' However, not limited to the above-stated phoneme sequences, phoneme sequences different from the examples may be obtained according to speech data.

In an operation **1707**, the speech recognition device **1430** may obtain a word 'oneul' corresponding to the phoneme sequence 'oneul' by using a pronunciation dictionary. In an operation **1713**, the speech recognition device **1430** may obtain a word 'gim yeon a' corresponding to the phoneme sequence 'gi myeo na' by using the pronunciation dictionary.

Furthermore, in operations **1713** and **1719**, the speech recognition device **1430** may divide 'gimyeona,' 'boyeojyo,' and 'boyeojeo' into designated unit components and obtain 'gi myeo na,' 'bo yeo jyo,' and 'bo yeo jeo,' respectively.

In operations **1709**, **1715**, and **1721**, the speech recognition device **1430** may determine 'oneul,' 'gi myeo na,' and 'bo yeo jeo' based on appearance probability information. From among the phoneme sequences, two appearance probability information may exist in relation to 'gi myeo na,' and thus an appearance probability regarding 'gi myeo na' may be determined by combining language models as described above.

In operations **1717** and **1723**, the speech recognition device **1430** may restore original words 'gimyeona' and 'boyeojyo' based on segment information. Since 'oneul' is not a word divided into predetermined unit components and segment information does not include 'oneul,' a restoration operation may not be performed.

In an operation **1725**, the speech recognition device **1430** may output 'oneul gimyeona boyeojyo' as a final result of speech recognition.

FIG. **18** is a block diagram showing a speech recognition system that executes a plurality of modules according to a result of speech recognition performed based on situation information, according to an embodiment.

Referring to FIG. **18**, the speech recognition system **1800** may include a speech recognition data updating device **1820**, a speech recognition device **1830**, a user device **1850**, and external device **1860** and **1870**. The speech recognition data updating device **1820**, the speech recognition device **1830**, and the user device **1850** may be embodied as independent devices as shown in FIG. **18**. However, the present invention is not limited thereto, and the speech recognition data updating device **1820**, the speech recognition device **1830**, and the user device **1850** may be embedded in a single device as components of the device. The speech recognition data updating device **1820** and the speech recognition device **1830** of FIG. **18** may correspond to the speech recognition data updating devices **220** and **420** and the speech recognition devices **230** and **430** described above with reference to FIGS. **1** through **17**, where repeated descriptions thereof will be omitted below.

First, a method of updating speech recognition data in consideration of situation information by using the speech recognition system **1800** shown in FIG. **18** will be described.

The speech recognition data updating device **1820** may obtain language data **1810** for updating speech recognition data. Furthermore, a situation information managing unit **1851** of the user device **1850** may obtain information regarding corresponding to the language data **1810** and transmit the obtained situation information to the speech recognition data updating device **1820**. The speech recognition data updating device **1820** may determine a language model to add new words included in the language data **1810** based on the situation information received from the situation information managing unit **1851**.

The speech recognition data updating device **1820** may detect new words 'winter kingdom' and '5.1 channels' included in the language data **1810**. Situation information regarding the word 'winter kingdom' may include information regarding related to a digital versatile disc (DVD) player device **1860** for movie playback. Furthermore, situation information regarding the word '5.1 channels' may include information regarding a home theatre device **1870** for audio output.

The speech recognition data updating device **1820** may add appearance probability information regarding 'winter kingdom' and '5.1 channels' to at least one or more language models respectively corresponding to the DVD player device **1860** and the home theatre device **1870**.

Second, a method that the speech recognition system **1800** shown in FIG. **18** performs speech recognition and each device performs a task based on a result of the speech recognition will be described.

The user device **1850** may include various types of terminals that may be used by a user.

The user deice **1850** according to an embodiment may collect at least one of speech data **1840** and situation information regarding the user device **1850**. Next, the user device **1850** may request at least one device to perform a task determined according to a speech-recognized language based on situation information.

The user device **1850** may include the situation information managing unit **1851** and a module selecting and instructing unit **1852**.

The situation information managing unit **1851** may collect situation information for selecting a language model for speech recognition performed by the speech recognition device **1830** and transmit the situation information to the speech recognition device **1830**.

The speech recognition device **1830** may select at least one language model to be used for speech recognition based on situation information. If situation information includes information indicating that the DVD player device **1860** and the home theatre device **1870** are available to be used, the speech recognition device **1830**, the speech recognition device **1830** may select language model corresponding to the DVD player device **1860** and the home theatre device **1870**. Alternatively, if a voice signal includes a module identifier, the speech recognition device **1830** may select a language model corresponding to the module identifier and perform speech recognition. A module identifier may include information for identifying not only a module, but also a module group or a module type.

The module selecting and instructing unit **1852** may determine at least one device to transmit a command thereto based on a result of speech recognition performed by the speech recognition device **1830** and transmit a command to the determined device.

If a result of speech recognition includes information for identifying a device, the module selecting and instructing unit **1852** may transmit a command to a device corresponding to the identification information.

If a result of speech recognition does not include information for identifying a device, the module selecting and instructing unit **1852** may obtain at least one of a keyword for a command included in the result of the speech recognition and situation information. The module selecting and instructing unit **1852** may determine at least one device for transmit a command thereto based on at least one of the keyword for a command and the situation information.

Referring to FIG. **18**, the module selecting and instructing unit **1852** may receive 'show me winter kingdom in 5.1 channels' as a result of speech recognition from the speech recognition device **1830**. Since the result of the speech recognition does not include a device identifier or an application identifier, the DVD player device **1860** and the home theatre device **1870** to transmit a command thereto may be determined based on situation information or a keyword for a command

In detail, the module selecting and instructing unit **1852** may determine a plurality of devices capable of output sound in 5.1 channels and capable of output moving pictures from among currently available devices. The module selecting and instructing unit **1852** may finally determine a device for performing a command from among the plurality of determined devices based on situation information, such as a history of usages of the respective devices.

Situation information that may be obtained by the situation information managing unit **1851** may be configured as shown below in Table 4.

TABLE 4

	Situation Information
Currently Used Module	TV Broadcasting Module
History of Simultaneous Module Usage	TV Broadcasting Module - Home Theater Device/20 Minutes Ago DVD Player Device - Home Theater Device/1 Day Ago
History of Voice Command	Home Theater Play [Singer 1] Song/10 Minutes Ago DVD Player Play [Movie 1]/1 Day Ago
Application having Language	TV Broadcasting Module DVD Player Device Movie Player Module 1 Home Theater Device

Next, the module selecting and instructing unit **1852** may transmit a command to the finally determined device. In detail, based on a result of recognition of a speech 'show me winter kingdom in 5.1 channels,' the module selecting and instructing unit **1852** may transmit a command requesting to play back 'winter kingdom' to the DVD player device **1860**. Furthermore, the module selecting and instructing unit **1852** may transmit a command requesting to output sound signal of the 'winter kingdom' in 5.1 channels to the home theatre device **1870**.

Therefore, according to an embodiment, based on a single result of speech recognition, commands may be transmitted to a plurality of devices or modules, and the plurality of devices or modules may simultaneously perform tasks. Furthermore, even if a result of speech recognition does not include a module or device identifier, the module selecting and instructing unit **1852** according to an embodiment may determine the most appropriate module or device for performing a task based on a keyword for a command and situation information.

FIG. **19** is a diagram showing an example of a voice command with respect to a plurality of devices, according to an embodiment.

Referring to FIG. **19**, based on the module selecting and instructing unit **1922**, an example of commands for devices capable of performing tasks according to voice commands are shown. The module selecting and instructing unit **1922** may correspond to a module selecting and instructing unit **1952** of FIG. **17**. Furthermore, a DVD player device **1921** and a home theatre device **1923** may correspond to the DVD player device **1860** and the home theatre device **1870** of FIG. **17**, respectively.

A speech instruction **1911** is an example of a result of speech recognition that may be output based on a speech recognition according to an embodiment. If the speech instruction **1911** includes name of a video and 5.1 channels, the module selecting and instructing unit **1922** may select the DVD player device **1921** and the home theatre device **1923** capable of playing back the video as devices for transmitting commands thereto.

As shown in FIG. **19**, the module selecting and instructing unit **1922** may include headers **1931** and **1934**, command languages **1932** and **1935**, video information **1933**, and a sound preset **1936** in information regarding the DVD player device **1921** and the home theatre device **1923**.

The headers **1931** and **1934** may include information for identifying the DVD player device **1921** and the home theatre device **1923**, respectively. The headers **1931** and **1934** may include information including types, locations, and names of the respective devices.

The command languages **1932** and **1935** may include examples of commands with respect to the devices **1921** and the **1923**. When voices identical to the command languages **1932** and **1935** are received, the respective devices **1921** and the **1923** may perform tasks corresponding to the received commands.

The video information **1933** may include information regarding a video that may be played back by the DVD player device **1921**. For example, the video information **1933** may include identification information and detailed information regarding a video file that may be played back by the DVD player device **1921**.

The sound preset **1936** may include information about available settings regarding sound output of the home theatre device **1923**. If the home theatre device **1923** may be set to 7.1 channels, 5.1 channels, and 2.1 channels, the sound preset **1936** may include 7.1 channels, 5.1 channels, and 2.1 channels as information regarding available settings regarding channels of the home theatre device **1923**. Other than channels, the sound preset **1936** may include an equalizer setting, a volume setting, etc., and may further include information regarding various available settings with respect to the home theatre device **1923** based on user settings.

The module selecting and instructing unit **1922** may transmit information **1931** through **1936** regarding the DVD player device **1921** and the home theatre device **1923** to the speech recognition data updating device **1820**. The speech recognition data updating device **1820** may update second language models corresponding to the respective devices **1921** and **1923** based on the received information **1931** through **1936**.

The speech recognition data updating device **1820** may update language models corresponding to the respective devices **1921** and **1923** by using words included in sentences of the command languages **1932** and **1935**, the video infor mation **1933**, or the sound preset **1936**. For example, the speech recognition data updating device **1820** may include words included in the video information **1933** or the sound preset **1936** in the sentences of the command languages **1932** and **1935** and obtain appearance probability information regarding the same.

FIG. **20** is a block diagram showing an example of speech recognition devices according to an embodiment.

Referring to FIG. **20**, a speech recognition device **2000** may include a front-end engine **2010** and a speech recognition engine **2020**.

The front-end engine **2010** may receive speech data or language data from the speech recognition device **2000** and output a result of speech recognition regarding the speech data. Furthermore, the front-end engine **2010** may perform a pre-processing with respect to the received speech data or language data and transmit the pre-processed speech data or language data to the speech recognition engine **2020**.

The front-end engine **2010** may correspond to the speech recognition data updating devices **220** and **420** described above with reference to FIGS. **1** through **17**. The speech recognition engine **2020** may correspond to the speech recognition devices **230** and **430** described above with reference to FIGS. **1** through **18**.

Since updating speech recognition data and speech recognition may be respectively performed by independent engines, speech recognition and updating speech recognition may be simultaneously performed in the speech recognition device **2000**.

The front-end engine **2010** may include a speech buffer **2011** for receiving speech data and transmitting the speech data to a speech recognizer **2022** and a language model updating unit **2012** for updating the speech recognition. Furthermore, the front-end engine **2010** may include segment information **2013** including information for restoring speech-recognized subwords to a word, according to an embodiment. The front-end engine **2010** may restore subwords speech-recognized by the speech recognizer **2022** to words by using the segment information **2013** and output a speech-recognized language **2014** including the restored words as a result of speech recognition.

The speech recognition engine **2020** may include a language model **2021** updated by the language model updating unit **2012**. Furthermore, the speech recognition engine **2020** may include the speech recognizer **2022** capable of performing speech recognition based on the speech data and the language model **2021** received from the speech buffer **2011**.

When speech data is input as recording is performed, the speech recognition device **2000** may collect language data including new words at the same time. Next, as speech data including a recorded speech is stored in the speech buffer **2011**, the language model updating unit **2012** may update a second language model of the language model **2021** by using the new words. When the second language model is updated, the speech recognizer **2022** may receive the speech data stored in the speech buffer **2011** and perform speech recognition. A speech-recognized language may be transmitted to the front-end engine **2010** and restored based on the segment information **2013**. The front-end engine **2010** may output a result of speech recognition including restored words.

FIG. **21** is a block diagram showing an example of performing speech recognition at a display device, according to an embodiment.

Referring to FIG. **21**, a display device **2110** may receive speech data from a user, transmit the speech data to a speech recognition server **2120**, receive a result of speech recognition from the speech recognition server **2120**, and output the result of speech recognition. The display device **2110** may perform a task based on the result of speech recognition.

The display device **2110** may include a language data generating unit **2114** for generating language data for updating speech recognition data at the speech recognition server **2120**. The language data generating unit **2114** may generate language data from information currently displayed on the display device **2110** or content information related to the information currently displayed on the display device **2110** and transmit the language data to the speech recognition server **2120**. For example, the language data generating unit **2114** may generate language data from a text **2111** and a current broadcasting information **2112** included in content that is currently displayed, is previously displayed, or will be displayed. Furthermore, the language data generating unit **2114** may receive information regarding a conversation displayed on the display device **2110** from a conversation managing unit **2113** and generate language data by using the received information. Information that may be received from the conversation managing unit **2113** may include texts included in a social network service (SNS), texts included in a short message service (SMS), texts included in a multimedia message service (MMS), and information regarding a conversation between the display device **2110** and a user.

A language model updating unit **2121** may update a language model by using language data received from the language data generating unit **2114** of the display device **2110**. Next, a speech recognition unit **2122** may perform speech recognition based on the updated language model. If a speech-recognized language includes subwords, a text restoration unit **2123** may perform text restoration based on segment information according to an embodiment. The speech recognition server **2120** may transmit a text-restored and speech-recognized language to the display device **2110**, and the display device **2110** may output the speech-recognized language.

In the case of updating speech recognition data by dividing a new word into predetermined unit components according to an embodiment, the display device **2110** may update the speech recognition in a couple of ms. Therefore, the speech recognition server **2120** may immediately add a new word in a text displayed on the display device **2110** to a language model.

A user may not only speak a set command, but also speak name of a broadcasting program that is currently being broadcasted or a text displayed on the display device **2110**. Therefore, the speech recognition server **2120** according to an embodiment may receive a text displayed on the display device **2110** or information regarding contents displayed on the display device **2110**, which are likely to be spoken. Next, the speech recognition server **2120** may update speech recognition data based on the received information. Since the speech recognition server **2120** is capable of updating a language model in from a couple of ms to a couple of seconds, a new word that is likely to be spoken may be processed to be recognized as soon as the new word is obtained.

FIG. **22** is a block diagram showing an example of updating a language model in consideration of situation information, according to an embodiment.

A speech recognition data updating device **2220** and a speech recognition device **2240** of FIG. **22** may correspond to the speech recognition data updating devices **220** and **420** and the speech recognition devices **230** and **430** shown in FIGS. **2** through **17**, respectively.

Referring to FIG. **22**, the speech recognition data updating device **2220** may obtain personalized information **2221** from a user device **2210** or a service providing server **2230**.

The speech recognition data updating device **2220** may include information regarding a user from the user device **2210**, the information including an address book **2211**, an installed application list **2212**, and a stored album list **2213**. However, the present invention is not limited thereto, and the speech recognition data updating device **2220** may receive various information regarding the user device **2210** from the user device **2210**.

Since individual users have different articulation patterns from one another, the speech recognition data updating device **2220** may periodically receive information for performing speech recognition for each of the users and store the information in the personalized information **2221**. Furthermore, a language model updating unit **2222** of the speech recognition data updating device **2220** may update language models based on the personalized information **2221** of the respective users. Furthermore, the speech recognition data updating device **2220** may collect information regarding service usages collected in relation to the respective users from the service providing server **2230** and store the information in the personalized information **2221**.

The service providing server **2230** may include a preferred channel list **2231**, a frequently viewed video-on-demand (VOD) **2232**, a conversation history **2233**, and a speech recognition result history **2234** for each user. In other words, the service providing server **2230** may store information regarding services provided to the user device **2210**, e.g., a broadcasting program providing service, a VOD service, a SNS service, a speech recognition service, etc. The collectable information is merely an example and is not limited thereto. The service providing server **2230** may collect various information regarding each of users and transmit the collected information to the speech recognition data updating device **2220**. The speech recognition result history **2234** may include information regarding results of speech recognition performed by the speech recognition device **2240** with respect to the respective users.

In detail, the language model updating unit **2222** may determine a second language model 2223 corresponding to each user. In the speech recognition data updating device **2220**, at least one second language model **2223** corresponding to each user may exist. If there is no second language model **2223** corresponding to a user, the language model updating unit **2222** may newly generate a second language model **2223** corresponding to the user. Next, the language model updating unit **2222** may update language models corresponding to the respective users based on the personalized information **2221**. In detail, the language model updating unit **2222** may detect new words from the personalized information **2221** and update the second language models **2223** corresponding to the respective users by using the detected new words.

A voice recognizer **2241** of the speech recognition device **2240** may perform speech recognition by using the second language models **2223** established with respect to the respective users. When speech data including a voice command is received, the voice recognizer **2241** may perform speech recognition by using the second language model **2223** corresponding to a user who is issuing voice commands.

FIG. **23** is a block diagram showing an example of a speech recognition system including language models corresponding to respective applications, according to an embodiment.

Referring to FIG. **23**, a second language model **2323** of a voice recognition data updating device **2320** may be updated or generated based on device information **2321** regarding at least one application installed on a user device **2310**. Therefore, each of applications installed in the user device **2310** may not perform speech recognition by itself, and speech recognition may be performed on a separate platform for speech recognition. Next, based on a result of performing speech recognition on the platform for speech recognition, a task may be requested to at least one application.

The user device **2310** may include various types of terminal devices that may be used by a user, where at least one application may be installed thereon. An application **2311** installed on the user device **2310** may include information regarding tasks that may be performed according to commands, For example, the application **2311** may include 'Play,' 'Pause,' and 'Stop' as information regarding tasks corresponding to commands 'Play,' 'Pause,' and 'Stop.' Furthermore, the application **2311** may include information regarding texts that may be included in commands. The user device **2310** may transmit at least one of information regarding tasks of the application **2311** that may be performed based on commands and information regarding texts that may be included in commands to the voice recognition data updating device **2320**. The voice recognition data updating device **2320** may perform speech recognition based on the information received from the user device **2310**.

The voice recognition data updating device **2320** may include the device information **2321**, a language model updating unit **2322**, the second language model **2323**, and segment information **2324**. The voice recognition data updating device **2320** may correspond to the speech recognition data updating devices **220** and **420** shown in FIGS. **2** through **20**.

The device information **2321** may include information regarding the application **2311**, the information received from the user device **2310**. The voice recognition data updating device **2320** may receive at least one of information regarding tasks of the application **2311** that may be performed based on commands and information regarding texts that may be included in commands from the user device **2310**. The voice recognition data updating device **2320** may store at least one of the information regarding the application **2311** received from the user device **2310** as the device information **2321**. The voice recognition data updating device **2320** may store the device information **2321** for each of the user devices **2310**.

The voice recognition data updating device **2320** may receive information regarding the application **2311** from the user device **2310** periodically or when a new event regarding the application **2311** occurs. Alternatively, when the speech recognition device **2330** starts performing speech recognition, the voice recognition data updating device **2320** may request information regarding the application **2311** to the user device **2310**. Furthermore, the voice recognition data updating device **2320** may store received information as the device information **2321**. Therefore, the voice recognition data updating device **2320** may update a language model based on the latest information regarding the application **2311**.

The language model updating unit **2322** may update a language model, which may be used to perform speech recognition, based on the device information **2321**. A language model that may be updated based on the device information **2321** may include a second language model corresponding to the user device **2310** from among the at least one second language model **2323**. Furthermore, a language model that may be updated based on the device information **2321** may include a second language model corresponding to the application **2311** from among the at least one second language model **2323**

The second language model **2323** may include at least one independent language model that may be selectively applied based on situation information. The speech recognition device **2330** may select at least one of the second language models **2323** based on situation information and perform speech recognition by using the selected second language model **2323**.

The segment information **2324** may include information regarding predetermined unit components of a new word that may be generated when speech recognition data is updated, according to an embodiment. The voice recognition data updating device **2320** may divide a new word into subwords and update speech recognition data according to an embodiment to add new words to the second language model **2323** in real time. Therefore, when a new word divided into subwords is speech-recognized, a result of speech recognition thereof may include subwords. If speech recognition is performed by the speech recognition device **2330**, the segment information **2324** may be used to restore speech-recognized subwords to an original word.

The speech recognition device **2330** may include a speech recognition unit **2331**, which performs speech recognition with respect to a received voice command, and a text restoration device **2332**, which restores subwords to an original word. The text restoration device **2332** may restore speech-recognized subwords to an original word and output a final result of speech recognition.

FIG. **24** is a diagram showing an example of a user device transmitting a request to perform a task based on a result of speech recognition, according to an embodiment. A user device **2410** may correspond to the user device **1850**, **2210**, and **2310** of FIG. **18**, **22**, or **21**.

Referring to FIG. **24**, if the user device **2410** is a television (TV), a command based on a result of speech recognition may be transmitted via the user device **2410** to external devices including the user device **2410**, that is, an air conditioner **2420**, a cleaner **2430**, and a laundry machine **2450**.

When a user issues a voice command at a location a **2440**, speech data may be collected by the air conditioner **2420**, the cleaner **2430**, and the user device **2410**. The user device **2410** may compare speech data collected by the user device **2410** to speech data collected by the air conditioner **2420** and the cleaner **2430** in terms of a signal-to-noise ratio (SNR) or volume. As a result of the comparison, the user device **2410** may select speech data of the highest quality and transmit the selected speech data to a speech recognition device for performing speech recognition. Referring to FIG. **24**, since the user is at a location closest to the cleaner **2430**, speech data collected by the cleaner **2430** may be speech data of the highest quality.

According to an embodiment, speech data may be collected by using a plurality of devices, and thus high quality speech data may be collected even if a user is far from the user device **2410**. Therefore, variation of success rates according to distances between a user and the user device **2410** may be reduced.

Furthermore, even if the user is at a location **2460** in a laundry room far from a living room in which the user device **2410** is located, speech data including a voice command of the user may be collected by the laundry machine **2450**. The laundry machine **2450** may transmit the collected speech data to the user device **2410**, and the user device **2410** may perform a task based on the received speech data. Therefore, the user may issue voice commands at a high success rate regardless a distance to the user device **2410** using various devices.

Hereinafter, a method of performing speech recognition regarding each user will be described in closer details.

FIG. **25** is a block diagram showing a method of generating an personal preferred content list regarding classes of speech data according to an embodiment.

Referring to FIG. **25**, the speech recognition device **230** may receive acoustic data **2520** and content information **2530** from speech data and text data **2510**. The text data and the acoustic data **2520** may correspond to each other, where the content information **2530** may be obtained from the text data, and the acoustic data **2520** may be obtained from the speech data. The text data may be obtained from a result of performing speech recognition to the speech data.

The acoustic data **2520** may include voice feature information for distinguishing voices of different persons. The speech recognition device **230** may distinguish classes based on the acoustic data **2520** and, if acoustic data **2520** differs with respect to a same user due to difference voice features according to time slots, the acoustic data **2520** may be classified into different classes. The acoustic data **2520** may include feature information regarding speech data, such as an average of pitches indicating how high or low a sound is, a variance, a jitter (change of vibration of vocal cords), a shimmer (regularity of voice waveforms), a duration, an average of Mel frequency cepstral coefficients (MFCC), and a variance.

The content information **2530** may be obtained based on title information included in the text data. The content information **2530** may include a title included in the text data as-is. Furthermore, the content information **2530** may further include words related to a title.

For example, if titles included in the text data are 'weather' and 'professional baseball game result,' 'weather information' related to 'weather', and 'sports news' and 'professional baseball replay' related to 'news' and 'professional baseball game result' may be obtained as the content information **2540**.

The speech recognition device **230** may determine a class related to speech data based on the acoustic data **2520** and the content information **2540** obtained from text data, Classes may include acoustic data and personal preferred content lists corresponding to the respective classes. The speech recognition device **230** may determine a class regarding speech data based on acoustic data and a personal preferred content list regarding the corresponding class.

Since no personal preferred content list exists before speech data is initially classified or is initialized, the speech recognition device **230** may classify speech data based on acoustic data. Next, the speech recognition device **230** may extract the content information **2540** from text data corresponding to the respective classified speech data and generate personal preferred content lists corresponding to the respective classes. Next, weights that are applied to personal preferred content lists during classification may be gradually increased by adding the extracted content information **2540** to the personal preferred content lists during later speech recognition.

A method of updating a class may be performed based on Equation 3-4 below.

$$Class_{similarity}=W_aA_v+W_lL_v \quad \text{[Equation 4]}$$

In Equation 4, A_v and W_a respectively denote a class based on acoustic data of speech data and a weight regarding the same, whereas L_v and W_l respectively denote a class based on a personal preferred content list and a weight regarding the same.

Initially, the value of W_l may be 0, and the value of W_l may increase as an personal preferred content list is updated.

Furthermore, the speech recognition device **230** may generate language models corresponding to respective classes based on personal preferred content lists and speech recognition histories of the respective classes. Furthermore, the speech recognition device **230** may generate personalized acoustic models for the respective classes based on speech data corresponding to the respective classes and a global acoustic model by applying a speaker-adaptive algorithm (e.g., a maximum likelihood linear regression (MLLR), a maximum A posterior (MAP), etc.).

During speech recognition, the speech recognition device **230** may identify a class from speech data and determine a language model or an acoustic model corresponding to the identified class. The speech recognition device **230** may perform speech recognition by using the determined language model or acoustic model.

After the speech recognition is performed, the speech recognition data updating device **220** may update a language model and an acoustic model, to which speech-recognized speech data and text data respectively belong, by using a result of the speech recognition.

FIG. **26** is a diagram showing an example of determining a class of speech data, according to an embodiment.

Referring to FIG. **26**, each acoustic data may have feature information including acoustic information and content information. Each acoustic data may be indicated by a graph, in which the x-axis indicates acoustic information and the y-axis indicates content information. Acoustic data may be classified into n classes based on acoustic information and content information by using a K-mean clustering method.

FIG. **27** is a flowchart showing a method of updating speech recognition data according to classes of speech data, according to an embodiment. Referring to FIG. **27**, in an operation S**2701**, the speech recognition data updating device **220** may obtain speech data and a text corresponding to the speech data. The speech recognition data updating device **220** may obtain a text corresponding to the speech data as a result of speech ecognition performed by the speech recognition device **230**.

In an operation S**2703**, the speech recognition data updating device **220** may detect the text obtained in the operation S**2701** or content information related to the text. For example, content information may further include words related to the text.

In an operation S**2705**, the speech recognition data updating device **220** may extract acoustic information from the speech data obtained in the operation S**2701**. The acoustic information that may be extracted in the operation S**2705** may include information regarding acoustic features of the speech data and may include the above-stated features information like a pitch, jitter, and shimmer.

In an operation S**2707**, the speech recognition data updating device **220** may determine a class corresponding to the content information and the acoustic information detected in the operation S**2703** and the operation S**2705**.

In an operation S**2709**, the speech recognition data updating device **220** may update a language model or an acoustic model corresponding to the class determined in the operation S**2707**, based on the content information and the acoustic information. The speech recognition data updating device **220** may update a language model by detecting a new word included in the content information. Furthermore, the speech recognition data updating device **220** may update an acoustic model by applying the acoustic information, a global acoustic model, and a speaker-adaptive algorithm.

FIGS. **28** and **29** are diagrams showing examples of acoustic data that may be classified according to embodiments.

Referring to FIG. **28**, speech data regarding a plurality of users may be classified into a single class. It is not necessary to classify users with similar acoustic characteristics and similar content preferences into different classes, and thus such users may be classified into a single class.

Referring to FIG. **29**, speech data regarding a same user may be classified into different classes based on characteristics of the respective speech data. In the case of a user whose voice differs in the morning and in the evening, acoustic information regarding speech data may be detected differently, and thus speech data regarding the voice in the morning and speech data regarding the voice in the evening may be classified into different classes.

Furthermore, if content information of speech data regarding a same user differs, the speech data may be classified into different classes. For example, a same user may use 'baby-related' content for nursing a baby. Therefore, if content information of speech data differs, speech data including voices of a same user may be classified into different classes.

According to an embodiment, the speech recognition device **230** may perform speech recognition by using second language models determined for respective users. Furthermore, in the case where a same device ID is used and users cannot be distinguished with device IDs, users may be classified based on acoustic information and content information of speech data. The speech recognition device **230** may determine an acoustic model or a language model based on the determined class and may perform speech recognition.

Furthermore, if users cannot be distinguished based on acoustic information only due to similarity of voices of the users (e.g., brothers, family members, etc.), the speech recognition device **230** may distinguish classes by further considering content information, thereby performing speaker-adaptive speech recognition.

FIGS. **30** and **31** are block diagrams showing an example of performing a personalized speech recognition method according to an embodiment.

Referring to FIGS. **30** and **31**, information for performing personalized speech recognition for respective classes may include language model updating units **3022**, **3032**, **3122**, and **3132** that update second language models **3023**, **3033**, **3123**, and **3133** based on the personalized information **3021**, **3031**, **3121**, and **3131** including information regarding individuals, and segment information **3024**, **3034**, **3124**, and **3134** that may be generated when the second language models **3023**, **3033**, **3123**, and **3133** are updated. The information for performing personalized speech recognition for respective classes may be included in a speech recognition device **3010**, which performs speech recognition, or the speech recognition data updating device **220**.

When a plurality of persons are articulating, the speech recognition device **3010** may interpolate language model for the respective individuals for speech recognition.

Referring to FIG. **30**, an interpolating method using a plurality of language models may be the method as described above with reference to Equations 1 through 3. For example, the speech recognition device **3010** may apply higher weight to a language model corresponding to a person holding a microphone. If a plurality of language models are used according to Equation 1, a word commonly included in the language models may have a high probability. According to Equations 2 and 3, words included in the language model for the respective individuals may be simply combined.

Referring to FIG. **30**, if sizes of language models for respective individuals are not large, speech recognition may be performed based on a single language model **3141**, which is a combination of the language models for a plurality of persons. As language models are combined, an amount of probabilities to be calculated for speech recognition may be reduced. However, in the case of combining language models, it is necessary to generate a combined language model by re-determining respective probabilities. Therefore, if sizes of language models for respective individuals are small, it is efficient to combine the language models. If a group consisting of a plurality of individuals may be set up in advance, the speech recognition device **3010** may obtain a combined language model regarding the group before a time point at which speech recognition is performed.

FIG. **32** is a block diagram showing the internal configuration of a speech recognition data updating device according to an embodiment. The speech recognition data updating device of FIG. **32** may correspond to the speech recognition data updating device of FIGS. **2** through **23**.

The speech recognition data updating device **3200** may include various types of devices that may be used by a user or a server device that may be connected to a user device via a network.

Referring to FIG. **32**, the speech recognition data updating device **3200** may include a controller **3210** and a memory **3220**.

The controller **3210** may detect new words included in collected language data and update a language model that may be used during speech recognition. In detail, the controller **3210** may convert new words to phoneme sequences, divide each of the phoneme sequences into predetermined unit components, and determine appearance probability information regarding the components of the phoneme sequences. Furthermore, the controller **3210** may update a language model by using the appearance probability information.

The memory **3220** may store the language model updated by the controller **3210**.

FIG. **33** is a block diagram showing the internal configuration of a speech recognition device according to an embodiment. The speech recognition device of FIG. **33** may correspond to the speech recognition device of FIGS. **2** through **31**.

The speech recognition device **3300** may include various types of devices that may be used by a user or a server device that may be connected to a user device via a network.

Referring to FIG. **33**, the speech recognition device **3300** may include a controller **3310** and a communication unit **3320**.

The controller **3310** may perform speech recognition by using speech data. In detail, the controller **3310** may obtain at least one phoneme sequence from speech data and obtain appearance probabilities regarding predetermined unit components obtained by dividing the phoneme sequence. Next, the controller **3310** may obtain one phoneme sequence based on the appearance probabilities and output a word corresponding to the phoneme sequence as a speech-recognized word based on segment information regarding the obtained phoneme sequence.

A communication unit **3320** may receive speech data including articulation of a user according to a user input. If the speech recognition device **3300** is a server device, the speech recognition device **3300** may receive speech data from a user device. Next, the communication unit **3320** may transmit a word speech-recognized by the controller **3310** to the user device.

FIG. **34** is a block diagram for describing the configuration of a user device **3400** according to an embodiment.

As shown in FIG. **34**, the user device **3400** may include various types of devices that may be used by a user, e.g., a mobile phone, a tablet PC, a PDA, a MP3 player, a kiosk, an electronic frame, a navigation device, a digital TV, and a wearable device, such as a wristwatch or a head mounted display (HMD).

The user device **3400** may correspond to the user device of FIGS. **2** through **24**, may receive a user's articulation, transmit the user's articulation to a speech recognition device, receive a speech-recognized language from the speech recognition device, and output the speech-recognized language.

For example, as shown in FIG. **34**, the user device **3400** according to embodiments may include not only a display unit **3410** and a controller **3470**, but also a memory **3420**, a GPS chip **3425**, a communication unit **3430**, a video processor **3435**, an audio processor **3440**, a user inputter **3445**, a microphone unit **3450**, an image pickup unit **3455**, a speaker unit **3460**, and a motion detecting unit **3465**.

Detailed descriptions of the above-stated components will be given below.

The display unit **3410** may include a display panel **3411** and a controller (not shown) for controlling the display panel **3411**. The display panel **3411** may be embodied as any of various types of display panels, such as a liquid crystal display (LCD) panel, an organic light emitting diode (OLED) display panel, an active-matrix organic light emitting diode (AM-OLED) panel, and a plasma display panel (PDP). The display panel **3411** may be embodied to be flexible, transparent, or wearable. The display unit **3410** may be combined with a touch panel **3447** of the user inputter **3445** and provided as a touch screen. For example, the touch screen may include an integrated module in which the display panel **3411** and the touch panel **3447** are combined with each other in a stack structure.

The display unit **3410** according to embodiments may display a result of speech recognition under the control of the controller **3470**.

The memory **3420** may include at least one of an internal memory (not shown) and an external memory (not shown).

For example, the internal memory may include at least one of a volatile memory (e.g., a dynamic random access memory (DRAM), a static RAM (SRAM), a synchronous dynamic RAM (SDRAM), etc.), a non-volatile memory (e.g., an one time programmable read-only memory (OTPROM), a programmable ROM (PROM), an erasable/programmable ROM (EPROM), an electrically erasable/programmable ROM (EEPROM), a mask ROM, a flash ROM, etc.), a hard disk drive (HDD), or a solid state disk (SSD). According to an embodiment, the controller **3470** may load a command or data received from at least one of a non-volatile memory or other components to a volatile memory and process the same. Furthermore, the controller **3470** may store data received from or generated by other components in the non-volatile memory.

The external memory may include at least one of a compact flash (CF), a secure digital (SD), a micro secure digital (Micro-SD), a mini secure digital (Mini-SD), an extreme digital (xD), and a memory stick.

The memory **3420** may store various programs and data used for operations of the user device **3400**. For example, the memory **3420** may temporarily or permanently store at least one of speech data including articulation of a user and result data of speech recognition based on the speech data.

The controller **3470** may control the display unit **3410** to display a part of information stored in the memory **3420** on the display unit **3410**. In other words, the controller **3470** may display a result of speech recognition stored in the **3420** on the display unit **3410**. Alternatively, when a user gesture is performed at a region of the display unit **3410**, the controller **3470** may perform a control operation corresponding to the user gesture.

The controller **3470** may include at least one of a RAM **3471**, a ROM **3472**, a CPU **3473**, a graphic processing unit (GPU) **3474**, and a bus **3475**. The RAM **3471**, the ROM **3472**, the CPU **3473**, and the GPU **3474** may be connected to one another via the bus **3475**.

The CPU **3473** accesses the memory **3420** and performs a booting operation by using an OS stored in the memory **3420**. Next, the CPU **3473** performs various operations by using various programs, contents, and data stored in the memory **3420**.

A command set for booting a system is stored in the ROM **3472**. For example, when a turn-on command is input and power is supplied to the user device **3400**, the CPU **3473** may copy an OS stored in the memory **3420** to the RAM **3471** according to commands stored in the ROM **3472**, execute the OS, and boot a system. When the user device **3400** is booted, the CPU **3473** copies various programs stored in the memory **3420** and performs various operations by executing the programs copied to the RAM **3471**. When the user device **3400** is booted, the GPU **3474** displays a UI screen image in a region of the display unit **3410**. In detail, the GPU **3474** may generate a screen image in which an electronic document including various objects, such as contents, icons, and menus, is displayed. The GPU **3474** calculates property values like coordinates, shapes, sizes, and colors of respective objects based on a layout of the screen image. Next, the GPU **3474** may generate screen images of various layouts including objects based on the calculated property values. Screen images generated by the GPU **3474** may be provided to the display unit **3410** and displayed in respective regions of the display unit **3410**.

The GPS chip **3425** may receive GPS signals from a global positioning system (GPS) satellite and calculate a current location of the user device **3400**. When a current location of a user is needed for using a navigation program or other purposes, the controller **3470** may calculate the current location of the user by using the GPS chip **3425**. For example, the controller **3470** may transmit situation information including a user's location calculated by using the GPS chip **3425** to a speech recognition device or a speech recognition data updating device. A language model may be updated or speech recognition may be performed by the speech recognition device or the speech recognition data updating device based on the situation information.

The communication unit **3430** may perform communications with various types of external devices via various forms of communication protocols. The communication unit **3430** may include at least one of a Wi-Fi chip **3431**, a Bluetooth chip **3432**, a wireless communication chip **3433**, and a NFC chip **3434**. The controller **3470** may perform communications with various external device by using the communication unit **3430**. For example, the controller **3470** may receive a request for controlling a memo displayed on the display unit **3410** and transmit a result based on the received request to an external device, by using the communication unit **3430**.

The Wi-Fi chip **3431** and the Bluetooth chip **3432** may perform communications via the Wi-Fi protocol and the Bluetooth protocol. In the case of using the Wi-Fi chip **3431** or the Bluetooth chip **3432**, various connection information, such as a service set identifier (SSID) and a session key, are transmitted and received first, communication is established by using the same, and then various information may be transmitted and received. The wireless communication chip **3433** refers to a chip that performs communications via various communication specifications, such as IEEE, Zigbee, 3rd generation (3G), 3rd generation partnership project (3GPP), and long term evolution (LTE). The NFC chip **3434** refers to a chip that operates according to the near field communication (NFC) protocol that uses 13.56 MHz band from among various RF-ID frequency bands; e.g., 135 kHz band, 13.56 MHz band, 433 MHz band, 860-960 MHz band, and 2.45 GHz band.

The video processor **3435** may process contents received via the communication unit **3430** or video data included in contents stored in the memory **3420**. The video processor **3435** may perform various image processing operations with respect to video data, e.g., decoding, scaling, noise filtering, frame rate conversion, resolution conversion, etc.

The audio processor **3440** may process audio data included in contents received via the communication unit **3430** or included in contents stored in the memory **3420**. The audio processor **3440** may perform various audio processing operation with respect to audio data, e.g., decoding, amplification, noise filtering, etc. For example, the audio processor **3440** may play back speech data including a user's articulation.

When a program for playing back multimedia content is executed, the controller **3470** may operate the user inputter **3445** and the audio processor **3440** and play back the corresponding content. The speaker unit **3460** may output audio data generated by the audio processor **3440**.

The user inputter **3445** may receive various commands input by a user. The user inputter **3445** may include at least one of a key **3446**, the touch panel **3447**, and a pen recognition panel **3448**. The user device **3400** may display various contents or user interfaces based on a user input received from at least one of the key **3446**, the touch panel **3447**, and the pen recognition panel **3448**.

The key **3446** may include various types of keys, such as a mechanical button or a wheel, formed at various regions of the outer surfaces, such as the front surface, side surfaces, or the rear surface, of the user device **3400**.

The touch panel **3447** may detect a touch of a user and output a touch event value corresponding to a detected touch signal. If a touch screen (not shown) is formed by combining the touch panel **3447** with the display panel **3411**, the touch screen may be embodied as any of various types of touch sensors, such as an capacitive type, a resistive type, and a piezoelectric type. When a body part of a user touches a surface of a capacitive type touch screen, coordinates of the touch is calculated by detecting a micro-electricity induced by the body part of the user. A resistive type touch screen includes two electrode plates arranged inside the touch screen and, when a user touches the touch screen, coordinates of the touch are calculated by detecting a current that flows as an upper plate and a lower plate at the touched location touch each other. A touch event occurring at a touch screen may usually be generated by a finger of a person, but a touch event may also be generated by an object formed of a conductive material for applying a capacitance change.

The pen recognition panel **3448** may detect a proximity pen input or a touch pen input of a touch pen (e.g., a stylus pen or a digitizer pen) operated by a user and output a detected pen proximity event or pen touch event. The pen recognition panel **3448** may be embodied as an electromagnetic resonance (EMR) type panel, for example, and is capable of detecting a touch input or a proximity input based on a change of intensity of an electromagnetic field due to an approach or a touch of a pen. In detail, the pen recognition panel **3448** may include an electromagnetic induction coil sensor (not shown) having a grid structure and an electromagnetic signal processing unit (not shown) that sequentially provides alternated signals having a predetermined frequency to respective loop coils of the electromagnetic induction coil sensor. When a pen including a resonating circuit exists near a loop coil of the pen recognition panel **3448**, a magnetic field transmitted by the corresponding loop coil generates a current in the resonating circuit inside the pen based on mutual electromagnetic induction. Based on the current, an induction magnetic field is generated by a coil constituting the resonating circuit inside the pen, and the pen recognition panel **3448** detects the induction magnetic field at a loop coil in signal reception mode, and thus a proximity location or a touch location of the pen may be detected. The pen recognition panel **3448** may be arranged to occupy a predetermined area below the display panel **3411**, e.g., an area sufficient to cover the display area of the display panel **3411**.

The microphone unit **3450** may receive a user's speech or other sounds and convert the same into audio data. The controller **3470** may use a user's speech input via the microphone unit **3450** for a phone call operation or may convert the user's speech into audio data and store the same in the memory **3420**. For example, the controller **3470** may convert a user's speech input via the microphone unit **3450** into audio data, include the converted audio data in a memo, and store the memo including the audio data.

The image pickup unit **3455** may pick up still images or moving pictures under the control of a user. The image pickup unit **3455** may be embodied as a plurality of units, such as a front camera and a rear camera.

If the image pickup unit **3455** and the microphone unit **3450** are arranged, the controller **3470** may perform a control operation based on a user's speech input via the microphone unit **3450** or the user's motion recognized by the image pickup unit **3455**. For example, the user device **3400** may operate in a motion control mode or a speech control mode. If the user device **3400** operates in the motion control mode, the controller **3470** may activate the image pickup unit **3455**, pick up an image of a user, trace changes of a motion of the user, and perform a control operation corresponding to the same. For example, the controller **3470** may display a memo or an electronic document based on a motion input of a user that is detected by the image pickup unit **3455**. If the user device **3400** operates in the speech control mode, the controller **3470** may operate in a speech recognition mode to analyze a user's speech input via the microphone unit **3450** and perform a control operation according to the analyzed speech of the user.

The motion detecting unit **3465** may detect motion of the main body of the user device **3400**. The user device **3400** may be rotated or tilted in various directions. Here, the motion detecting unit **3465** may detect motion characteristics, such as a rotating direction, a rotating angle, and a tilted angle, by using at least one of various sensors, such as a geomagnetic sensor, a gyro sensor, and an acceleration sensor. For example, the motion detecting unit **3465** may receive a user's input by detecting a motion of the main body of the user device **3400** and display a memo or an electronic document based on the received input.

Furthermore, although not shown in FIG. **34**, according to embodiments, the user device **3400** may further include a USB port via which a USB connector may be connected into the user device **3400**, various external input ports to be connected to various external terminals, such as a headset, a mouse, and a LAN, a digital multimedia broadcasting (DMB) chip for receiving and processing DMB signals, and various other sensors.

Names of the above-stated components of the user device **3400** may vary. Furthermore, the user device **3400** according to the present embodiment may include at least one of the above-stated components, where some of the components may be omitted or additional components may be further included.

The present invention can also be embodied as computer readable codes on a computer readable recording medium. The computer readable recording medium is any data storage device that can store data which can be thereafter read by a computer system. Examples of the computer readable recording medium include read-only memory (ROM), random-access memory (RAM), CD-ROMs, magnetic tapes, floppy disks, optical data storage devices, etc.

While the present invention has been particularly shown and described with reference to preferred embodiments thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the present invention as defined by the appended claims. The preferred embodiments should be considered in descriptive sense only and not for purposes of limitation. Therefore, the scope of the present invention is defined not by the detailed description of the invention but by the appended claims, and all differences within the scope will be construed as being included in the present invention.

What is claimed:

1. A method of performing speech recognition of a voice spoken by a user, the method comprising:

obtaining first audio data based on the voice spoken by the user detected by a first electronic device;

obtaining second audio data based on the voice spoken by the user detected by a second electronic device;

determining first audio quality of the first audio data;

determining second audio quality of the second audio data;

selecting audio data from among the first audio data and the second audio data, based on the first audio quality and the second audio quality;

selecting an electronic device that obtained the audio data from among the first electronic device and the second electronic device;

performing speech recognition of the voice spoken by the user, based on the audio data; and

outputting a result of the speech recognition at the electronic device.

2. The method of claim **1**, wherein the first audio quality comprises a first volume of the first audio data, and

wherein the second audio quality comprises a second volume of the second audio data.

3. The method of claim **1**, wherein the first audio quality comprises a first signal to noise ratio of the first audio data, and

wherein the second audio quality comprises a second signal to noise ratio of the second audio data.

4. The method of claim **1**, wherein the first audio data comprises at least one of a first volume of the first audio data and a first signal to noise ratio of the first audio data, and

wherein the second audio data comprises at least one of a second volume of the second audio data and a second signal to noise ratio of the second audio data.

5. An electronic device for performing speech recognition of a voice spoken by a user, the electronic device comprising:

a memory storing computer-readable instructions; and

at least one processor when executing the computer-readable instructions configured to obtain first audio data based on the voice spoken by the user detected by the electronic device, obtain second audio data based on the voice spoken by the user detected by a second electronic device, determine first audio quality of the first audio data, determine second audio quality of the second audio data, select the first audio data from among the first audio data and the second audio data, based on the first audio quality and the second audio quality, select the electronic device that obtained the first audio data from among the electronic device and the second electronic device, perform speech recognition of the voice spoken by the user, based on the audio data, and output a result of the speech recognition at the electronic device.

6. The electronic device of claim **5**, wherein the first audio quality comprises a first volume of the first audio data, and

wherein the second audio quality comprises a second volume of the second audio data.

7. The electronic device of claim **5**, wherein the first audio quality comprises a first signal to noise ratio of the first audio data, and

wherein the second audio quality comprises a second signal to noise ratio of the second audio data.

8. The electronic device of claim **5**, wherein the first audio data comprises at least one of a first volume of the first audio data and a first signal to noise ratio of the first audio data, and

wherein the second audio data comprises at least one of a second volume of the second audio data and a second signal to noise ratio of the second audio data.

9. A method of performing speech recognition of a voice spoken by a user, the method comprising:

obtaining first audio data based on the voice spoken by the user detected by a first electronic device;

obtaining second audio data based on the voice spoken by the user detected by a second electronic device;

determining first audio quality of the first audio data;

determining second audio quality of the second audio data;

selecting a closest electronic device that is closest to the user from among the first electronic device and the second electronic device, based on the first audio quality and the second audio quality;

performing speech recognition of the voice spoken by the user based on the closest electronic device; and

outputting a result of the speech recognition at the closest electronic device.

10. The method of claim **9**, wherein the first audio quality comprises a first volume of the first audio data, and

wherein the second audio quality comprises a second volume of the second audio data.

11. The method of claim **9**, wherein the first audio quality comprises a first signal to noise ratio of the first audio data, and

wherein the second audio quality comprises a second signal to noise ratio of the second audio data.

12. The method of claim **9**, wherein the first audio data comprises at least one of a first volume of the first audio data and a first signal to noise ratio of the first audio data, and

wherein the second audio data comprises at least one of a second volume of the second audio data and a second signal to noise ratio of the second audio data.

13. An electronic device for performing speech recognition of a voice spoken by a user, the electronic device comprising:

a memory storing computer-readable instructions; and

at least one processor when executing the computer-readable instructions configured to obtain first audio data based on the voice spoken by the user detected the electronic device, obtain second audio data based on the voice spoken by the user detected by a second electronic device, determine first audio quality of the first audio data, determine second audio quality of the second audio data, select the electronic device as a closest electronic device that is closest to the user from among the electronic device and the second electronic device, based on the first audio quality and the second audio quality, perform speech recognition of the voice spoken by the user based on the closest electronic device, and output a result of the speech recognition at the electronic device that is the closest electronic device closest to the user.

14. The electronic device of claim **13**, wherein the first audio quality comprises a first volume of the first audio data, and

wherein the second audio quality comprises a second volume of the second audio data.

15. The electronic device of claim **13**, wherein the first audio quality comprises a first signal to noise ratio of the first audio data, and

wherein the second audio quality comprises a second signal to noise ratio of the second audio data.

16. The electronic device of claim **13**, wherein the first audio data comprises at least one of a first volume of the first audio data and a first signal to noise ratio of the first audio data, and

wherein the second audio data comprises at least one of a second volume of the second audio data and a second signal to noise ratio of the second audio data.

17. A method of performing speech recognition of a voice spoken by a user, the method comprising:

obtaining first audio data based on the voice spoken by the user received by a first electronic device;

obtaining second audio data based on the voice spoken by the user received by a second electronic device;

determining first audio quality of the first audio data;

determining second audio quality of the second audio data;

identifying an electronic device from among the first electronic device and the second electronic device, based on the first audio quality and the second audio quality;

performing speech recognition of a voice received by the identified electronic device; and

outputting a result of the speech recognition at the identified electronic device.

18. The method of claim 17, wherein the identifying the electronic device from among the first electronic device and the second electronic device comprises:

selecting audio data from among the first audio data and the second audio data, based on the first audio quality and the second audio quality; and

identifying the electronic device that obtained the selected audio data from among the first electronic device and the second electronic device.

19. The method of claim 17, wherein the first audio quality comprises a first volume of the first audio data, and

wherein the second audio quality comprises a second volume of the second audio data.

20. The method of claim 17, wherein the first audio quality comprises a first signal to noise ratio of the first audio data, and

wherein the second audio quality comprises a second signal to noise ratio of the second audio data.

21. The method of claim 17, wherein the first audio data comprises at least one of a first volume of the first audio data and a first signal to noise ratio of the first audio data, and

wherein the second audio data comprises at least one of a second volume of the second audio data and a second signal to noise ratio of the second audio data.

22. An electronic device for performing speech recognition of a voice spoken by a user, the electronic device comprising:

a memory storing computer-readable instructions; and

at least one processor when executing the computer-readable instructions configured to:

obtain first audio data based on the voice spoken by the user received by the electronic device,

obtain second audio data based on the voice spoken by the user received by a second electronic device,

determine first audio quality of the first audio data,

determine second audio quality of the second audio data,

identify the electronic device from among the electronic device and the second electronic device, based on the first audio quality and the second audio quality,

perform speech recognition of a voice received by the identified electronic device, and

output a result of the speech recognition at the identified electronic device.

23. The electronic device of claim 22, The electronic device of claim 6, wherein the at least one processor is configured to:

select audio data from among the first audio data and the second audio data, based on the first audio quality and the second audio quality; and

identify the electronic device that obtained the selected audio data from among the electronic device and the second electronic device.

24. The electronic device of claim 22, wherein the first audio quality comprises a first volume of the first audio data, and

wherein the second audio quality comprises a second volume of the second audio data.

25. The electronic device of claim 22, wherein the first audio quality comprises a first signal to noise ratio of the first audio data, and

wherein the second audio quality comprises a second signal to noise ratio of the second audio data.

26. The electronic device of claim 22, wherein the first audio data comprises at least one of a first volume of the first audio data and a first signal to noise ratio of the first audio data, and

wherein the second audio data comprises at least one of a second volume of the second audio data and a second signal to noise ratio of the second audio data.

27. A method of performing speech recognition of a voice spoken by a user, the method comprising:

obtaining first audio data based on the voice spoken by the user received by a first electronic device;

obtaining second audio data based on the voice spoken by the user received by a second electronic device;

determining first audio quality of the first audio data;

determining second audio quality of the second audio data;

identifying a closest electronic device that is closest to the user from among the first electronic device and the second electronic device, based on the first audio quality and the second audio quality;

performing speech recognition of a voice received by the closest electronic device; and

outputting a result of the speech recognition at the closest electronic device.

28. The method of claim 27, wherein the first audio quality comprises a first volume of the first audio data, and

wherein the second audio quality comprises a second volume of the second audio data.

29. The method of claim 27, wherein the first audio quality comprises a first signal to noise ratio of the first audio data, and

wherein the second audio quality comprises a second signal to noise ratio of the second audio data.

30. The method of claim 27, wherein the first audio data comprises at least one of a first volume of the first audio data and a first signal to noise ratio of the first audio data, and

wherein the second audio data comprises at least one of a second volume of the second audio data and a second signal to noise ratio of the second audio data.

31. An electronic device for performing speech recognition of a voice spoken by a user, the electronic device comprising:

a memory storing computer-readable instructions; and

at least one processor when executing the computer-readable instructions configured to

obtain first audio data based on the voice spoken by the user received by the electronic device,

obtain second audio data based on the voice spoken by the user received by a second electronic device,

determine first audio quality of the first audio data,

determine second audio quality of the second audio data,

identify the electronic device as a closest electronic device that is closest to the user from among the electronic device and the second electronic device, based on the first audio quality and the second audio quality,

perform speech recognition of a voice received by the closest electronic device, and

output a result of the speech recognition at the closest electronic device.

32. The electronic device of claim 31, wherein the first audio quality comprises a first volume of the first audio data, and

wherein the second audio quality comprises a second volume of the second audio data.

33. The electronic device of claim 31, wherein the first audio quality comprises a first signal to noise ratio of the first audio data, and

wherein the second audio quality comprises a second signal to noise ratio of the second audio data.

34. The electronic device of claim 31, wherein the first audio data comprises at least one of a first volume of the first audio data and a first signal to noise ratio of the first audio data, and

wherein the second audio data comprises at least one of a second volume of the second audio data and a second signal to noise ratio of the second audio data.

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