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(54) **Method and apparatus for speech synthesis without prosody modification**

(57) A speech synthesizer is provided that concatenates stored samples of speech units without modifying the prosody of the samples. The present invention is able to achieve a high level of naturalness in synthesized speech with a carefully designed training speech corpus by storing samples based on the prosodic and phonetic

context in which they occur. In particular, some embodiments of the present invention limit the training text to those sentences that will produce the most frequent sets of prosodic contexts for each speech unit. Further embodiments of the present invention also provide a multi-tier selection mechanism for selecting a set of samples that will produce the most natural sounding speech.

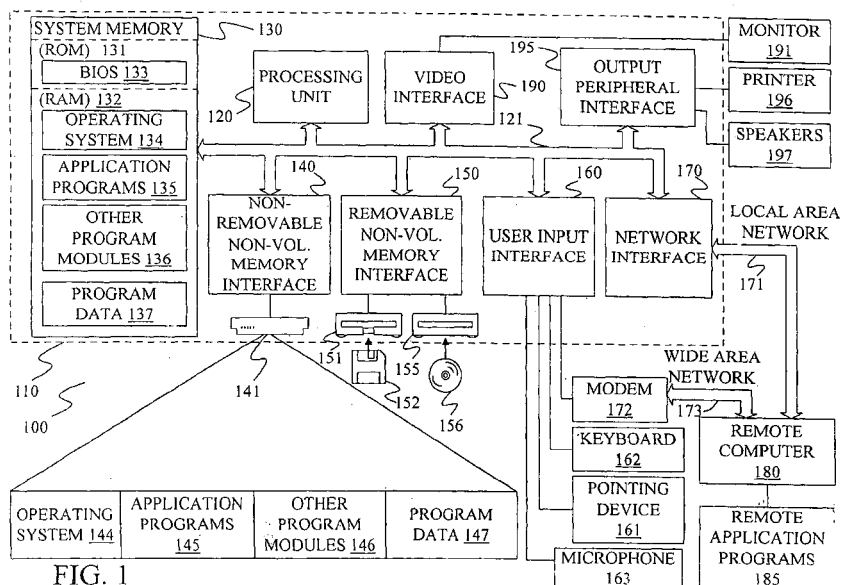


FIG. 1



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# EUROPEAN SEARCH REPORT

Application Number  
EP 07 00 2565

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	HUANG X ET AL: "Recent improvements on Microsoft's trainable text-to-speech system-Whistler" ACOUSTICS, SPEECH, AND SIGNAL PROCESSING, 1997. ICASSP-97., 1997 IEEE INTERNATIONAL CONFERENCE ON MUNICH, GERMANY 21-24 APRIL 1997, LOS ALAMITOS, CA, USA, IEEE COMPUT. SOC, US, 21 April 1997 (1997-04-21), pages 959-962, XP010225955 ISBN: 0-8186-7919-0	1-3, 8-11,16	INV. G10L13/08 G10L13/06
Y	* abstract *  * page 959, right-hand column, paragraph 3 - page 960, left-hand column, paragraph 1 *  * page 960, left-hand column, paragraph 5 - right-hand column, paragraph 2; figure 1 *	4-7,12, 13	
X	----- HUNT A J ET AL: "Unit selection in a concatenative speech synthesis system using a large speech database" 1996 IEEE INTERNATIONAL CONFERENCE ON ACOUSTICS, SPEECH, AND SIGNAL PROCESSING - PROCEEDINGS. (ICASSP). ATLANTA, MAY 7 - 10, 1996, IEEE INTERNATIONAL CONFERENCE ON ACOUSTICS, SPEECH, AND SIGNAL PROCESSING - PROCEEDINGS. (ICASSP), NEW YORK, IEEE, US, vol. VOL. 1 CONF. 21, 7 May 1996 (1996-05-07), pages 373-376, XP002133444 ISBN: 0-7803-3193-1	15	TECHNICAL FIELDS SEARCHED (IPC)  G10L
Y	* abstract * * page 373, right-hand column, paragraphs 3,4 * * page 374, right-hand column, paragraph 2-7 *	12,13	
	----- -/--		
The present search report has been drawn up for all claims			
Place of search <b>Munich</b>		Date of completion of the search <b>9 May 2008</b>	Examiner <b>Greiser, Norbert</b>
<p>CATEGORY OF CITED DOCUMENTS</p> <p>X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document</p> <p>T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons ----- &amp; : member of the same patent family, corresponding document</p>			

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EP 07 00 2565

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y	US 6 064 960 A (BELLEGARDA JEROME R ET AL) 16 May 2000 (2000-05-16) * column 1, paragraph 1 * * column 5, paragraph 1 * * column 8, paragraph 3; figure 6 *	4,5	
Y	----- TIEN YING FUNG ET AL: "Concatenating syllables for response generation in spoken language applications" IEEE INTERNATIONAL CONFERENCE ON ACOUSTICS, SPEECH, AND SIGNAL PROCESSING, 2000; PROCEEDINGS, vol. 2, 5 June 2000 (2000-06-05), pages 933-936, XP010504877 Istanbul, Turkey, 5-9 June 2000 * abstract * * page 934, left-hand column, paragraph 3 * * page 935, left-hand column, paragraph 2 *	6,7	
A	----- FU-CHIANG CHOU ET AL: "A Chinese text-to-speech system based on part-of-speech analysis, prosodic modeling and non-uniform units" ACOUSTICS, SPEECH, AND SIGNAL PROCESSING, 1997. ICASSP-97., 1997 IEEE INTERNATIONAL CONFERENCE ON MUNICH, GERMANY 21-24 APRIL 1997, LOS ALAMITOS, CA, USA, IEEE COMPUT. SOC, US, 21 April 1997 (1997-04-21), pages 923-926, XP010225946 ISBN: 0-8186-7919-0 * abstract * * page 925, right-hand column, paragraph 1-3 * * page 926, left-hand column, paragraph 1; figure 3 * ----- -/--	14	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (IPC)
4	Place of search Munich	Date of completion of the search 9 May 2008	Examiner Greiser, Norbert
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons ----- & : member of the same patent family, corresponding document	

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	<p>BIGORGNE D ET AL: "Multilingual PSOLA text-to-speech system" STATISTICAL SIGNAL AND ARRAY PROCESSING. MINNEAPOLIS, APR. 27 - 30, 1993, PROCEEDINGS OF THE INTERNATIONAL CONFERENCE ON ACOUSTICS, SPEECH, AND SIGNAL PROCESSING (ICASSP), NEW YORK, IEEE, US, vol. VOL. 4, 27 April 1993 (1993-04-27), pages 187-190, XP010110425 ISBN: 0-7803-0946-4 * abstract * * page 188, left-hand column, paragraph 4 * * page 189, right-hand column, paragraph 7 - page 190, left-hand column, paragraph 1 *</p>	14	
A	<p>-----</p> <p>NAKAJIMA S ET AL: "Automatic generation of synthesis units based on context oriented clustering" ICASSP 88: 1988 INTERNATIONAL CONFERENCE ON ACOUSTICS, SPEECH, AND ICASSP 88: 1988 INTERNATIONAL CONFERENCE ON ACOUSTICS, SPEECH, AND SIGNAL PROCESSING (CAT. NO.88CH2561-9) - 11-14 APRIL 1988, 11 April 1988 (1988-04-11), pages 659-662, XP010073228 NEW YORK, USA * abstract * * page 660, left-hand column, paragraph 3 - page 662, left-hand column, paragraph 1 *</p> <p>-----</p> <p style="text-align: center;">-/--</p>	14	<p>TECHNICAL FIELDS SEARCHED (IPC)</p>
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 9 May 2008	Examiner Greiser, Norbert
<p>CATEGORY OF CITED DOCUMENTS</p> <p>X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document</p>		<p>T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons ----- &amp; : member of the same patent family, corresponding document</p>	

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	EP 0 984 426 A (CANON KK) 8 March 2000 (2000-03-08) * abstract * * column 1, line 55 - column 2, line 31 * -----	15,16	
A	BLACK A W ET AL: "OPTIMISING SELECTION OF UNITS FROM SPEECH DATABASES FOR CONCATENATIVE SYNTHESIS" 4TH EUROPEAN CONFERENCE ON SPEECH COMMUNICATION AND TECHNOLOGY. EUROSPEECH '95. MADRID, SPAIN, SEPT. 18 - 21, 1995, EUROPEAN CONFERENCE ON SPEECH COMMUNICATION AND TECHNOLOGY. (EUROSPEECH), MADRID : GRAFICAS BRENS, ES, vol. VOL. 1 CONF. 4, 18 September 1995 (1995-09-18), pages 581-584, XP000854776 * abstract * * page 581, right-hand column, paragraph 2 - page 582, left-hand column, paragraph 3 * -----	15,16	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (IPC)
Place of search Munich		Date of completion of the search 9 May 2008	Examiner Greiser, Norbert
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### CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing more than ten claims.

- ☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims and for those claims for which claims fees have been paid, namely claim(s):
- ☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims.

### LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

- ☐ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.
- ☒ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.
- ☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:
- ☐ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:
- ☐ The present supplementary European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims (Rule 164 (1) EPC).



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**LACK OF UNITY OF INVENTION  
SHEET B**

Application Number  
EP 07 00 2565

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. claims: 1-13, 16

Synthesizing speech with stored speech samples  
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2. claim: 14

Selecting sentences for reading into a training speech  
corpus based upon a frequency of occurrence of context  
vectors  
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3. claim: 15

Selecting speech segments for concatenative speech synthesis  
based on a smoothness cost between speech segments  
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**ANNEX TO THE EUROPEAN SEARCH REPORT  
ON EUROPEAN PATENT APPLICATION NO.**

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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.  
The members are as contained in the European Patent Office EDP file on  
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

09-05-2008

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 6064960 A	16-05-2000	US 6366884 B1	02-04-2002
EP 0984426 A	08-03-2000	DE 69908723 D1	17-07-2003
		DE 69908723 T2	13-05-2004
		JP 2000075878 A	14-03-2000
		US 2003125949 A1	03-07-2003