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Nakata

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(54) **DEVICE METHOD, AND COMPUTER PROGRAM PRODUCT FOR CALCULATING SCORE REPRESENTING CORRECTNESS OF VOICE**

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G10L 13/08 (2013.01)
G10L 25/60 (2013.01)
G09B 19/04 (2006.01)
G10L 15/02 (2006.01)

(52) **U.S. Cl.**
CPC ***G10L 25/60*** (2013.01); ***G09B 19/04*** (2013.01); *G10L 2015/025* (2013.01)

(58) **Field of Classification Search**
CPC G10L 25/60; G10L 2015/025; G09B 19/04
USPC 704/257–268
See application file for complete search history.

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(57) **ABSTRACT**

According to an embodiment, a voice processor includes a presenting unit to present text to an operator; a voice acquisition unit to acquire a voice of the operator reading aloud the text; an identifying unit to identify output intervals of phonemes included in the voice; a determination unit to determine whether each of time lengths of the output intervals is normal; a frequency acquisition unit to acquire frequency values respectively representing occurrence frequencies of contexts, respectively corresponding to the phonemes, the context including the phoneme and another phoneme adjacent to at least one side of the phoneme; and a score calculator to calculate a score representing correctness of the voice on the basis of the determination results of the time lengths of the output intervals and the frequency values of the contexts acquired respectively corresponding to the phonemes.

8 Claims, 14 Drawing Sheets

POSITION	PHONEME	CONTEXT	FREQUENCY VALUE
1	ae	sil-ae	1,000,000
2	v	ae-v	2,000,000
3	@	v-@	2,000,000
4	k	@-k	1,000,000
5	aa	k-aa	1,000,000
6	d	aa-d	2,000
7	ou	d-ou	2,000
8	k	ou-k	500,000
9	ei	k-ei	1,000,000
10	k	ei-k	1,000,000

FIG.1

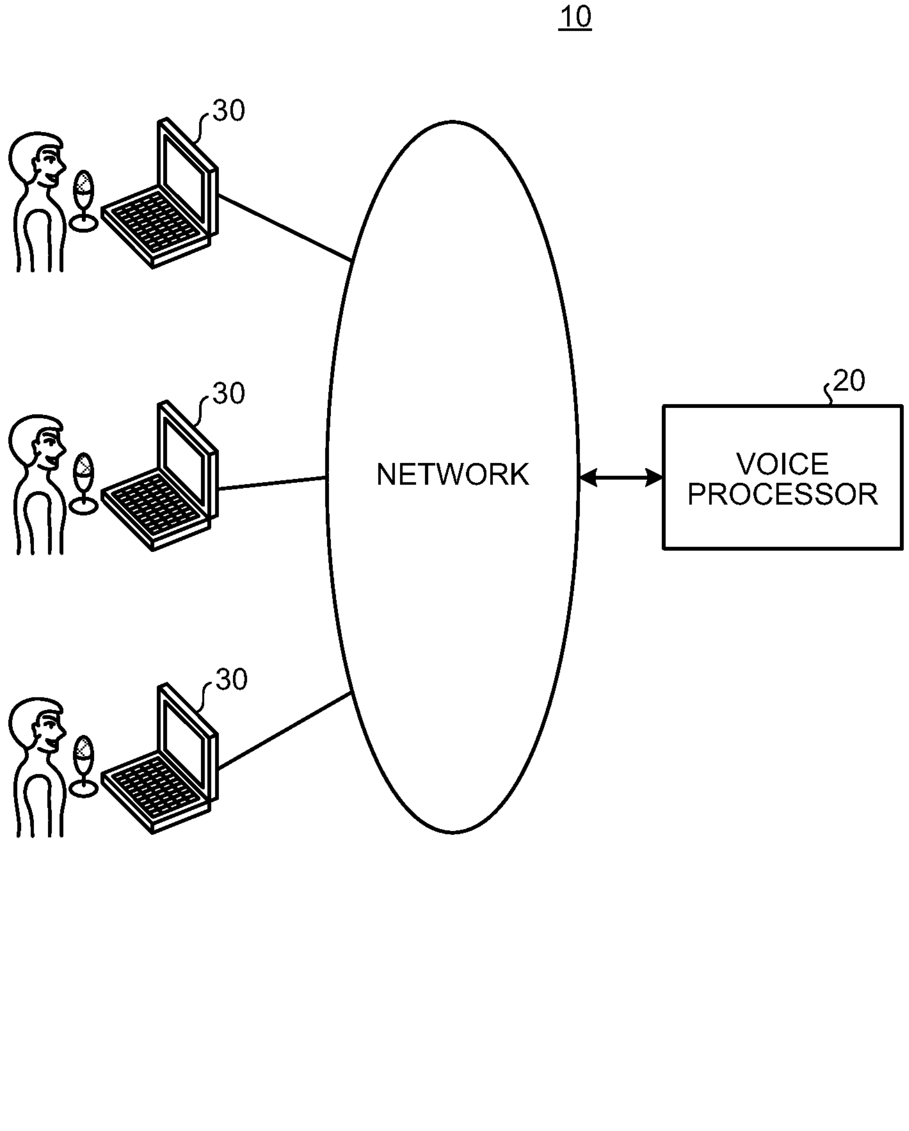
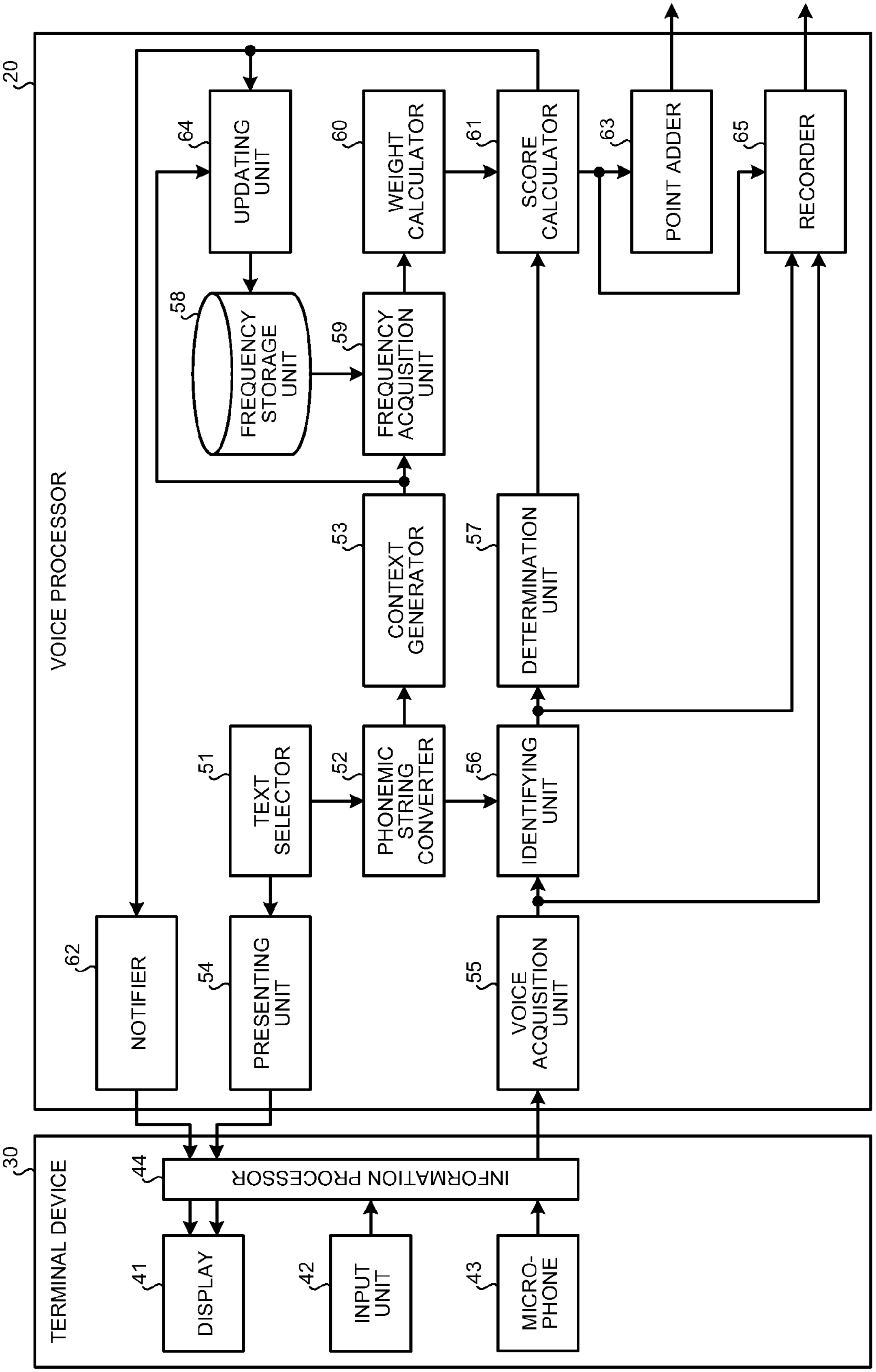


FIG.2



VOICE PROCESSOR
20
62
NOTIFIER
54
PRESENTING UNIT
51
TEXT SELECTOR
52
PHONEMIC STRING CONVERTER
53
CONTEXT GENERATOR
55
VOICE ACQUISITION UNIT
56
IDENTIFYING UNIT
57
DETERMINATION UNIT
58
FREQUENCY STORAGE UNIT
59
FREQUENCY ACQUISITION UNIT
64
UPDATING UNIT
60
WEIGHT CALCULATOR
61
SCORE CALCULATOR
63
POINT ADDER
65
RECORDER
TERMINAL DEVICE
30
44
INFORMATION PROCESSOR
41
DISPLAY
42
INPUT UNIT
43
MICRO-PHONE

FIG.3

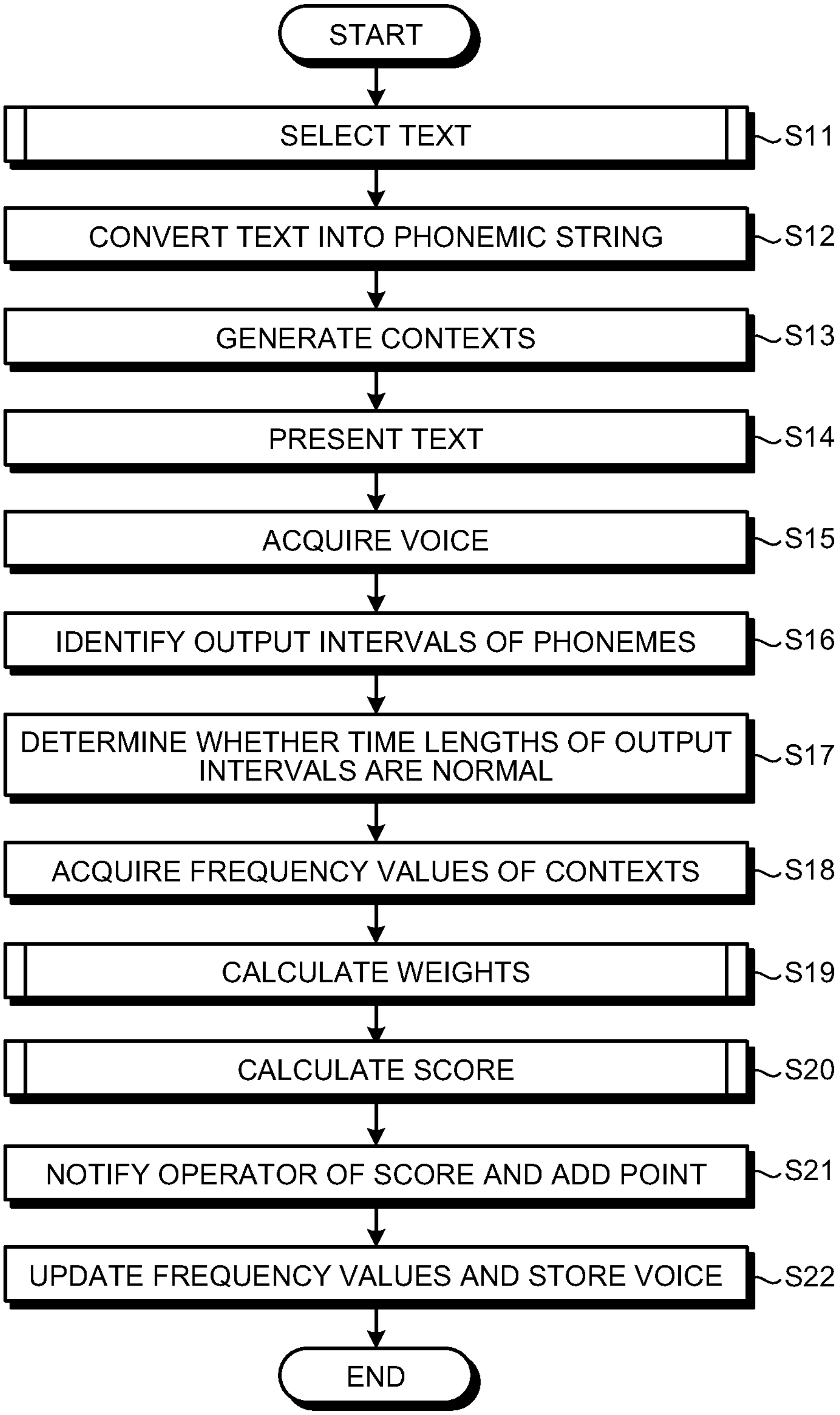

START
SELECT TEXT
S11
CONVERT TEXT INTO PHONEMIC STRING
S12
GENERATE CONTEXTS
S13
PRESENT TEXT
S14
ACQUIRE VOICE
S15
IDENTIFY OUTPUT INTERVALS OF PHONEMES
S16
DETERMINE WHETHER TIME LENGTHS OF OUTPUT INTERVALS ARE NORMAL
S17
ACQUIRE FREQUENCY VALUES OF CONTEXTS
S18
CALCULATE WEIGHTS
S19
CALCULATE SCORE
S20
NOTIFY OPERATOR OF SCORE AND ADD POINT
S21
UPDATE FREQUENCY VALUES AND STORE VOICE
S22
END

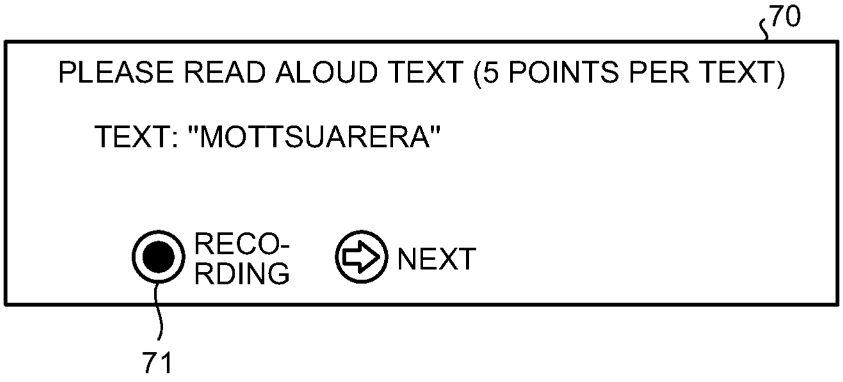
FIG.4

POSITION	PHONEME
1	m
2	o
3	Q
4	cw
5	a
6	r
7	e
8	r
9	a

FIG.5

POSITION	PHONEME	CONTEXT
1	m	sil-m
2	o	m-o
3	Q	o-Q
4	cw	Q-cw
5	a	cw-a
6	r	a-r
7	e	r-e
8	r	e-r
9	a	r-a

FIG.6



PLEASE READ ALOUD TEXT (5 POINTS PER TEXT)

TEXT: "MOTTSUARERA"

FIG.7

POSITION	PHONEME	START TIME (SECONDS)	END TIME (SECONDS)
1	m	1.20	1.29
2	o	1.29	1.39
3	Q	1.39	1.43
4	cw	1.43	1.47
5	a	1.47	1.66
6	r	1.66	1.73
7	e	1.73	1.80
8	r	1.80	1.87
9	a	1.87	1.94

FIG.8

POSITION	PHONEME	START TIME (SECONDS)	END TIME (SECONDS)	LABEL
1	m	1.20	1.29	NORMAL
2	o	1.29	1.39	NORMAL
3	Q	1.39	1.43	ABNORMAL
4	cw	1.43	1.47	ABNORMAL
5	a	1.47	1.66	ABNORMAL
6	r	1.66	1.73	NORMAL
7	e	1.73	1.80	NORMAL
8	r	1.80	1.87	NORMAL
9	a	1.87	1.94	NORMAL

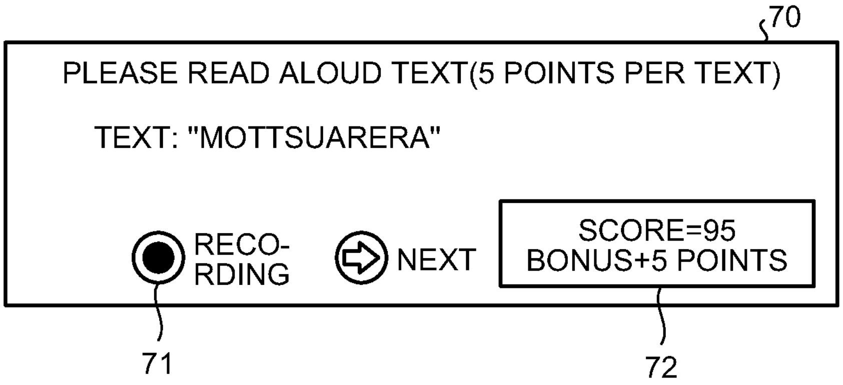
FIG.9

POSITION	PHONEME	CONTEXT	FREQUENCY VALUE
1	m	sil-m	1,000,000
2	o	m-o	500,000
3	Q	o-Q	100,000
4	cw	Q-cw	1,000
5	a	cw-a	2,000
6	r	a-r	1,000,000
7	e	r-e	2,000,000
8	r	e-r	1,000,000
9	a	r-a	1,000,000

FIG.10

POSITION	PHONEME	WEIGHT
1	m	1.0
2	o	1.0
3	Q	1.0
4	cw	0.1
5	a	0.1
6	r	1.0
7	e	1.0
8	r	1.0
9	a	1.0

FIG.11



PLEASE READ ALOUD TEXT(5 POINTS PER TEXT)

TEXT: "MOTTSUARERA"

SCORE=95
BONUS+5 POINTS

FIG.12

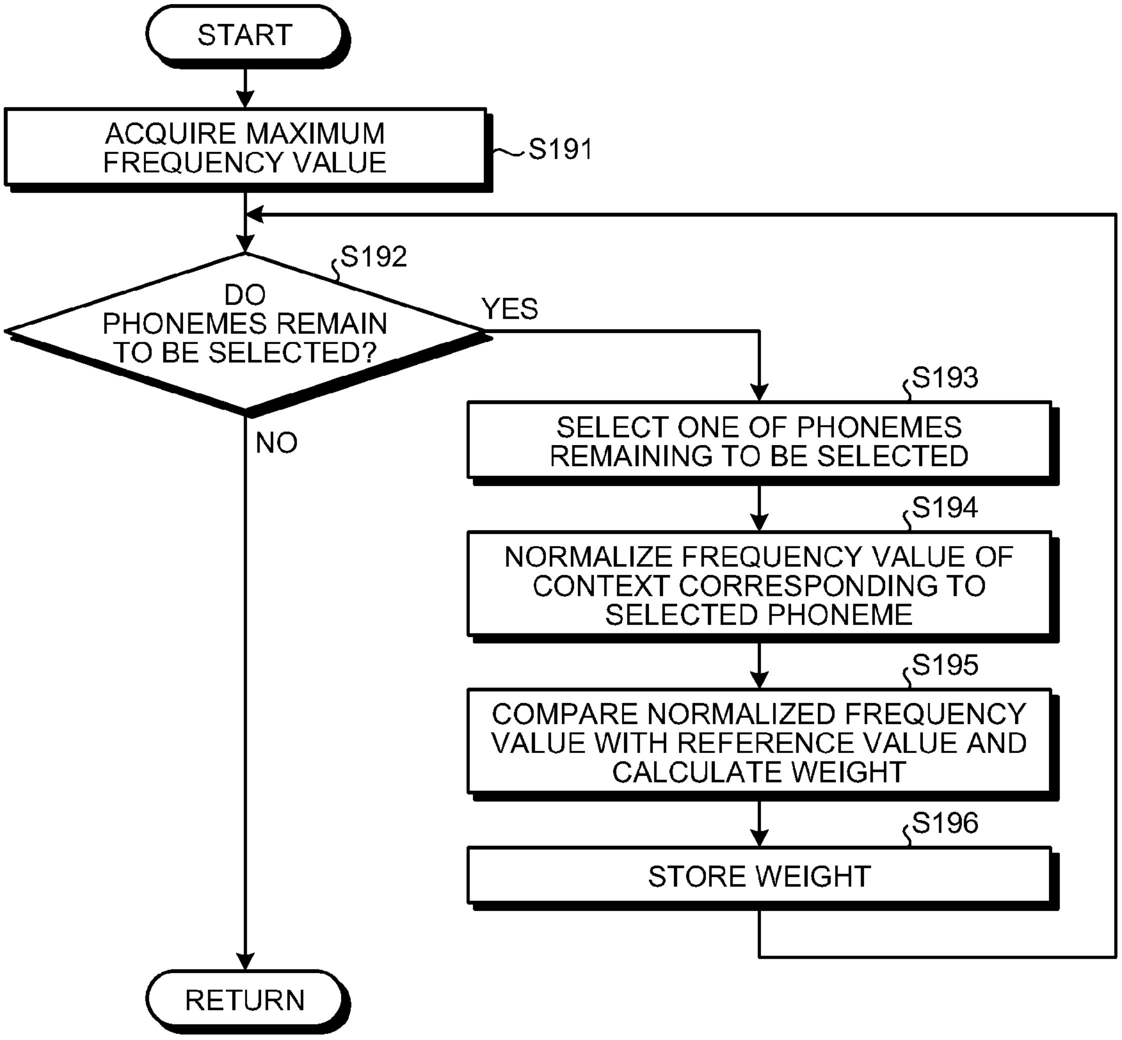

START
ACQUIRE MAXIMUM FREQUENCY VALUE
S191
S192
DO PHONEMES REMAIN TO BE SELECTED?
YES
NO
S193
SELECT ONE OF PHONEMES REMAINING TO BE SELECTED
S194
NORMALIZE FREQUENCY VALUE OF CONTEXT CORRESPONDING TO SELECTED PHONEME
S195
COMPARE NORMALIZED FREQUENCY VALUE WITH REFERENCE VALUE AND CALCULATE WEIGHT
S196
STORE WEIGHT
RETURN

FIG.13

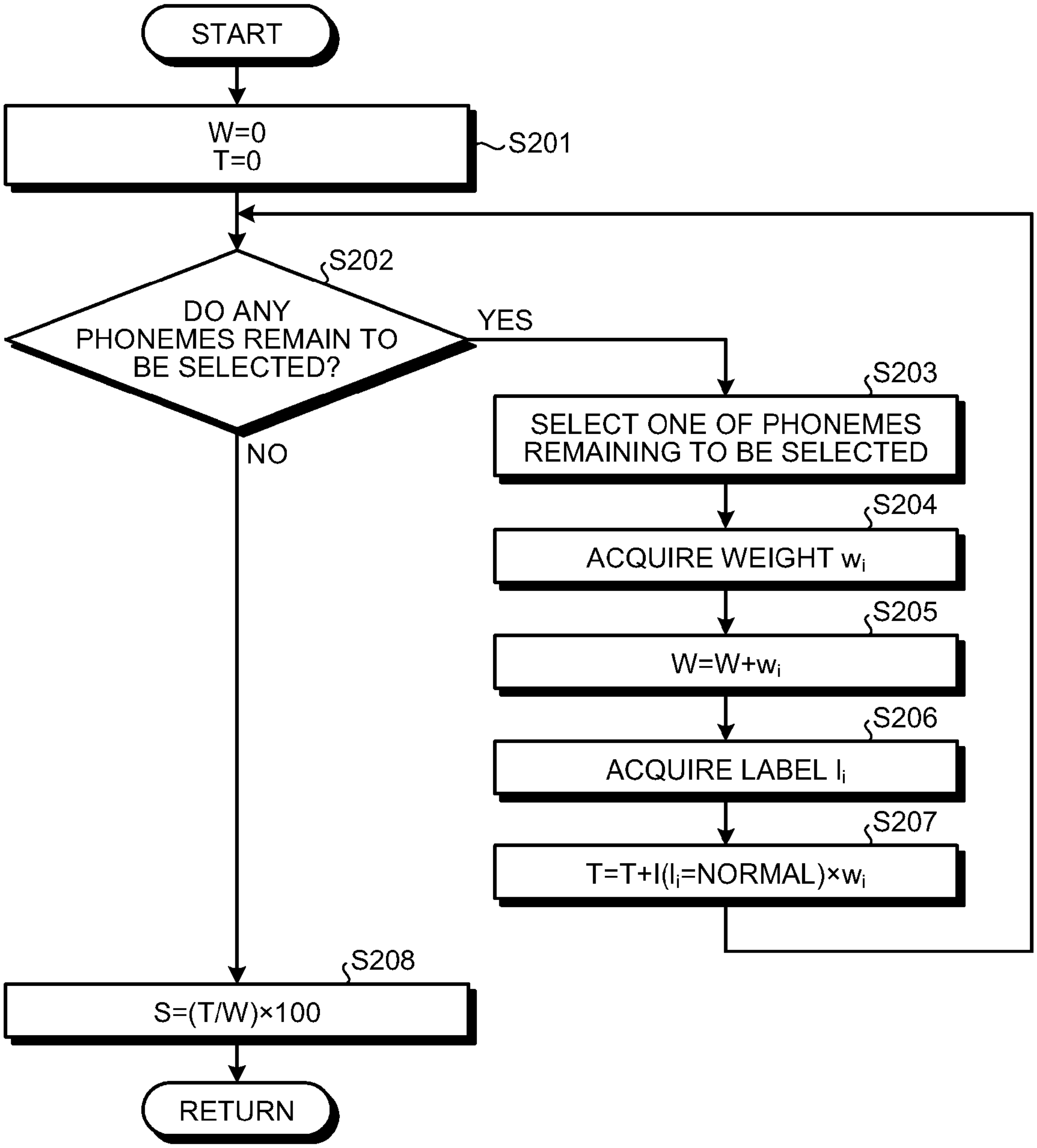

START
W=0
T=0
S201
S202
DO ANY PHONEMES REMAIN TO BE SELECTED?
YES
NO
S203
SELECT ONE OF PHONEMES REMAINING TO BE SELECTED
S204
ACQUIRE WEIGHT w_i
S205
$W=W+w_i$
S206
ACQUIRE LABEL l_i
S207
$T=T+I(l_i=NORMAL)\times w_i$
S208
$S=(T/W)\times 100$
RETURN

FIG.14

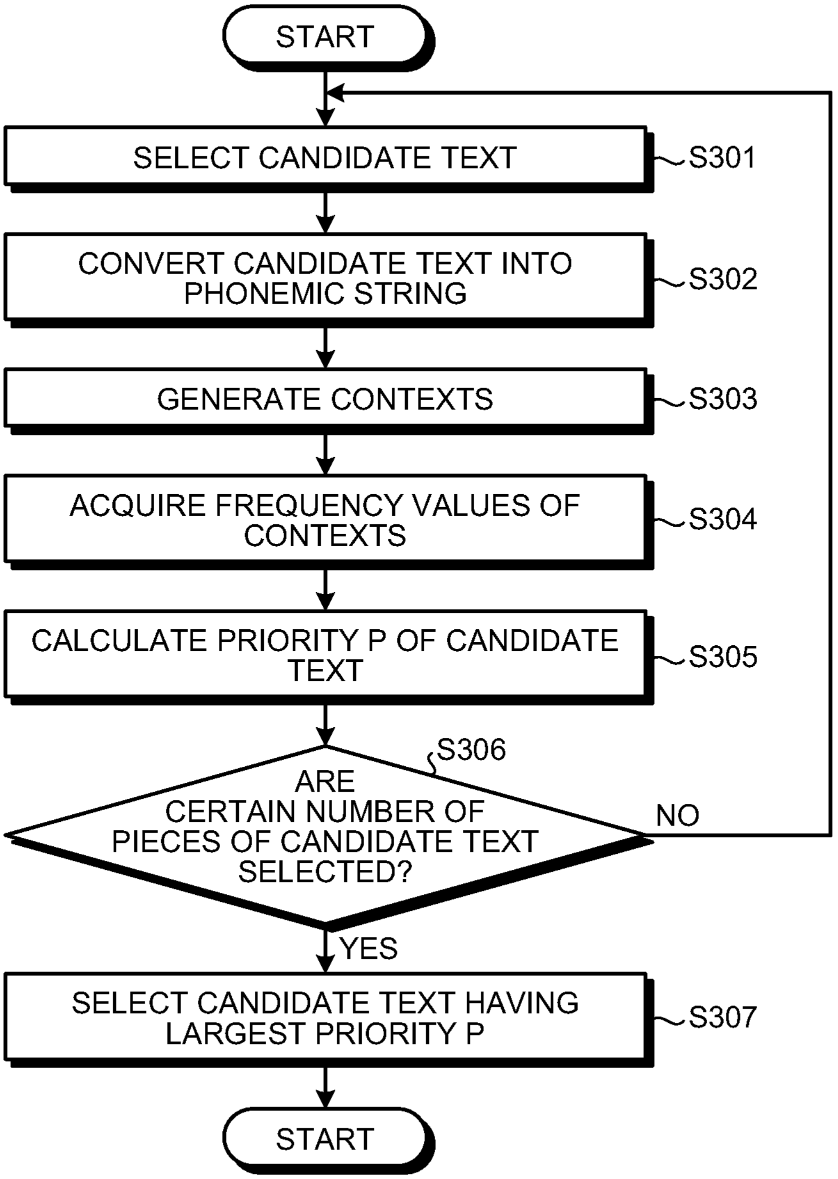

START
SELECT CANDIDATE TEXT
S301
CONVERT CANDIDATE TEXT INTO PHONEMIC STRING
S302
GENERATE CONTEXTS
S303
ACQUIRE FREQUENCY VALUES OF CONTEXTS
S304
CALCULATE PRIORITY P OF CANDIDATE TEXT
S305
S306
ARE CERTAIN NUMBER OF PIECES OF CANDIDATE TEXT SELECTED?
NO
YES
SELECT CANDIDATE TEXT HAVING LARGEST PRIORITY P
S307
START

FIG.15

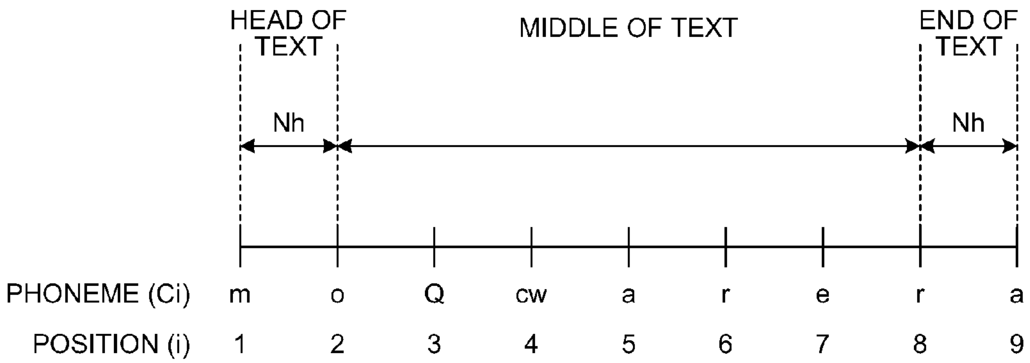


FIG.16

POSITION	PHONEME	CONTEXT
1	ae	sil-ae
2	v	ae-v
3	@	v-@
4	k	@-k
5	aa	k-aa
6	d	aa-d
7	ou	d-ou
8	k	ou-k
9	ei	k-ei
10	k	ei-k

FIG.17

POSITION	PHONEME	START TIME (SECONDS)	END TIME (SECONDS)
1	ae	1.20	1.29
2	v	1.29	1.39
3	@	1.39	1.45
4	k	1.45	1.51
5	aa	1.51	1.62
6	d	1.62	1.65
7	ou	1.65	1.81
8	k	1.81	1.87
9	ei	1.87	1.94
10	k	1.94	2.00

FIG.18

POSITION	PHONEME	START TIME (SECONDS)	END TIME (SECONDS)	LABEL
1	ae	1.20	1.29	NORMAL
2	v	1.29	1.39	NORMAL
3	@	1.39	1.45	NORMAL
4	k	1.45	1.51	NORMAL
5	aa	1.51	1.62	NORMAL
6	d	1.62	1.65	ABNORMAL
7	ou	1.65	1.81	ABNORMAL
8	k	1.81	1.87	NORMAL
9	ei	1.87	1.94	NORMAL
10	k	1.94	2.00	NORMAL

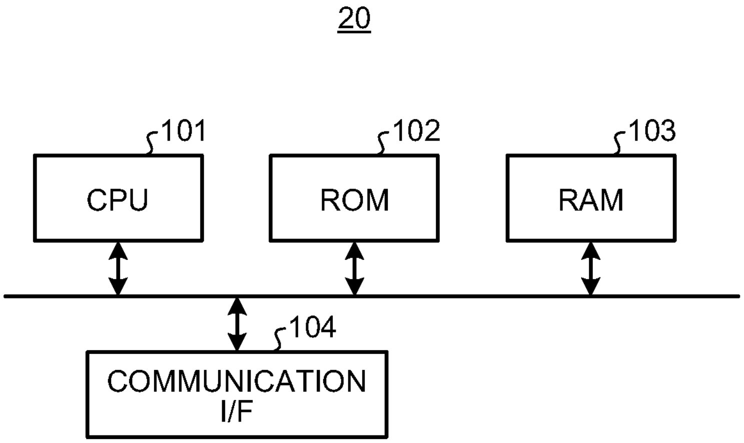
FIG.19

POSITION	PHONEME	CONTEXT	FREQUENCY VALUE
1	ae	sil-ae	1,000,000
2	v	ae-v	2,000,000
3	@	v-@	2,000,000
4	k	@-k	1,000,000
5	aa	k-aa	1,000,000
6	d	aa-d	2,000
7	ou	d-ou	2,000
8	k	ou-k	500,000
9	ei	k-ei	1,000,000
10	k	ei-k	1,000,000

FIG.20

POSITION	PHONEME	WEIGHT
1	ae	1.0
2	v	1.0
3	@	1.0
4	k	1.0
5	aa	1.0
6	d	0.1
7	ou	0.1
8	k	1.0
9	ei	1.0
10	k	1.0

FIG.21



DEVICE METHOD, AND COMPUTER PROGRAM PRODUCT FOR CALCULATING SCORE REPRESENTING CORRECTNESS OF VOICE

CROSS-REFERENCE TO RELATED APPLICATION(S)

This application is based upon and claims the benefit of priority from Japanese Patent Application No. 2013-117261, filed on Jun. 3, 2013; the entire contents of which are incorporated herein by reference.

FIELD

An embodiment described herein relates generally to a voice processor, a voice processing method, and a computer program product.

BACKGROUND

Voice processing such as voice recognition or voice synthesis needs to collect a large amount of voices used for, for example, learning or evaluation. As one of the ways to collect voices, a system may be structured that collects voices from a large number of operators through the Internet and rewards the operators in return for their work. For example, JP-A 2003-186489 discloses a voice collection system that enables an utterer to perform recording by himself or herself by displaying character strings to be uttered and direction information to the utterer. Such a system can collect a large number of voices with a low cost in terms of time and economy.

In such a system, an operator performs recording work while reading aloud presented text at the operator's discretion. Thus, the operator may transmit a voice without reading aloud the text again when the operator fails to read aloud the text, and the poor quality voice that does not coincide with the text may be collected in the system. The use of the voices including a large number of such poor quality voices due to mistakes in reading aloud causes accuracy in voice processing to deteriorate.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is an exemplary structural diagram of a voice processing system;

FIG. **2** is an exemplary structural diagram of a voice processor and a terminal device;

FIG. **3** is an exemplary flowchart of processing performed by the voice processor;

FIG. **4** is an exemplary diagram illustrating a phonemic string when Japanese text is selected;

FIG. **5** is an exemplary diagram illustrating contexts when the Japanese text is selected;

FIG. **6** is an exemplary schematic diagram illustrating a text presenting screen;

FIG. **7** is an exemplary diagram illustrating output intervals of phonemes when the Japanese text is selected;

FIG. **8** is an exemplary diagram illustrating determination results of time lengths of the respective phonemes when the Japanese text is selected;

FIG. **9** is an exemplary diagram illustrating frequency values of the contexts when the Japanese text is selected;

FIG. **10** is an exemplary diagram illustrating weights of the respective phonemes when the Japanese text is selected;

FIG. **11** is an exemplary schematic diagram illustrating the text presenting screen on which a score is displayed;

FIG. **12** is an exemplary flowchart of processing to calculate the weights of the respective phonemes;

FIG. **13** is an exemplary flowchart of processing to calculate the score;

FIG. **14** is an exemplary flowchart of processing to select text;

FIG. **15** is an exemplary diagram illustrating appearance positions of the contexts;

FIG. **16** is an exemplary diagram illustrating a phonemic string and contexts when English text is selected;

FIG. **17** is an exemplary diagram illustrating the output intervals of the phonemes when the English text is selected;

FIG. **18** is an exemplary diagram illustrating the determination results of the time lengths of the respective phonemes when the English text is selected;

FIG. **19** is an exemplary diagram illustrating the frequency values of the contexts when the English text is selected;

FIG. **20** is an exemplary diagram illustrating the weights of the respective phonemes when the English text is selected; and

FIG. **21** is an exemplary hardware structural diagram of the voice processor.

DETAILED DESCRIPTION

According to a voice processor includes a presenting unit, a voice acquisition unit, an identifying unit, a determination unit, a frequency acquisition unit, and a score calculator. The presenting unit is configured to present text to an operator. The voice acquisition unit is configured to acquire a voice of the operator reading aloud the text. The identifying unit is configured to identify output intervals of phonemes included in the voice of the operator. The determination unit is configured to determine whether each of time lengths of the output intervals is normal. The frequency acquisition unit is configured to acquire frequency values respectively representing occurrence frequencies of contexts, respectively corresponding to the phonemes. The context includes the phoneme and another phoneme adjacent to at least one side of the phoneme. The score calculator is configured to calculate a score representing correctness of the voice of the operator on the basis of the determination results of the time lengths of the output intervals and the frequency values of the contexts acquired respectively corresponding to the phonemes.

An embodiment is described below with reference to the accompanying drawings.

FIG. **1** illustrates a structure of a voice processing system **10** according to an embodiment. The voice processing system **10** presents text to a plurality of operators and requests the operators to read aloud the text. The text is a character string such as a word or a sentence of any language. The voice processing system **10** converts voices read aloud by the operators to signals and acquires the signals. Hereinafter, the acquired signals converted from the voices are also referred to as the acquired voices. The voice processing system **10** enables the voices acquired in such a manner to be used for learning or evaluation in voice processing such as voice recognition or voice synthesis.

The voice processing system **10** includes a voice processor **20** and a plurality of terminal devices **30**. The voice processor **20** is a computer connected to a network such as the Internet. Each of the terminal devices **30** is a computer, which is operated by the operator. The voice processor **20** and the respective terminal devices **30** are coupled with each other through the network.

The voice processor **20** presents text to the operators through their respective terminal devices **30** and instructs the respective operators to read aloud the presented text. The voice processor **20** acquires the voices read aloud by the respective operators as the signals and stores the acquired voices.

The voice processor **20** calculates a score representing correctness of the acquired voice. The voice processor **20** notifies each operator of the score through the terminal device **30**, for example. The voice processor **20** stores the scores and the acquired voices in association with each other. The larger value of the score indicates that the operator reads aloud more correctly the text with fewer mistakes in reading aloud, for example. In other words, the smaller value of the score indicates that the voice of the operator is incorrect due to a lot of mistakes in reading aloud, for example.

The voice processing system **10** thus structured can make the operator aware of the correctness in reading aloud by notifying the operator of the score. The voice processing system **10** thus structured, which stores the acquired voices and the scores in association with each other, can also increase accuracy in voice processing by causing the voices having high scores to be used for learning or evaluation in the voice processing, for example.

FIG. **2** illustrates structures of the voice processor **20** and the terminal device **30** according to the embodiment.

The terminal device **30** includes a display **41**, an input unit **42**, a microphone **43**, and an information processor **44**. The display **41** displays the text acquired from the voice processor **20**. The display **41** displays the score acquired from the voice processor **20**.

The input unit **42**, which is a keyboard or a mouse, for example, receives operation of the operator. The microphone **43** converts the voice of the operator reading aloud the text to the signal.

The information processor **44** includes a central processing unit (CPU) and controls the terminal device **30** totally. The information processor **44** receives the text and the score from the voice processor **20** through the network and causes the display **41** to display the received text and score. The information processor **44** transmits the signal converted from the voice by the microphone **43** to the voice processor **20** through the network.

The voice processor **20** includes a text selector **51**, a phonemic string converter **52**, a context generator **53**, a presenting unit **54**, a voice acquisition unit **55**, an identifying unit **56**, a determination unit **57**, a frequency storage unit **58**, a frequency acquisition unit **59**, a weight calculator **60**, a score calculator **61**, a notifier **62**, a point adder **63**, an updating unit **64**, and a recorder **65**.

The text selector **51** selects the text to be presented to the operator. The text selector **51** may read out the text selected in advance by an administrator, for example, or select the text to be presented to the operator from among a plurality of pieces of candidate text.

The phonemic string converter **52** converts the text selected by the text selector **51** into a phonemic string. A phoneme is a minimal unit of a sound to identify meanings of words uttered by persons. The phonemic string converter **52** converts the text into a symbolic sequence representing the respective phonemes on the basis of a correspondence table of the text and the phonemic string. The phonemic system varies depending on languages and interpretations of theories. The phonemic string converter **52** may convert the text into a phonemic string based on any interpretation as long as the phonemic system corresponds to the language of the selected text.

The context generator **53** generates contexts corresponding to the respective phonemes included in the phonemic string obtained by the conversion with the phonemic string converter **52**. The context represents the combination of a certain phoneme and an adjacent phoneme adjacent to at least one side of the certain phoneme, i.e., the adjacent phoneme immediately before the certain phoneme and the adjacent phoneme immediately after the certain phoneme. The contexts called a biphone and a triphone are known. The biphone is the context representing the combination of a certain phoneme and the adjacent phoneme immediately before the certain phoneme. The triphone is the context representing the combination of a certain phoneme and the adjacent phonemes immediately before and after the certain phoneme. The context generator **53** may generate the biphones or the triphones.

The presenting unit **54** presents the text selected by the text selector **51** to the operator. The presenting unit **54** transmits the text to the terminal device **30** through the network and causes the display **41** of the terminal device **30** to display the text, for example.

The voice acquisition unit **55** acquires the voice of the operator reading aloud the presented text. The voice acquisition unit **55** receives the signal converted from the voice by the microphone **43** of the terminal device **30** through the network and stores the signal in a memory, for example.

The identifying unit **56** identifies output intervals of the respective phonemes included in the voice of the operator. Specifically, the identifying unit **56** detects the separations of the phonemes included in the voice of the operator and identifies start time and end time of each of the phonemes.

The identifying unit **56** analyzes the voice acquired by the voice acquisition unit **55** on the basis of the phonemic string obtained by the conversion with the phonemic string converter **52** using a forced alignment technique and identifies the output interval of each of the phonemes. The forced alignment technique identifies the output interval of the phoneme using the waveform or the like of the phoneme collected in the past, for example. In the forced alignment technique, it is highly likely that the output interval of the phoneme being collected more in the past can be identified more correctly than that of the phoneme being collected less in the past.

The determination unit **57** determines whether the time length of the output interval, which is identified by the identifying unit **56**, of each of the phonemes is normal. The determination unit **57** then associates the determination results with the respective phonemes included in the voice. Specifically, the determination unit **57** associates labels each indicating that the time length is normal or abnormal (i.e., the time length is not normal) with the respective phonemes.

The time length of each of the phonemes included in the voice uttered by a person is typically in a certain range. Thus, when the time length, identified by the identifying unit **56**, of the output interval of the phoneme is out of a certain range, the time length of the output interval of the identified phoneme is estimated as abnormal. The determination unit **57** thus determines for each phoneme whether the time length of the output interval of the phoneme is in a predetermined range, and if the time length of the output interval of the phoneme is in the predetermined range, determines the phoneme as normal and if the time length is out of the predetermined range, determines the phoneme as abnormal.

In other words, if the time length of the output interval of the phoneme is equal to or larger than the predetermined lower limit time length and equal to or smaller than the predetermined upper limit time length, the determination unit **57** determines that the phoneme is normal whereas if the time length is smaller than the lower limit time length or larger than the upper limit time length, the determination unit **57** determines that the phoneme is abnormal.

The range in which the time length of each of the phonemes is determined as normal may be the same regardless of the types of phonemes or may vary according to the type of phoneme. The range in which the time length of each of the phonemes is determined as normal may vary depending on languages.

The frequency storage unit **58** stores therein, for each context, a value representing occurrence frequency of the context included in the voices acquired in the past as frequency value. The frequency value is large when the number of times the context is included in the voices acquired in the past is large whereas the frequency value is small when the number of times the context is included in the voices acquired in the past is small.

The voices acquired in the past may be the voices acquired by the voice processing system **10** or may be the voices acquired by another system. The voices acquired in the past may include both of the voices acquired by the voice processing system **10** and the voices acquired by another system.

The frequency value does not have to be a value directly representing the occurrence frequency as long as it represents the occurrence frequency. Examples of the frequency value include a representative value of a level obtained by classifying the occurrence frequency into about 10 levels and a normalized value of the occurrence frequency.

The frequency acquisition unit **59** acquires, from the frequency storage unit **58**, the frequency values of the contexts corresponding to the respective phonemes obtained by the conversion of the phonemic string converter **52**. Specifically, the frequency acquisition unit **59** reads out, from the frequency storage unit **58**, the frequency values corresponding to the respective contexts generated by the context generator **53**.

The weight calculator **60** calculates a weight corresponding to each of the phonemes obtained by the conversion of the phonemic string converter **52** in accordance with the frequency value of the context acquired by the frequency acquisition unit **59**. The weight is a coefficient represented by a numeral value, for example. The larger the frequency value the larger weight value the weight calculator **60** calculates whereas the smaller the frequency value the smaller weight value the weight calculator **60** calculates, for example.

The score calculator **61** calculates the score representing the correctness of the voice of the operator reading aloud the text on the basis of the results of the determination by the determination unit **57** on the time lengths of the output intervals of the phonemes and the weights calculated by the weight calculator **60** respectively corresponding to the phonemes.

Specifically, the score calculator **61** weights the determination results of the phonemes with corresponding respective weights. The score calculator **61** then calculates, as the score, a ratio of the number of determination results of the phonemes determined as normal to the total number of determination results after the weighting. The score calculator **61** can reflect in the score the determination results of the phonemes having large weights (i.e., phonemes having large occurrence frequencies) further than the determination results of the phonemes having small weights (i.e., phonemes having small occurrence frequencies).

The notifier **62** notifies the operator of content according to the score calculated by the score calculator **61**. The notifier **62** transmits the score to the terminal device **30** through the network and causes the display **41** of the terminal device **30** to display the score, for example. The notifier **62** may convert the score into an evaluation value classified in two levels or three levels (e.g., evaluation level A, evaluation level B, and evaluation level C) and cause the display **41** to display the evaluation value, for example. As a result, the notifier **62** can make the operator aware of the correctness of the voice of the operator reading aloud the text.

The point adder **63** accesses an external point management server, for example, and adds a point to the operator in return for the reading aloud work. The point may be cash or electronic money, for example. Alternatively, the point adder **63** may transfer the corresponding amount of money to the operator's bank account, for example.

The point adder **63** may change the point in accordance with the score. The point adder **63** may add a bonus point to the operator who has read aloud the text in addition to a regular point when the calculated score of the voice of the operator is equal to or larger than a preset threshold, for example. As a result, the point adder **63** can motivate the operator to read aloud text more correctly.

The updating unit **64** updates the frequency values, stored in the frequency storage unit **58**, of the contexts corresponding to the respective phonemes included in the voice of the operator reading aloud the text. In this case, the updating unit **64** may update the frequency values of the contexts on the condition that the score is equal to or larger than a certain threshold. As a result, the updating unit **64** can prevent the frequency values from being reflected in the frequency storage unit **58** when the text is incorrectly read aloud.

The recorder **65** stores the voice acquired by the voice acquisition unit **55** and the output intervals of the respective phonemes identified by the identifying unit **56** in an internal or an external storage device. As a result, the recorder **65** can cause the acquired voice to be used for voice processing.

In this case, the recorder **65** may further store the score in association with the voice. As a result, the recorder **65** can cause the voice having a high score (i.e., correct voice) to be used for voice processing. The recorder **65** can cause the reasons of mistakes in reading aloud to be analyzed by analyzing the voice having a low score.

FIG. **3** illustrates a processing flow performed by the voice processor **20** according to the embodiment. The following describes the processing performed by the voice processor **20** with reference to FIG. **3**.

At Step S**11**, the text selector **51** selects the text to be presented to the operator. As an example, the text selector **51** selects text of "mottsuarera (mozzarella in English)", a word in Japanese.

At Step S**12**, the phonemic string converter **52** converts the selected text into a phonemic string. In the example, the phonemic string converter **52** converts the text of "mottsuarera" into the phonemic string of "m-o-Q-cw-a-r-e-r-a", which is composed of nine phonemes as illustrated in FIG. **4**.

At Step S**13**, the context generator **53** generates the contexts corresponding to the respective phonemes included in the phonemic string as the result of the conversion. In the example, the context generator **53** generates the contexts called the biphones.

Specifically, as illustrated in FIG. **5**, the context generator **53** generates the context of "sil-m" corresponding to the phoneme of "m". The symbol of "sil" represents silence.

The context generator **53** generates the context of "m-o" corresponding to the phoneme of "o". The context generator **53** generates the context "o-Q" corresponding to the phoneme "Q". The context generator **53** generates the context of "Q-cw" corresponding to the phoneme of "cw". The context generator **53** generates the context of "cw-a" corresponding to the phoneme of "a". The context generator **53** generates the context of "a-r" corresponding to the phoneme of "r". The context generator **53** generates the context of "r-e" corresponding to the phoneme of "e". The context generator **53** generates the context of "e-r" corresponding to the phoneme of "r". The context generator **53** generates the context of "r-a" corresponding to the phoneme of "a".

At Step S**14**, the presenting unit **54** causes the display **41** of the terminal device **30** to display the selected text. In the example, the presenting unit **54** causes the display **41** to display a presenting screen **70** including the text of "mottsuarera" as illustrated in FIG. **6**.

A point indicating the reward for the reading aloud of the text (e.g., "5 points") may be displayed on the presenting screen **70** together with the text. On the presenting screen **70**, a recording button **71** that starts recording of a voice is displayed, for example. The terminal device **30** starts recording of a voice of the operator through the microphone **43** once the recording button **71** is pressed by the operator.

At Step S**15**, the voice acquisition unit **55** acquires the voice recorded by the terminal device **30** through the network. The voice acquisition unit **55** then stores the acquired voice in a memory, for example.

At Step S**16**, the identifying unit **56** identifies the output intervals of the respective phonemes included in the acquired voice. In the example, the identifying unit **56** identifies the output intervals of the respective phonemes using the forced alignment technique. The identifying unit **56** identifies the output interval corresponding to each of the respective phonemes converted from the presented text, using the waveforms or the like of the respective phonemes collected in the past.

In the example, the identifying unit **56** identifies the start times and end times of the respective phonemes of "m", "o", "Q", "cw", "a", "r", "e", "r", and "a" as illustrated in FIG. **7**. For example, the identifying unit **56** identifies on the first phoneme of "m" that the start time is 1.20 seconds and the end time is 1.29 seconds. For another example, the identifying unit **56** identifies on the fourth phoneme of "cw" that the start time is 1.43 seconds and the end time is 1.47 seconds.

The reference of the start time and the end time may be set to any time. In the example, the reference of the start time and the end time is the time of starting the recording.

At Step S**17**, the determination unit **57** determines whether the time length of the identified output interval of each of the respective phonemes is normal. As illustrated in FIG. **8**, the determination unit **57** determines that the phoneme is normal when its time length from the star time to the end time is equal to or larger than 0.05 seconds and equal to or smaller than 0.15 seconds, in the example. In other words, the determination unit **57** determines that the phoneme is abnormal when its time length from the start time to the end time is smaller than 0.05 seconds or larger than 0.15 seconds. For example, the determination unit **57** determines that the first phoneme of "m" is normal because the time length is 0.09 seconds. For another example, the determination unit **57** determines that the fourth phoneme of "cw" is abnormal because the time length is 0.04 seconds.

As illustrated in FIG. **8**, the determination unit **57** associates the labels each indicating normal or abnormal with the respective phonemes.

At Step S**18**, the frequency acquisition unit **59** acquires, from the frequency storage unit **58**, the frequency values of the contexts corresponding to the respective phonemes converted from the presented text. In the example, the frequency acquisition unit **59** acquires the frequency values corresponding to the respective contexts of "sil-m", "m-o", "o-Q", "Q-cw", "cw-a", "a-r", "r-e", "e-r", and "r-a" as illustrated in FIG. **9**. For example, the frequency acquisition unit **59** acquires "1000000" as the frequency value of the context of "sil-m" corresponding to the first phoneme of "m". For another example, the frequency acquisition unit **59** acquires "1000" as the frequency value of the context of "Q-cw" corresponding to the fourth phoneme of "cw".

At Step S**19**, the weight calculator **60** calculates the weights corresponding to the respective phonemes converted from the presented text in accordance with the acquired frequency values of the contexts. As illustrated in FIG. **10**, the weight calculator **60** calculates the weight corresponding to the phoneme for which the context has the frequency value smaller than a predetermined reference value, to be a first value (e.g., 0.1), while the weight calculator **60** calculates the weight corresponding to the phoneme for which the context has the frequency value equal to or larger than the predetermined reference value, to be a second value (e.g., 1.0), which is larger than the first value, in the example. For example, the weight calculator **60** calculates the weight corresponding to the first phoneme of "m" to be the second value (1.0). For another example, the weight calculator **60** calculates the weight corresponding to the fourth phoneme of "cw" to be the first value (0.1).

The weight calculator **60** sets the ratio of the first value to the second value as 10 times in the example. The ratio may be larger or smaller than 10 times. The specific processing at Step S**19** will be described later with reference to FIG. **12**.

At Step S**20**, the score calculator **61** calculates the score on the basis of the determination results of the time lengths of the output intervals of the respective phonemes and the weights calculated corresponding to the respective phonemes. In the example, the score calculator **61** calculates the score represented by any numeral value from 0 to 100. The specific processing at Step S**20** will be described later with reference to FIG. **13**.

At Step S**21**, the notifier **62** causes the display **41** of the terminal device **30** to display the score to notify the operator of the score. As illustrated in FIG. **11**, the notifier **62** causes the display **41** to display a score window **72** displaying the score on a part of the presenting screen **70**, in the example. The point adder **63** accesses the point management server, for example, and adds the point to the operator.

When the score is equal to or larger than a preset threshold, the notifier **62** adds a bonus point to the operator in addition to a regular point. In this case, as illustrated in FIG. **11**, the notifier **62** causes the display **41** to display the value of the bonus point on the score window **72** to notify the operator that the bonus point is added.

At Step S**22**, the updating unit **64** updates the frequency values stored in the frequency storage unit **58** on the condition that the score is equal to or larger than a certain threshold. The recorder **65** stores the acquired voice and the output intervals of the respective phonemes in an internal or an external storage device. In this case, the recorder **65** stores the score in association with the voice.

Upon completion of the processing at Step S**22**, the voice processor **20** ends the processing of the flow.

FIG. **12** is a processing flow to calculate the weights of the phonemes. The weight calculator **60** performs the processing illustrated in FIG. **12** at Step S**19** of FIG. **3**.

At Step S**191**, the weight calculator **60** acquires a maximum in the frequency values of the contexts acquired by the frequency acquisition unit **59** from the frequency storage unit **58**. As illustrated in FIG. **9**, the weight calculator **60** acquires "2000000", which is the frequency value of the context of "r-e" corresponding to the seventh phoneme of "e", as the maximum, in the example.

At Step S**192**, the weight calculator **60** determines whether any phonemes remain to be selected in the phonemes converted from the presented text. If no phonemes remain to be selected (No at Step S**192**), the weight calculator **60** ends this flow and the processing returns to the main flow. If any phonemes remain to be selected (Yes at Step S**192**), the weight calculator **60** proceeds to Step S**193**.

At Step S**193**, the weight calculator **60** selects, as the processing target, any one phoneme from the phonemes remaining to be selected.

At Step S**194**, the weight calculator **60** normalizes the frequency value of the context corresponding to the selected phoneme. Specifically, the weight calculator **60** divides the frequency value of the context corresponding to the selected phoneme by the maximum acquired at Step S**191** in the normalization processing. In the example illustrated in FIG. **9**, when the first phoneme of "m" is selected, the normalized frequency value is calculated as follows: 1000000/2000000=0.5. In the example illustrated in FIG. **9**, when the fourth phoneme of "cw" is selected, the normalized frequency value is calculated as follows: 1000/2000000=0.0005.

At Step S**195**, the weight calculator **60** compares the normalized frequency value with a preset reference value and calculates the weight corresponding to the selected phoneme. Specifically, the weight calculator **60** calculates the weight corresponding to the selected phoneme to be the first value (0.1) when the normalized frequency value is smaller than the reference value. The weight calculator **60** calculates the weight corresponding to the selected phoneme to be the second value (1.0) which is larger than the first value when the normalized frequency value is equal to or larger than the reference value.

In the example, the reference value is set to "0.1". As illustrated in FIG. **10**, when the first phoneme of "m" is selected, the weight calculator **60** calculates the weight to be the second value (1.0) because the normalized frequency value is "0.5", which is larger than the reference value. When the fourth phoneme of "cw" is selected, the weight calculator **60** calculates the weight to be the first value (0.1) because the normalized frequency value is "0.0005", which is smaller than the reference value.

The weight calculator **60** may calculate the weight using not only two values but also three or more values. The weight calculator **60** may calculate the logarithmic value of the normalized frequency value as the weight.

At Step S**196**, the weight calculator **60** stores the calculated weight in association with the selected phoneme. The weight calculator **60** then returns to Step S**192**, and continues the processing from Step S**192** to Step S**196** until no phonemes remain to be selected.

FIG. **13** illustrates a processing flow to calculate the score. The score calculator **61** performs the processing illustrated in FIG. **13** at Step S**20** of FIG. **3**.

At Step S**201**, the score calculator **61** substitutes "0" for variables W and T.

At Step S**202**, the score calculator **61** determines whether any phonemes remain to be selected in the phonemes converted from the presented text. If no phonemes remain to be selected (No at Step S**202**), the score calculator **61** proceeds to Step S**208**. If any phonemes remain to be selected (Yes at Step S**202**), the score calculator **61** proceeds to Step S**203**.

At Step S**203**, the score calculator **61** selects, as the processing target, any one phoneme from the phonemes remaining to be selected.

At Step S**204**, the score calculator **61** acquires a weight w_i corresponding to the selected phoneme. For example, when the first phoneme of "m" is selected, the score calculator **61** acquires "weight w_1=1.0" as illustrated in FIG. **10**. For another example, when the fourth phoneme of "cw" is selected, the score calculator **61** acquires "weight w_4=0.1" as illustrated in FIG. **10**.

At Step S**205**, the score calculator **61** performs an arithmetic operation of $W=W+w_i$. In other words, the score calculator **61** adds the weight w_i of the selected phoneme to the variable W.

At Step S**206**, the score calculator **61** acquires a label l_i corresponding to the selected phoneme. For example, when the first phoneme of "m" is selected, the score calculator **61** acquires "label l_1=normal" as illustrated in FIG. **8**. For another example, when the fourth phoneme of "cw" is selected, the score calculator **61** acquires "label l_4=abnormal" as illustrated in FIG. **8**.

At Step S**207**, the score calculator **61** performs an arithmetic operation of "$T=T+I\ (l_i\text{=normal})\times w_i$". I(x) is a function. I(x)=1 when x is true while I(x)=0 when x is false. The score calculator **61** adds w_i to T when the label l_i is normal while the score calculator **61** adds no value to T when the label l_i is abnormal.

Upon completion of the processing at Step S**207**, the score calculator **61** returns to Step S**202**, and repeats the processing from Step S**202** to Step S**207** until no phonemes remain to be selected. When no phonemes remain to be selected, the score calculator **61** proceeds to Step S**208**.

At Step S**208**, the score calculator **61** performs an arithmetic operation of "S=(T/W)×100" to calculate a score S. W represents the sum of the weights corresponding to the respective phonemes. T represents the sum of weights corresponding to the phonemes determined as normal.

The score calculator **61** thus calculates the score S by multiplying the ratio of the sum of the weights corresponding to the phonemes determined as normal to the sum of the weights corresponding to the respective phonemes by 100 in the arithmetic operation of "S=(T/W)×100".

The processing from Step S**201** to Step S**208** is expressed by the following expression (1).

$$S=\left[\sum_{i=1}^{N}\{I(l_i=\text{Normal})\times w_i\}\Big/\sum_{i=1}^{N}w_i\right]\times 100 \tag{1}$$

In the example illustrated in FIGS. **8** and **10**, the score calculator **61** calculates the score S as follows: S={(1×1.0)+(1×1.0)+(0×1.0)+(0×0.1)+(0×0.1)+(1×1.0)+(1×1.0)+(1×1.0)+(1×1.0)}/{1.0+1.0+1.0+0.1+0.1+1.0+1.0+1.0+1.0}×100=83.3.

As described above, the voice processor **20** reflects, in the score, the determination results of the phonemes included in the contexts having high occurrence frequencies by weighting the determination results in accordance with the occurrence frequencies of the phonemes included in the voices collected in the past.

In the forced alignment technique, the phoneme that was collected less in the past is more likely to include mistakes in the determination result than the phoneme that was collected more in the past. The voice processor **20** thus weights the phonemes that are more likely to include mistakes in the determination results by the forced alignment technique with small weights to reduce the influences whereas the voice processor **20** weights the phonemes that are less likely to include mistakes in the determination results by the forced alignment technique with large weights to increase the influences. As a result, the voice processor **20** can calculate the scores with high accuracy.

FIG. **14** illustrates an example of the processing flow to select the text. The text selector **51** performs the processing flow illustrated in FIG. **14** to select the text to be presented to the operator, for example. The text selector **51** may perform the processing illustrated in FIG. **14** for each access from the terminal device **30** or in advance of the access from the terminal device **30**.

At Step S**301**, the text selector **51** selects one piece of candidate text from a plurality of pieces of preliminarily prepared candidate text.

At Step S**302**, the text selector **51** converts the selected candidate text into a phonemic string. The processing at Step S**302** is the same as that at Step S**12** of FIG. **3**.

At Step S**303**, the text selector **51** generates the contexts corresponding to the respective phonemes included in the phonemic string obtained by the conversion. The processing at Step S**303** is the same as that at Step S**13** of FIG. **3**.

At Step S**304**, the text selector **51** acquires, from the frequency storage unit **58**, the frequency values of the contexts corresponding to the respective phonemes converted from the candidate text. The processing at Step S**304** is the same as that at Step S**18** of FIG. **3**.

At Step S**305**, the text selector **51** calculates a priority P of the candidate text on the basis of the frequency values corresponding to the respective phonemes. Specifically, the text selector **51** calculates the priority P by performing an arithmetic operation using the following expression (2).

$$P=\left[\sum_{i=1}^{Nh} I(f_{(ci)} > f_{th}) + \sum_{i=N-Nh+1}^{N} I(f_{(ci)} > f_{th}) + \sum_{i=Nh+1}^{N-Nh} I(f_{(ci)} < f_{th})\right] \Big/ N \qquad (2)$$

In expression (2), N is an integer equal to or larger than one and represents the number of phonemes of the candidate text. As illustrated in FIG. **15**, i is an integer equal to or larger than one and represents the position of the phoneme from the head. C_i represents the i-th phoneme. $f(C_i)$ represents the frequency value of the context corresponding to the i-th phoneme. f_{th} is a constant and represents a threshold.

In expression (2), N_h is a constant and represents an integer smaller than half the number of phonemes of the candidate text. More specifically, as illustrated in FIG. **15**, N_h is the constant designating the phonemes at the head of the text and the phonemes at the end of the text.

In expression (2), the first term of the numerator represents the number of phonemes with the contexts having the frequency values larger than the threshold, in N_h phonemes at the head of the text. In expression (2), the second term of the numerator represents the number of phonemes with the

contexts having the frequency values larger than the threshold, in N_h phonemes at the end of the text.

In expression (2), the third term of the numerator represents the number of phonemes for which the contexts have the frequency values smaller than the threshold, in the phonemes excluding the N_h phonemes at the head of the text and the N_h phonemes at the end of the text (i.e., the phonemes in the middle of the text).

The text selector **51** calculates the priority P by adding the first term, the second term, and the third term of the numerator and dividing the numerator by the number N of phonemes of the candidate text as the result of the arithmetic operation of expression (2).

At Step S**306**, the text selector **51** determines whether a predetermined number of pieces of candidate text are selected. If the predetermined number of pieces of candidate text are not selected (No at Step S**306**), the text selector **51** returns to Step S**301** and repeats the processing on another candidate text from Step S**301**. If the predetermined number of pieces of candidate text are selected (Yes at Step S**306**), the text selector **51** proceeds to Step S**307**.

At Step S**307**, the text selector **51** selects the candidate text having the largest priority P in the pieces of candidate text as the text to be presented to the operator. Upon completion of the processing at Step S**307**, the text selector **51** ends the flow.

Through the processing described above, the text selector **51** can select the following candidate text in preference to the other candidate text. The preferred candidate text includes the phonemes for which the contexts have the frequency values larger than the threshold, at the head and the end of the text, and the phonemes for which the contexts have the frequency values smaller than the threshold, in a part of the text other than the head and the end thereof (i.e., in the middle of the text).

In this way, the voice processor **20** preferentially selects the text including the phonemes for which the contexts have large frequency values at the head of the text. The voice processor **20** thus can increase the weights corresponding to the phonemes at the head of the text. As a result, when the phonemes at the head of the text are determined as abnormal because it is cut out due to wrong operation of the recording button **71**, for example, the voice processing system **10** can reduce the score without fail.

The voice processor **20** preferentially selects the text including the phonemes for which the contexts have large frequency values at the end of the text. As a result, the voice processor **20** can increase the weights corresponding to the phonemes at the end of the text. When the operator stops reading aloud the text halfway and thus the phonemes at the end of the text are determined as abnormal, for example, the voice processor **20** can reduce the score without fail.

The voice processor **20** preferentially selects the text including the phonemes for which the contexts have small frequency values, in a part of the text other than the head and the end thereof (i.e., in the middle of the text). It is preferable for the voice processing system **10** to collect different phonemes as many as possible to the certain minimum number of the respective phonemes. The voice processor **20** preferentially selects the text including the phonemes for which the contexts have small frequency values, thus can reliably acquire the voices including the phonemes collected less in the past.

As described above, the voice processing system **10** according to the embodiment weights the determination results of the phonemes included in the acquired voice in accordance with the occurrence frequencies of the contexts included in the voices collected in the past. The voice processing system **10** thus can increase the weights of the determination results of the phonemes that are more likely to be correct and reduce the weights of the determination results of the phonemes that are less likely to be correct. As a result, the voice processing system **10** can calculate the scores with high accuracy.

The voice processing system **10** encourages the operator to read aloud the text correctly by notifying the operator of the accurate score, thereby making it possible to acquire high quality voices. The voice processing system **10** can calculate the accurate score, thereby enabling the voice processing using the acquired voices to be performed with high accuracy.

The voice processing system **10** preferentially selects the text from which the accurate score is calculated and presents the text to the operator, thereby enabling the accurate score to be reliably calculated.

FIGS. **16** to **20** illustrate an example of a case where text in English is read aloud. In the embodiment described above, a case is described where text in Japanese is read aloud. The voice processing system **10** can also be applied to a case where text in a language other than Japanese is read aloud.

As an example, the text selector **51** selects an English sentence of "avocado cake". In this case, as illustrated in FIG. **16**, the phonemic string converter **52** converts the text of "avocado cake" into the phonemic string of "ae-v-@-k-aa-d-ou-k-ei-k", which is composed of 10 phonemes.

As illustrated in FIG. **16**, the context generator **53** generates the contexts of "sil-ae", "ae-v", "v-@", "@-k", "k-aa", "aa-d", "d-ou", "ou-k", "k-ei", and "ei-k" corresponding to the respective phonemes.

As illustrated in FIG. **17**, the identifying unit **56** identifies the output intervals of the respective phonemes. For example, the identifying unit **56** identifies on the first phoneme of "ae" that the start time is 1.20 seconds and the end time is 1.29 seconds. For another example, the identifying unit **56** identifies on the sixth phoneme of "d" that the start time is 1.62 seconds and the end time is 1.65 seconds.

As illustrated in FIG. **18**, the determination unit **57** determines whether the time length of the identified output interval of each of the respective phonemes is normal. For example, the determination unit **57** determines that the phoneme having the time length smaller than 0.05 seconds or larger than 0.15 seconds is abnormal. For example, the determination unit **57** determines that the first phoneme of "ae" is normal because the time length is 0.09 seconds. For another example, the determination unit **57** determines that the sixth phoneme of "d" is abnormal because the time length is 0.03 seconds.

As illustrated in FIG. **19**, the frequency acquisition unit **59** acquires, from the frequency storage unit **58**, the frequency values of the contexts corresponding to the respective phonemes. For example, the frequency acquisition unit **59** acquires "1000000" as the frequency value of the context of "sil-ae" corresponding to the first phoneme of "ae". For another example, the frequency acquisition unit **59** acquires "2000" as the frequency value of the context of "aa-d" corresponding to the sixth phoneme of "d".

As illustrated in FIG. **20**, the weight calculator **60** calculates the weights corresponding to the respective phonemes in accordance with the acquired frequency values of the contexts. For example, the weight calculator **60** calculates the weight corresponding to the first phoneme of "ae" to be the second value (1.0). For another example, the weight calculator **60** calculates the weight corresponding to the sixth phoneme of "d" to be the first value (0.1).

The score calculator **61** calculates the score on the basis of the determination results of the time lengths of the output intervals of the respective phonemes illustrated in FIG. **18** and the weights calculated corresponding to the respective phonemes illustrated in FIG. **20**. Specifically, in the example illustrated in FIGS. **18** and **20**, the score calculator **61** calculates the score S as follows: $S=\{(1\times1.0)+(1\times1.0)+(1\times1.0)+(1\times1.0)+(1\times1.0)+(0\times0.1)+(0\times0.1)+(1\times1.0)+(1\times1.0)+(1\times1.0)\}/\{1.0+1.0+1.0+1.0+1.0+0.1+0.1+1.0+1.0+1.0\}\times100=97.5$.

FIG. **21** is a schematic diagram illustrating an example of a hardware structure of the voice processor **20** in the embodiment. The voice processor **20** in the embodiment comprises a controller such as a central processing unit (CPU) **101**, storage devices such as a read only memory (ROM) **102** and a random access memory (RAM) **103**, a communication interface (I/F) **104** that communicates by being connected to a network, and a bus connecting these components.

A voice processing program executed by the voice processor **20** in the embodiment is provided by being preliminarily stored in the ROM **102**, for example.

The voice processing program executed by the voice processor **20** in the embodiment may be recorded in a storage medium readable by a computer as a file in an installable or executable format, and provided as a computer program product. The examples of the storage medium include a compact disk ROM (CD-ROM), a flexible disk (FD), a CD-recordable (CD-R), and a digital versatile disk (DVD).

The voice processing program executed by the voice processor **20** in the embodiment may be stored in a computer coupled with the network such as the Internet, and be provided by being downloaded through the network. The voice processing program executed by the voice processor **20** in the embodiment may be provided or distributed through the network such as the Internet.

The voice processing program executed by the voice processor **20** in the embodiment can cause the computer to function as the respective units of the voice processor **20** (the text selector **51**, the phonemic string converter **52**, the context generator **53**, the presenting unit **54**, the voice acquisition unit **55**, the identifying unit **56**, the determination unit **57**, the frequency storage unit **58**, the frequency acquisition unit **59**, the weight calculator **60**, the score calculator **61**, the notifier **62**, the point adder **63**, the updating unit **64**, and the recorder **65**). A part or all of the units may be achieved by hardware implementation. The CPU **101** of the computer can read out the program from the computer readable storage medium to the main storage device and execute the program.

While certain embodiments have been described, the embodiment has been presented by way of example only, and is not intended to limit the scope of the inventions. Indeed, the novel embodiment described herein may be embodied in a variety of other forms; furthermore, various omissions, substitutions and changes in the form of the embodiment described herein may be made without departing from the spirit of the inventions. The accompanying claims and their equivalents are intended to cover such forms or modifications as would fall within the scope and spirit of the inventions.

What is claimed is:

1. A voice processing device, comprising:

a processor that operates as:

a presenting unit that presents text to an operator;

a voice acquisition unit that acquires a voice of the operator reading aloud the text;

an identifying unit that identifies output intervals of phonemes included in the voice of the operator;

a determination unit that determines whether each of time lengths of the output intervals is normal;

a frequency acquisition unit that acquires frequency values respectively representing occurrence frequencies of contexts, respectively corresponding to the phonemes, each context including the phoneme and another phoneme adjacent to at least one side of the phoneme;

a weight calculator that calculates a weight corresponding to each of the phonemes in accordance with a frequency value of the context; and

a score calculator that calculates, as a score representing correctness of the voice of the operator, a value in accordance with a ratio of a first value to a second value, the first value representing a sum of weights corresponding to the phonemes, the second value representing a sum of weights corresponding to the phonemes having the time lengths of the output intervals that are determined as normal.

2. The voice processing device according to claim **1**, wherein the weight calculator calculates the weight such that a weight corresponding to a first phoneme is larger than a weight corresponding to a second phoneme, the first phoneme having a value that is equal to or larger than a value for which a corresponding frequency value is preset, the second phoneme having a value that is smaller than the value for which the corresponding frequency value is preset.

3. The voice processing device according to claim **1**, wherein the processor further operates as:

a notifier that notifies the operator of content according to the score.

4. The voice processing device according to claim **1**, wherein the processor further operates as:

a frequency storage unit that stores therein occurrence frequencies of a plurality of contexts included in voices acquired in the past, as the frequency values;

an updating unit that updates the frequency values, which are stored in the frequency storage unit, of the contexts corresponding to the phonemes included in the voice of the operator reading aloud the text in accordance with the score; and

a text selector that selects, as the text, one piece of text from among a plurality of pieces of candidate text, wherein

the text selector selects the text on the basis of the frequency values of contexts corresponding to a plurality of phonemes included in the pieces of candidate text when the pieces of candidate text are read aloud.

5. The voice processing device according to claim **4**, wherein the text selector selects the candidate text in preference to the other candidate text, the preferred candidate text including the phonemes for which the contexts have the frequency values larger than a threshold at the head of and the end of the text and the phonemes for which the contexts have the frequency values smaller than the threshold at a part of the text other than the head and the end of the text.

6. A voice processing method, comprising: presenting, by a processor, text to an operator; acquiring, by the processor, a voice of the operator reading aloud the text;

identifying, by the processor, output intervals of phonemes included in the voice of the operator;

determining, by the processor, whether each of time lengths of the output intervals is normal;

acquiring, by the processor, frequency values respectively representing occurrence frequencies of contexts, respectively corresponding to the phonemes, each context including the corresponding phoneme and another phoneme adjacent to at least one side of the phoneme;

calculating, by the processor, a weight corresponding to each of the phonemes in accordance with a frequency value of the context; and

calculating, by the processor, as a score representing correctness of the voice of the operator, a value in accordance with a ratio of a first value to a second value, the first value representing a sum of weights corresponding to the phonemes, the second value representing a sum of weights corresponding to the phonemes having the time lengths of the output intervals that are determined as normal.

7. A computer program product comprising a non-transitory

computer-readable medium containing a voice processing program that causes a computer to function as:

a presenting unit that presents text to an operator;

a voice acquisition unit that acquires a voice of the operator reading aloud the text;

an identifying unit that identifies output intervals of phonemes included in the voice of the operator;

a determination unit that determines whether each of time lengths of the output intervals is normal;

a frequency acquisition unit that acquires frequency values respectively representing occurrence frequencies of contexts, respectively corresponding to the phonemes, each context including the phoneme and another phoneme adjacent to at least one side of the phoneme;

a weight calculator that calculates a weight corresponding to each of the phonemes in accordance with a frequency value of the context; and

a score calculator that calculates, as a score representing correctness of the voice of the operator, a value in accordance with a ratio of a first value to a second value, the first value representing a sum of weights corresponding to the phonemes, the second value representing a sum of weights corresponding to the phonemes having the time lengths of the output intervals that are determined as normal.

8. A voice processing device, comprising:

a processor that operates as:

a presenting unit that presents text to an operator;

a voice acquisition unit that acquires a voice of the operator reading aloud the text;

an identifying unit that identifies output intervals of phonemes included in the voice of the operator;

a determination unit that determines whether each of time lengths of the output intervals is normal;

a frequency acquisition unit that acquires frequency Values respectively representing occurrence frequencies of contexts, respectively corresponding to the phonemes, each context including the phoneme and another phoneme adjacent to at least one side of the phoneme;

a score calculator that calculates a score representing correctness of the voice of the operator on the basis of the frequency values of the contexts acquired respectively corresponding to the phonemes having the time lengths of the output intervals that are determined as normal;

a frequency storage unit that stores therein occurrence frequencies of a plurality of contexts included in voices acquired in the past, as the frequency values;

an updating unit that updates the frequency values, which are stored in the frequency storage unit, of the contexts corresponding to the phonemes included in the voice of the operator reading aloud the text in accordance with the score; and

a text selector that selects, as the text, one piece of text from among a plurality of pieces of candidate text, wherein

the text selector selects the text on the basis of the frequency values of contexts corresponding to a plurality of phonemes included in the pieces of candidate text when the pieces of candidate text are read aloud.

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