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**Young et al.**

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(54) **EXPANDING AN EFFECTIVE VOCABULARY OF A SPEECH RECOGNITION SYSTEM**

(Continued)

FOREIGN PATENT DOCUMENTS

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DE 195 10 083 A 9/1996

(Continued)

OTHER PUBLICATIONS

SYSTRAN® Personal for Windows 95 or NT (Version 1.0.2); <http://www.systransoft.com/personal.html>, pp. 1-2, May 6, 1998.

(Continued)

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(57) **ABSTRACT**

The invention provides techniques for creating and using fragmented word models to increase the effective size of an active vocabulary of a speech recognition system. The active vocabulary represents all words and word fragments that the speech recognition system is able to recognize. Each word may be represented by a combination of acoustic models. As such, the active vocabulary represents the combinations of acoustic models that the speech recognition system may compare to a user's speech to identify acoustic models that best match the user's speech. The effective size of the active vocabulary may be increased by dividing words into constituent components or fragments (for example, prefixes, suffixes, separators, infixes, and roots) and including each component as a separate entry in the active vocabulary. Thus, for example, a list of words and their plural forms (for example, "book, books, cook, cooks, hook, hooks, look and looks") may be represented in the active vocabulary using the words (for example, "book, cook, hook and look") and an entry representing the suffix that makes the words plural (for example, "+s", where the "+" preceding the "s" indicates that "+s" is a suffix). For a large list of words, and ignoring the entry associated with the suffix, this technique may reduce the number of vocabulary entries needed to represent the list of words considerably.

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**G10L 15/00** (2006.01)  
**G10L 15/06** (2006.01)

(52) **U.S. Cl.** ..... **704/255; 704/243**

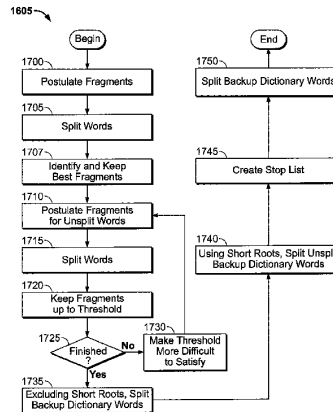
(58) **Field of Classification Search** ..... **704/243-245, 704/255-257, 4, 9-10**  
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,181,821 A	1/1980	Pirz et al.
4,227,176 A	10/1980	Moshier
4,481,593 A	11/1984	Bahler
4,489,435 A	12/1984	Moshier
4,783,803 A	11/1988	Baker et al.
4,805,218 A	2/1989	Bamberg et al.
4,805,219 A	2/1989	Baker et al.
4,829,576 A	5/1989	Porter
4,837,831 A	6/1989	Gillick et al.

**43 Claims, 31 Drawing Sheets**



U.S. PATENT DOCUMENTS

4,903,305	A	2/1990	Gillick et al.	
5,027,406	A	6/1991	Roberts et al.	
5,202,952	A	4/1993	Gillick et al.	
5,233,681	A	8/1993	Bahl et al.	
5,267,345	A	11/1993	Brown et al.	
5,428,707	A	6/1995	Gould et al.	
5,526,463	A	6/1996	Gillick et al.	
5,680,511	A	10/1997	Baker et al.	
5,754,972	A	5/1998	Baker et al.	
5,765,132	A *	6/1998	Roberts	704/254
5,797,122	A	8/1998	Spies	
5,835,888	A *	11/1998	Kanevsky et al.	704/9
6,092,044	A *	7/2000	Baker et al.	704/254
6,212,498	B1 *	4/2001	Sherwood et al.	704/244

FOREIGN PATENT DOCUMENTS

EP	0 982 712	A2	3/2000
EP	0 992 979	A2	4/2000

OTHER PUBLICATIONS

SYSTRAN® Professional for Windows (Version 2.0); <http://www.systransoft.com/pro.html>, pp. 1-4, Nov. 13, 1997.

SYSTRAN® Classic for Windows (Version 1.6.2); <http://www.systransoft.com/clas.html>, pp. 1-3, Nov. 12, 1997.

SYSTRAN® Professional Client/Server (Version 1.6.2); <http://www.systransoft.com/cliser.html>, pp. 1-3, Nov. 12, 1997.

SYSTRAN's MT Architecture, <http://www.systransoft.com/how-works.html>, pp. 1-3, Nov. 19, 1997.

Langenscheidt's T1, "The translator for translators", <http://www.gmsmuc.de/english/tl.html>, pp. 1-2, 1997.

Langenscheidt's T1 Plus, <http://www.gmsmuc.de/english/tlplus.html>, p. 1, 1997.

Langenscheidt's T1, "Professional—Setting New Standards in Machine Translation", <http://www.gmsmuc.de/english/tlprofi.html>, pp. 1-2, 1997.

Langenscheidt's T1 Translation Memory, <http://www.gmsmuc.de/english/memory.html>, p. 1, 1997.

Langenscheidt's T1 Hotline Support, <http://www.gmsmuc.de/english/hotline.html>, p. 1-2, 1997.

GLOBALINK® Power Translator 6.0, <http://www.globalink.com/pages/product-pwtrans6.html>, p. 1.

Comprende—Real Time Internet Translation Services, <http://www.globalink.com/pages/product-comprende.html>, p. 1.

Intranet Translator—Real Time Intranet Translation Services, <http://www.globalink.com/pages/product-intranet-translator.html>, p. 1.

Web Translator, <http://www.globalink.com/pages/product-web-translator.html>, pp. 1-2.

Talk to Me, <http://www.globalink.com/pages/product-talktome.html>, p. 1.

Language Assistance Series, <http://www.globalink.com/pages/product-language-assistant.html>, p. 1.

Subject Dictionaries, <http://www.globalink.com/pages/product-subject-dictionaries.html>, p. 1.

E-mail Translator Plug-In for Eudora, <http://www.globalink.com/pages/product-plugins.html>, p. 1.

Frisch et al., "Spelling Assistance for Compound Words", IBM Journal of Research & Development; vol. 32, No. 2, Mar. 1, 1988, pp. 197-198.

Marcus Spies; "A Language Model for Compound Words in Speech Recognition", European Conference on Speech Communication and Technology, Sep. 1995, pp. 1767-1770.

Bandara et al., "Handling German Compound Words in an Isolated-Word Speech Recognizer", IEEE Workshop on Speech Recognition, Harriman, NY, Dec. 15-18, 1992, pp. 1-3.

Steeneken et al., "Multi-Lingual Assessment of Independent Large Vocabulary Speech-Recognition Systems: The SqaLe-Project", European Conference on Speech Communication and Technology, Sep. 1995, pp. 1271-1274.

Dugast et al., "The Philips Large-Vocabulary Recognition System for Americal English, French and German", European Conference on Speech Communication and Technology, Sep. 1995, pp. 197-200.

Pye, et al., "Large Vocabulary Multilingual Speech Recognition Using HTK", European Conference on Speech Communication and Technology, Sep. 1995, pp. 181-184.

Lamel et al., "Issues in Large Vocabulary, Multilingual Speech Recognition", European Conference on Speech Communication and Technology, Sep. 1995, pp. 185-188.

Barnett et al., Comparative Performance in Large-Vocabulary Isolated-Word Recognition in Five European Languages, European Conference on Speech Communication and Technology, Sep. 1995, pp. 189-192.

Geutner, P.; "Using Morphology Towards Better Large-Vocabulary Speech Recognition Systems"; *Proceedings of the International Conference on Acoustics, Speech and Signal Processing (ICASSP)*; pp. 445-448; May 9, 1995; XP 000658026.

Hwang, "Vocabulary Optimization Based on Perplexity"; *IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP)*; pp. 1419-1422; Apr. 21, 1997; XP000822723.

Berton et al., "Compound Words in Large-Vocabulary German Speech Recognition Systems"; *Proceedings of the International Conference on Spoken Language Processing*, vol. 2; pp. 1165-1168; Oct. 3, 1996; XP002142831.

Wothke, K.; "Morphologically based automatic phonetic transcription"; *IBM Systems Journal*, vol. 32(3); pp. 486-511; 1993.

\* cited by examiner

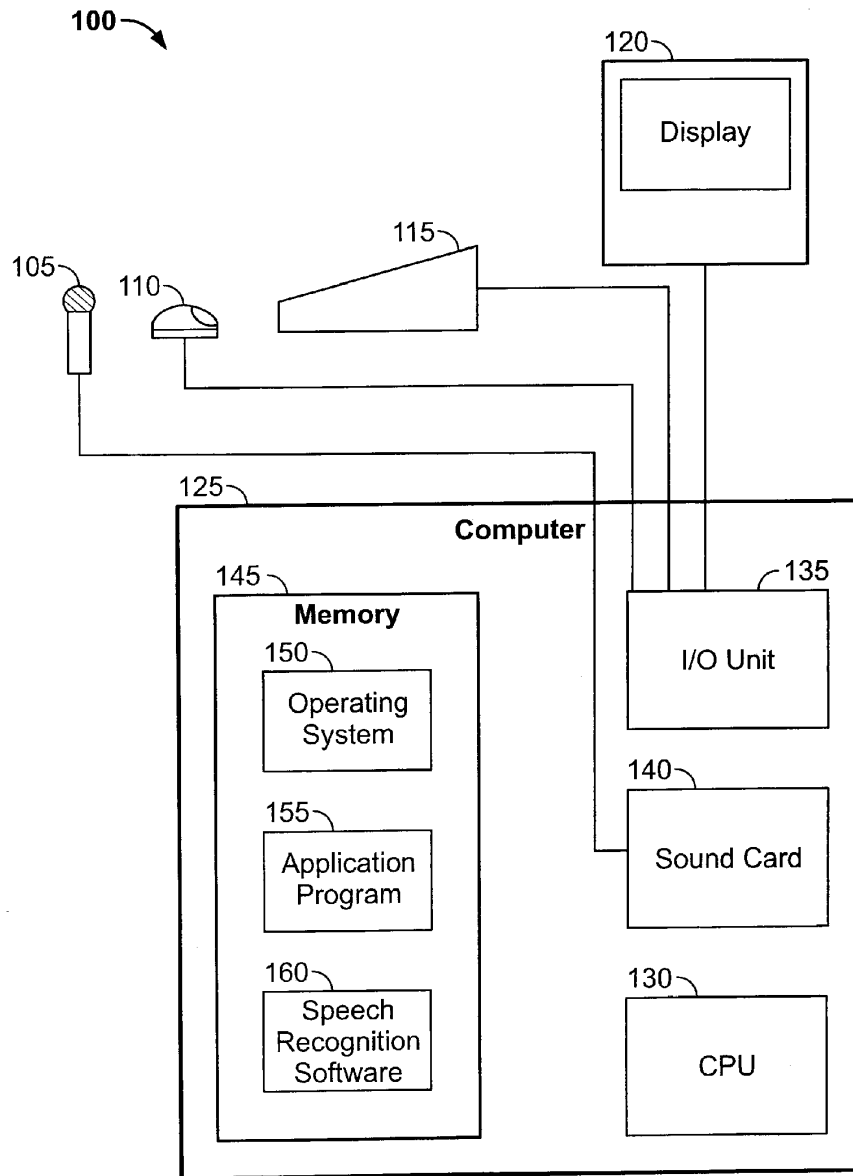


FIG. 1  
(Prior Art)

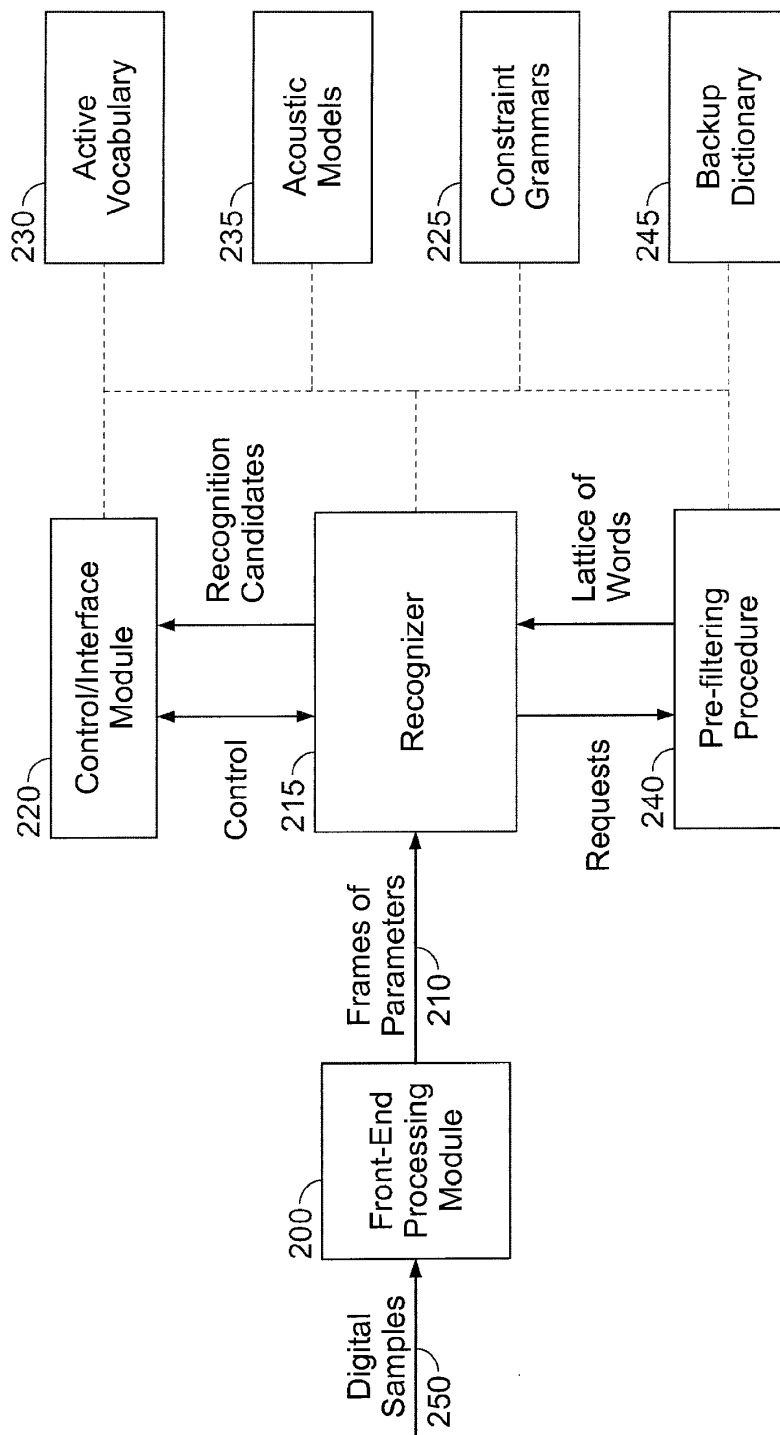
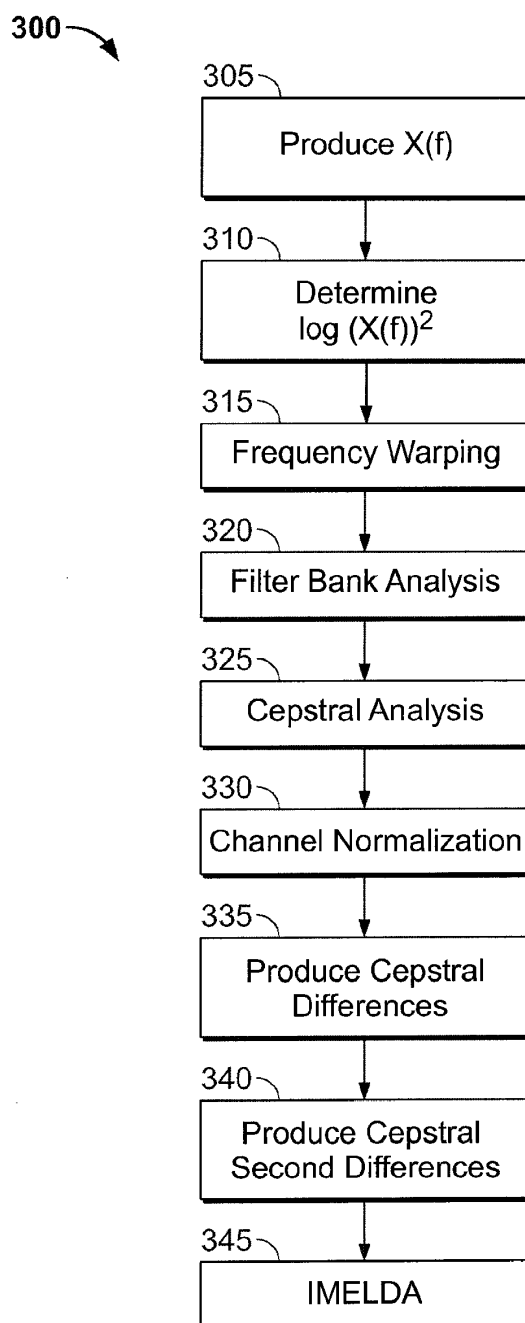


FIG. 2  
(Prior Art)



**FIG. 3**  
**(Prior Art)**

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