



US007779011B2

(12) **United States Patent**  
**Venkataraman et al.**

(10) **Patent No.:** **US 7,779,011 B2**  
(45) **Date of Patent:** **Aug. 17, 2010**

(54) **METHOD AND SYSTEM FOR  
DYNAMICALLY PROCESSING AMBIGUOUS,  
REDUCED TEXT SEARCH QUERIES AND  
HIGHLIGHTING RESULTS THEREOF**

FOREIGN PATENT DOCUMENTS

EP 1050794 11/2000

(75) Inventors: **Sashikumar Venkataraman**, Bangalore  
(IN); **Rakesh Barve**, Bangalore (IN);  
**Murali Aravamudan**, Windham, NH  
(US); **Ajit Rajasekharan**, West Windsor,  
NJ (US)

(Continued)

OTHER PUBLICATIONS

Press Release From TEGIC Communications, TEGIC Communica-  
tions Is Awarded Patent for Japanese T9(R) Text Input Software From  
the Japan Patent Office, Oct. 12, 2004. Retrieved Nov. 18, 2005 From  
[http://www.tegic.com/press\\_view.html?release\\_num=55254242](http://www.tegic.com/press_view.html?release_num=55254242).

(Continued)

*Primary Examiner*—John R. Cottingham

*Assistant Examiner*—Mariela D Reyes

(74) *Attorney, Agent, or Firm*—Wilmer Cutler Pickering Hale  
and Dorr LLP

(73) Assignee: **Veveo, Inc.**, Andover, MA (US)

(\*) Notice: Subject to any disclaimer, the term of this  
patent is extended or adjusted under 35  
U.S.C. 154(b) by 201 days.

(21) Appl. No.: **11/312,908**

(22) Filed: **Dec. 20, 2005**

(65) **Prior Publication Data**

US 2007/0050337 A1 Mar. 1, 2007

**Related U.S. Application Data**

(60) Provisional application No. 60/716,101, filed on Sep.  
12, 2005, provisional application No. 60/711,866,  
filed on Aug. 26, 2005.

(51) **Int. Cl.**  
**G06F 7/00** (2006.01)  
**G06F 17/30** (2006.01)

(52) **U.S. Cl.** ..... **707/742; 707/741**

(58) **Field of Classification Search** ..... **707/741,**  
**707/742**

See application file for complete search history.

(56) **References Cited**

**U.S. PATENT DOCUMENTS**

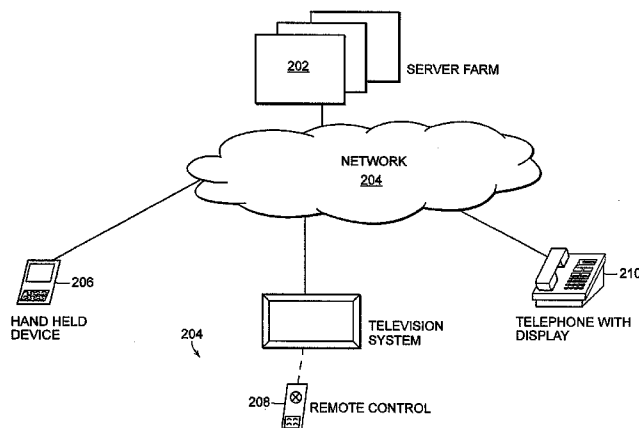
1,261,167 A 4/1918 Russell

(57) **ABSTRACT**

A method and system are provided of processing a search  
query entered by a user of a device having a text input inter-  
face with overloaded keys. The search query is directed at  
identifying an item from a set of items. Each of the items has  
a name including one or more words. The system receives  
from the user an ambiguous search query directed at identi-  
fying a desired item. The search query comprises a prefix  
substring of at least one word in the name of the desired item.  
The system dynamically identifies a group of one or more  
items from the set of items having one or more words in the  
names thereof matching the search query as the user enters  
each character of the search query. The system also orders the  
one or more items of the group in accordance with given  
criteria. The names of the one or more items of the identified  
group are output to be displayed on the device operated by the  
user as ordered with the characters of the one or more words  
in the names corresponding to the prefix substring of the  
search query being highlighted.

(Continued)

**24 Claims, 7 Drawing Sheets**



# US 7,779,011 B2

Page 2

U.S. PATENT DOCUMENTS					
4,045,777 A	8/1977	Mierzwinski et al.	6,907,273 B1	6/2005	Smethers
4,453,217 A	6/1984	Boivie	6,965,374 B2	11/2005	Villet et al.
4,760,528 A	7/1988	Levin	7,013,304 B1	3/2006	Schuetze et al.
4,893,238 A	1/1990	Venema	7,117,207 B1	10/2006	Kerschberg et al.
5,224,060 A	6/1993	Ma et al.	7,130,866 B2	10/2006	Schaffer
5,337,347 A	8/1994	Halstead-Nussloch et al.	7,136,854 B2	11/2006	Smith
5,369,605 A	11/1994	Parks	7,146,627 B1	12/2006	Ismail et al.
5,487,616 A	1/1996	Ichbiah	7,149,983 B1	12/2006	Robertson et al.
5,532,754 A	7/1996	Young et al.	7,213,256 B1	5/2007	Kikinis
5,623,406 A	4/1997	Ichbiah	7,225,180 B2	5/2007	Donaldson et al.
5,635,989 A	6/1997	Rothmuller	7,225,184 B2	5/2007	Carrasco et al.
5,745,889 A	4/1998	Burrows	7,225,455 B2	5/2007	Bennington et al.
5,774,588 A	6/1998	Li	7,269,548 B2	9/2007	Fux et al.
5,802,361 A	9/1998	Wang et al.	7,293,231 B1	11/2007	Gunn et al.
5,805,155 A	9/1998	Allibhoy et al.	7,487,151 B2	2/2009	Yamamoto et al.
5,818,437 A	10/1998	Grover et al.	7,594,244 B2	9/2009	Scholl et al.
5,828,420 A	10/1998	Marshall et al.	2002/0002550 A1	1/2002	Berman
5,828,991 A	10/1998	Skiena et al.	2002/0042791 A1	4/2002	Smith et al.
5,835,087 A	11/1998	Herz et al.	2002/0052873 A1	5/2002	Delgado et al.
5,859,662 A	1/1999	Cragun et al.	2002/0059621 A1	5/2002	Thomas et al.
5,880,768 A	3/1999	Lemmons et al.	2002/0083448 A1	6/2002	Johnson
5,912,664 A	6/1999	Eick et al.	2002/0133481 A1	9/2002	Smith et al.
5,937,422 A	8/1999	Nelson et al.	2002/0144267 A1	10/2002	Gutta et al.
5,945,928 A	8/1999	Kushler et al.	2002/0152190 A1	10/2002	Biebesheimer et al.
5,945,987 A	8/1999	Dunn	2002/0184373 A1	12/2002	Maes
5,953,541 A	9/1999	King et al.	2002/0188488 A1	12/2002	Hinkle
6,005,565 A	12/1999	Legall et al.	2002/0199194 A1	12/2002	Ali
6,005,597 A	12/1999	Barrett et al.	2003/0005452 A1	1/2003	Rodriguez
6,006,225 A	12/1999	Bowman et al.	2003/0005462 A1	1/2003	Broadus et al.
6,009,459 A *	12/1999	Belfiore et al. .... 709/203	2003/0011573 A1	1/2003	Villet et al.
6,011,554 A	1/2000	King et al.	2003/0014753 A1	1/2003	Beach et al.
6,041,311 A	3/2000	Chislenko et al.	2003/0023976 A1	1/2003	Kamen et al.
6,047,300 A	4/2000	Walfish et al.	2003/0037043 A1	2/2003	Chang et al.
6,075,526 A	6/2000	Rothmuller	2003/0037333 A1	2/2003	Ghashghai et al.
6,133,909 A	10/2000	Schein et al.	2003/0046698 A1	3/2003	Kamen et al.
6,169,984 B1	1/2001	Bogdan	2003/0051240 A1	3/2003	Schaffer et al.
6,184,877 B1	2/2001	Dodson et al.	2003/0066068 A1	4/2003	Gutta et al.
6,189,002 B1	2/2001	Roitblat	2003/0066079 A1	4/2003	Suga
6,223,059 B1 *	4/2001	Haestrup ..... 455/566	2003/0084270 A1	5/2003	Coon et al.
6,260,050 B1	7/2001	Yost et al.	2003/0103088 A1	6/2003	Dresti et al.
6,266,048 B1	7/2001	Carau, Sr.	2003/0217121 A1	11/2003	Willis
6,266,814 B1	7/2001	Lemmons et al.	2003/0226146 A1	12/2003	Thurston et al.
6,269,361 B1	7/2001	Davis et al.	2003/0229900 A1	12/2003	Reisman
6,286,064 B1	9/2001	King et al.	2003/0237096 A1	12/2003	Barrett et al.
6,292,804 B1	9/2001	Ardoin et al.	2004/0013909 A1	1/2004	Shimizu et al.
6,307,548 B1	10/2001	Flinchem et al.	2004/0021691 A1	2/2004	Dostie et al.
6,307,549 B1	10/2001	King et al.	2004/0024777 A1	2/2004	Schaffer
6,377,945 B1	4/2002	Risvik	2004/0046744 A1	3/2004	Rafii et al.
6,438,579 B1	8/2002	Hosken et al.	2004/0049783 A1	3/2004	Lemmons et al.
6,438,751 B1	8/2002	Voyticky et al.	2004/0054520 A1	3/2004	Dehlinger et al.
6,466,933 B1	10/2002	Huang et al.	2004/0073926 A1	4/2004	Nakamura et al.
6,529,903 B2	3/2003	Smith	2004/0078815 A1	4/2004	Lemmons et al.
6,564,213 B1 *	5/2003	Ortega et al. .... 707/5	2004/0078816 A1	4/2004	Johnson
6,564,313 B1	5/2003	Kashyap	2004/0078820 A1	4/2004	Nickum
6,594,657 B1	7/2003	Livovsky et al.	2004/0083198 A1	4/2004	Bradford et al.
6,600,496 B1	7/2003	Wagner et al.	2004/0093616 A1	5/2004	Johnson
6,614,455 B1	9/2003	Cuijpers et al.	2004/0111745 A1	6/2004	Schein et al.
6,615,248 B1	9/2003	Smith	2004/0128686 A1	7/2004	Boyer et al.
6,631,496 B1	10/2003	Li et al.	2004/0139091 A1	7/2004	Shin
6,721,954 B1	4/2004	Nickum	2004/0143569 A1	7/2004	Gross et al.
6,732,369 B1	5/2004	Schein et al.	2004/0163032 A1	8/2004	Guo et al.
6,757,906 B1	6/2004	Look et al.	2004/0194141 A1	9/2004	Sanders
6,766,526 B1	7/2004	Ellis	2004/0216160 A1	10/2004	Lemmons et al.
6,772,147 B2	8/2004	Wang	2004/0220926 A1	11/2004	Lamkin et al.
6,785,671 B1	8/2004	Bailey et al.	2004/0221308 A1	11/2004	Cuttner et al.
6,801,909 B2	10/2004	Delgado et al.	2004/0261021 A1	12/2004	Mittal et al.
6,839,702 B1 *	1/2005	Patel et al. .... 707/3	2005/0015366 A1	1/2005	Carrasco et al.
6,839,705 B1	1/2005	Grooters	2005/0071874 A1	3/2005	Elcock et al.
6,850,693 B2	2/2005	Young et al.	2005/0086234 A1	4/2005	Tosey
6,865,575 B1	3/2005	Smith et al.	2005/0086691 A1	4/2005	Dudkiewicz et al.
6,865,746 B1	3/2005	Herrington et al.	2005/0086692 A1	4/2005	Dudkiewicz et al.
			2005/0174333 A1	8/2005	Robinson et al.
			2005/0192944 A1	9/2005	Flinchem

2005/0210020	A1	9/2005	Gunn et al.	
2005/0210383	A1	9/2005	Cucerzan et al.	
2005/0210402	A1	9/2005	Gunn et al.	
2005/0223308	A1	10/2005	Gunn et al.	
2005/0240580	A1	10/2005	Zamir et al.	
2005/0246311	A1	11/2005	Whelan et al.	
2005/0267994	A1	12/2005	Wong et al.	
2005/0278175	A1	12/2005	Hyvonen	
2005/0283468	A1	12/2005	Kamvar et al.	
2006/0010477	A1	1/2006	Yu	
2006/0013487	A1	1/2006	Longe et al.	
2006/0036640	A1	2/2006	Tateno et al.	
2006/0059044	A1	3/2006	Chan et al.	
2006/0075429	A1	4/2006	Istvan et al.	
2006/0090182	A1	4/2006	Horowitz et al.	
2006/0090185	A1	4/2006	Zito et al.	
2006/0101499	A1	5/2006	Aravamudan et al.	
2006/0101503	A1	5/2006	Venkataraman	
2006/0101504	A1	5/2006	Aravamudan et al.	
2006/0112162	A1	5/2006	Marot et al.	
2006/0117019	A1	6/2006	Sylthe et al.	
2006/0163337	A1	7/2006	Unruh	
2006/0167676	A1	7/2006	Plumb	
2006/0167859	A1*	7/2006	Verbeck Sibley et al.	707/3
2006/0173818	A1	8/2006	Berstis et al.	
2006/0190308	A1	8/2006	Janssens et al.	
2006/0195435	A1*	8/2006	Laird-McConnell et al.	707/4
2006/0206454	A1	9/2006	Forstall et al.	
2006/0242178	A1	10/2006	Butterfield et al.	
2006/0256078	A1	11/2006	Flinchem et al.	
2006/0259344	A1	11/2006	Patel et al.	
2006/0274051	A1	12/2006	Longe et al.	
2006/0282856	A1	12/2006	Errico et al.	
2007/0005526	A1	1/2007	Whitney et al.	
2007/0005563	A1	1/2007	Aravamudan	
2007/0016476	A1	1/2007	Hoffberg et al.	
2007/0027852	A1	2/2007	Howard et al.	
2007/0027861	A1	2/2007	Huentelman et al.	
2007/0044122	A1	2/2007	Scholl et al.	
2007/0050348	A1*	3/2007	Aharoni et al.	707/4
2007/0061244	A1	3/2007	Ramer et al.	
2007/0061317	A1	3/2007	Ramer et al.	
2007/0061321	A1	3/2007	Venkataraman	
2007/0061754	A1	3/2007	Ardhanari et al.	
2007/0067272	A1	3/2007	Flynt et al.	
2007/0088681	A1	4/2007	Aravamudan et al.	
2007/0100650	A1	5/2007	Ramer et al.	
2007/0130128	A1	6/2007	Garg et al.	
2007/0143567	A1	6/2007	Gorobets	
2007/0150606	A1	6/2007	Flinchem et al.	
2007/0208718	A1	9/2007	Javid et al.	
2007/0219984	A1	9/2007	Aravamudan et al.	
2007/0219985	A1	9/2007	Aravamudan et al.	
2007/0255693	A1	11/2007	Ramaswamy et al.	
2007/0256070	A1	11/2007	Bykov et al.	
2007/0260703	A1	11/2007	Ardhanari et al.	
2007/0266021	A1	11/2007	Aravamudan et al.	
2007/0266026	A1	11/2007	Aravamudan et al.	
2007/0266406	A1	11/2007	Aravamudan et al.	
2007/0271205	A1	11/2007	Aravamudan et al.	
2007/0276773	A1	11/2007	Aravamudan et al.	
2007/0276821	A1	11/2007	Aravamudan et al.	
2007/0276859	A1	11/2007	Aravamudan et al.	
2007/0288456	A1	12/2007	Aravamudan et al.	
2007/0288457	A1	12/2007	Aravamudan et al.	

## FOREIGN PATENT DOCUMENTS

EP	1143691	10/2001
EP	1338967 A2	8/2003
EP	1463307 A2	9/2004
WO	WO-00/70505	11/2000
WO	WO-2004/010326	1/2004

WO	WO-2004/031931 A1	4/2004
WO	WO-2005/033967 A3	4/2005
WO	WO-2005/084235 A2	9/2005

## OTHER PUBLICATIONS

Gadd T.N., Phonix: The Algorithm, Program 24(4), Oct. 1990, pp. 363-369.

Dalianis, Improving Search Engine Retrieval Using a Compound Splitter for Swedish, Abstract of Presentation at NODALIDA 2005—15th Nordic Conference on Computational Linguistics, Joensuu Finland, May 21-22 2005. Retrieved Jan. 5, 2006 from <http://phon.joensuu.fi/nodalida/abstracts/03.shtml>.

Silfverberg et al., Predicting Text Entry Speed on Mobile Phones, Proceedings of the ACM Conference on Human Factors in Computing Systems—CHI 2000, pp. 9-16.

Mackenzie et al., Letterwise: Prefix-Based Disambiguation for Mobile Text Input, Proceedings of the ACM Symposium on User Interface Software and Technology—UIST 2001, pp. 111-120.

U.S. Appl. No. 60/548,589, filed Sep. 1, 2005, Flinchem.

U.S. Appl. No. 11/855,661, Venkataraman et al.

U.S. Appl. No. 11/862,917, Aravamudan.

U.S. Appl. No. 11/939,086, Ramakrishnan et al.

U.S. Appl. No. 12/018,566, Venkataraman et al.

Ardissono, L. et al., User Modeling and Recommendation Techniques for Personalized Electronic Program Guides, Personalized Digital Television, Editors: Ardissono, et al., Kluwer Academic Press, 2004.

Digital Video Broadcasting, <http://www.dvb.org> (Oct. 12, 2007).

Good, N. et al., Combining Collaborative Filtering with Personal Agents for Better Recommendations, in Proc. of the 16th National Conference on Artificial Intelligence, pp. 439-446, Orlando, Florida, Jul. 18-22, 1999.

International Search Report, International Application No. PCT/US06/25249, mailed Jan. 29, 2008 (2 pages).

International Search Report, International Application No. PCT/US06/33204, mailed Sep. 21, 2007 (2 pages).

International Search Report, International Application No. PCT/US06/33257, mailed Mar. 26, 2008 (2 pages).

International Search Report, International Application No. PCT/US06/33258, mailed Mar. 26, 2008 (2 pages).

International Search Report, International Application No. PCT/US06/40005, mailed Jul. 3, 2007 (4 pages).

International Search Report, International Application No. PCT/US07/65703, mailed Jan. 25, 2008 (2 pages).

International Search Report, International Application No. PCT/US07/67100, mailed Mar. 7, 2008 (2 pages).

Matthom, "Text Highlighting in Search Results", Jul. 22, 2005. Available at [www.matthom.com/archive/2005/07/22/text-highlighting-in-search-results](http://www.matthom.com/archive/2005/07/22/text-highlighting-in-search-results); retrieved Jun. 23, 2006. (4 pages).

Mokotoff, Soundexing and Genealogy, Available at <http://www.avotaynu.com/soundex.html>, retrieved Mar. 19, 2008, last updated Sep. 8, 2007 (6 pages).

Review of Personalization Technologies: Collaborative Filtering vs. ChoiceStream's Attributed Bayesian Choice Modeling, Technology Brief, ChoiceStream Technologies, Cambridge, MA.

Roe, David et al., "Mapping UML Models Incorporating OCL Constraints into Object-Z", Technical Report, Sep. 2003, Department of Computing, Imperial College London (17 pages).

Talbot, David. "Soul of a New Mobile Machine." *Technology Review: The Design Issue* May/Jun. 2007. (pp. 46-53).

Wikipedia's entry for Levenshtein distance (n.d.). Retrieved Nov. 15, 2006 from [http://en.wikipedia.org/wiki/Levenshtein\\_distance](http://en.wikipedia.org/wiki/Levenshtein_distance).

Written Opinion of the International Searching Authority, International Application No. PCT/US06/25249, mailed Jan. 29, 2008.

Written Opinion of the International Searching Authority, International Application No. PCT/US06/33204, mailed Sep. 21, 2007 (3 pages).

Written Opinion of the International Searching Authority, International Application No. PCT/US06/33257, mailed Mar. 26, 2008 (4 pages).

Written Opinion of the International Searching Authority, International Application No. PCT/US06/33258, mailed Mar. 26, 2008 (4 pages).

Written Opinion of the International Searching Authority, International Application No. PCT/US06/40005, mailed Jul. 3, 2007 (4 pages).

Written Opinion of the International Searching Authority, International Application No. PCT/US07/65703, mailed Jan. 25, 2008 (4 pages).

Written Opinion of the International Searching Authority, International Application No. PCT/US07/67100, mailed Mar. 7, 2008 (3 pages).

Kurapati, et al., "A Multi-Agent TV Recommender," In Proceedings of the UM 2001 Workshop "Personalization in Future TV," 2001, 8 pages.

Nardi, et al., "Integrating Communication and Information Through Contact Map," Communications of the ACM, vol. 45, No. 4, Apr. 2002, 7 pages, retrieved from URL:<http://portal.acm.org/citation.cfm?id+505251>.

Supplemental European Search Report for 05826114.0 dated Aug. 20, 2009, 13 pages.

Supplemental European Search Report for 05826129.8 dated Aug. 11, 2009, 15 pages.

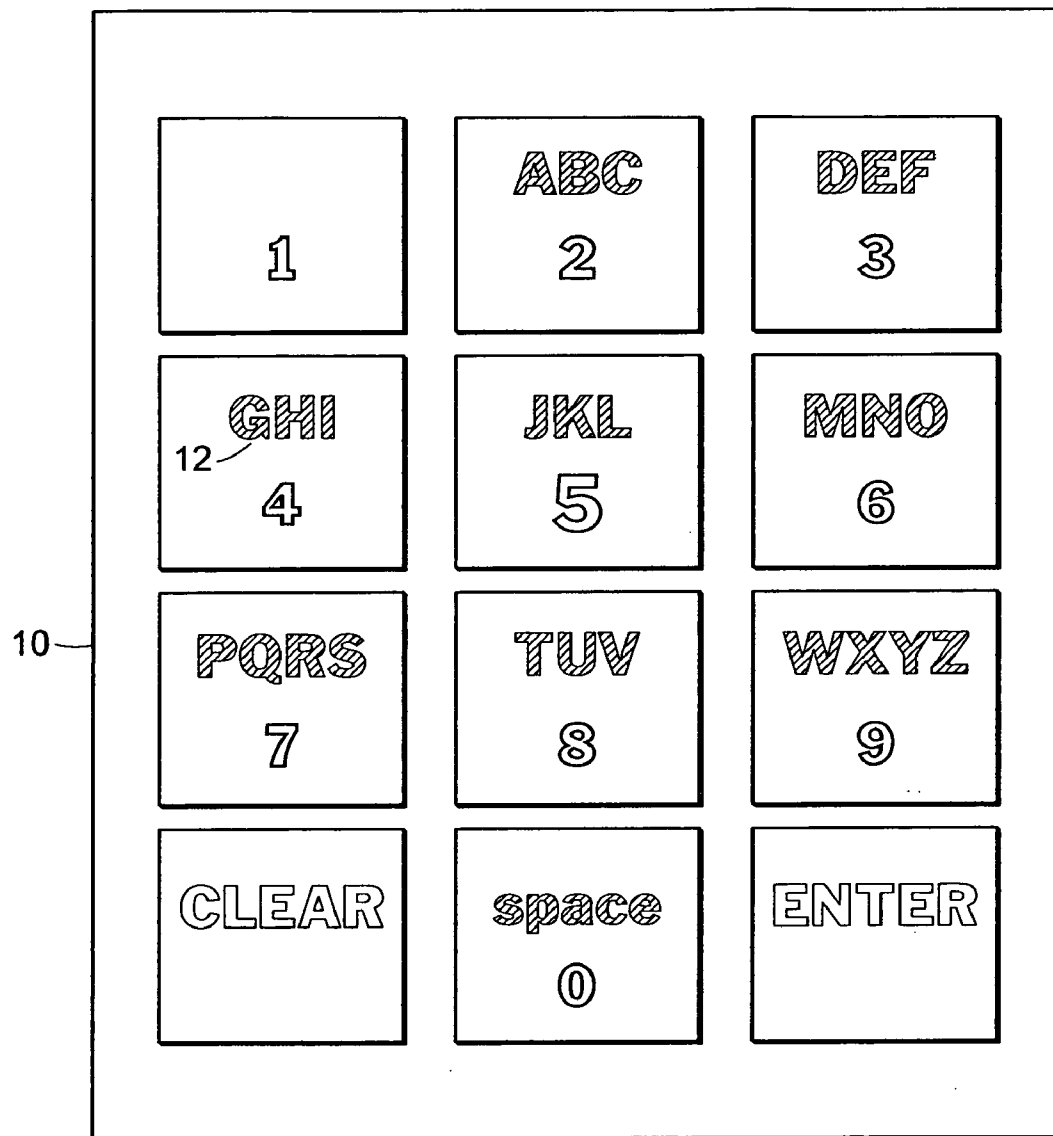
Supplemental European Search Report for 06838179.7 dated Dec. 9, 2009, 7 pages.

Supplemental European Search Report for 07761026.9 dated Jan. 28, 2010, 8 pages.

Turski, et al., "Inner Circle—People Centered Email Client," CHI 2005 Conference on Human Factors in Computing Systems, Apr. 2005, pp. 1845-1848, 4 pages, retrieved from URL:<http://portal.acm.org/citation.cfm?id+1056808.1057037>.

Zimmerman, et al., "TV Personalization System Design of a TV Show Recommender Engine and Interface," in Liliana Adrisono, Alfred Kosba, Mark Maybury (eds) Personalized Digital Television: Targeting Programs to Individual Viewers, Kluwer, 29 pages.

\* cited by examiner



PRIOR ART  
FIG. 1

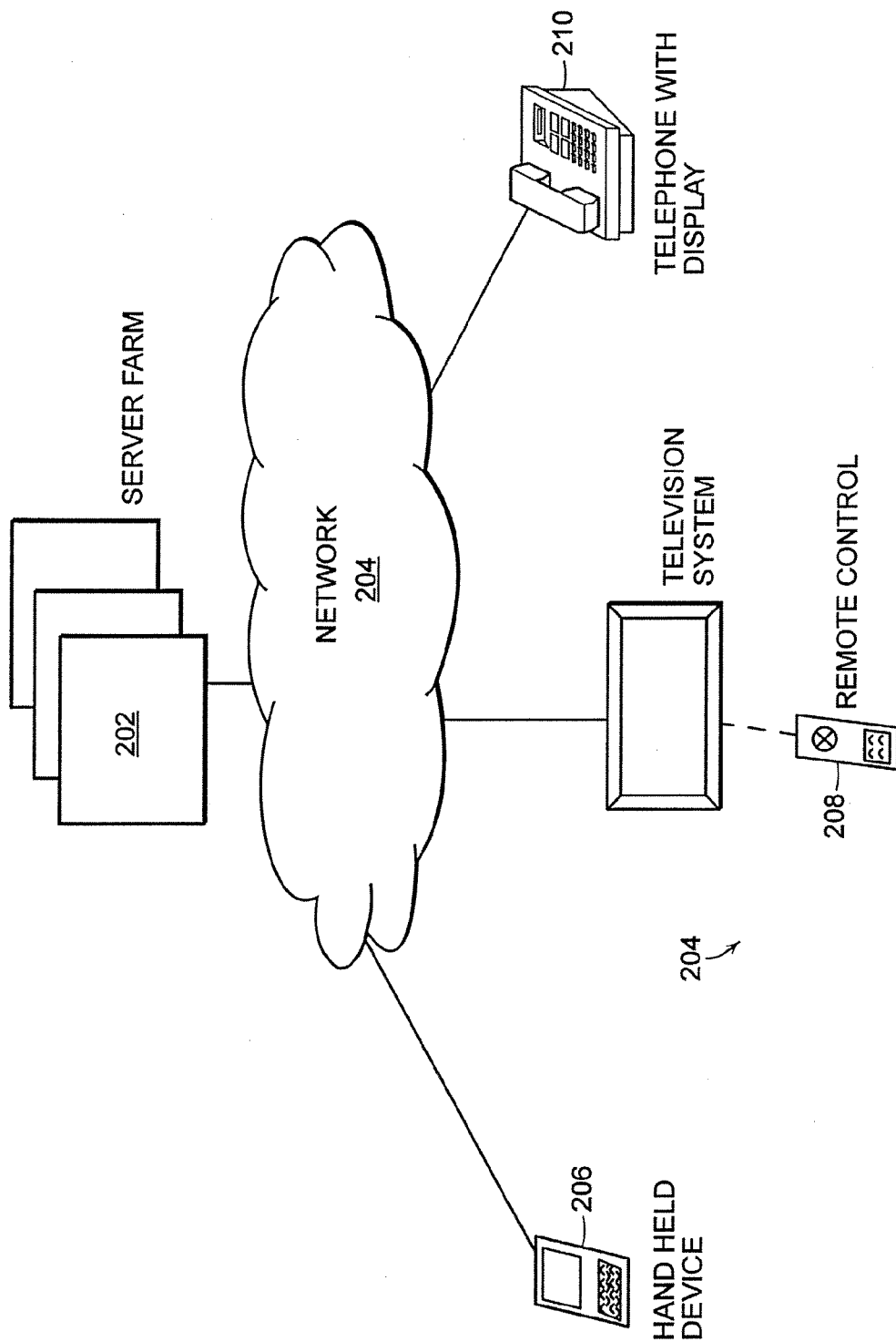


FIG. 2

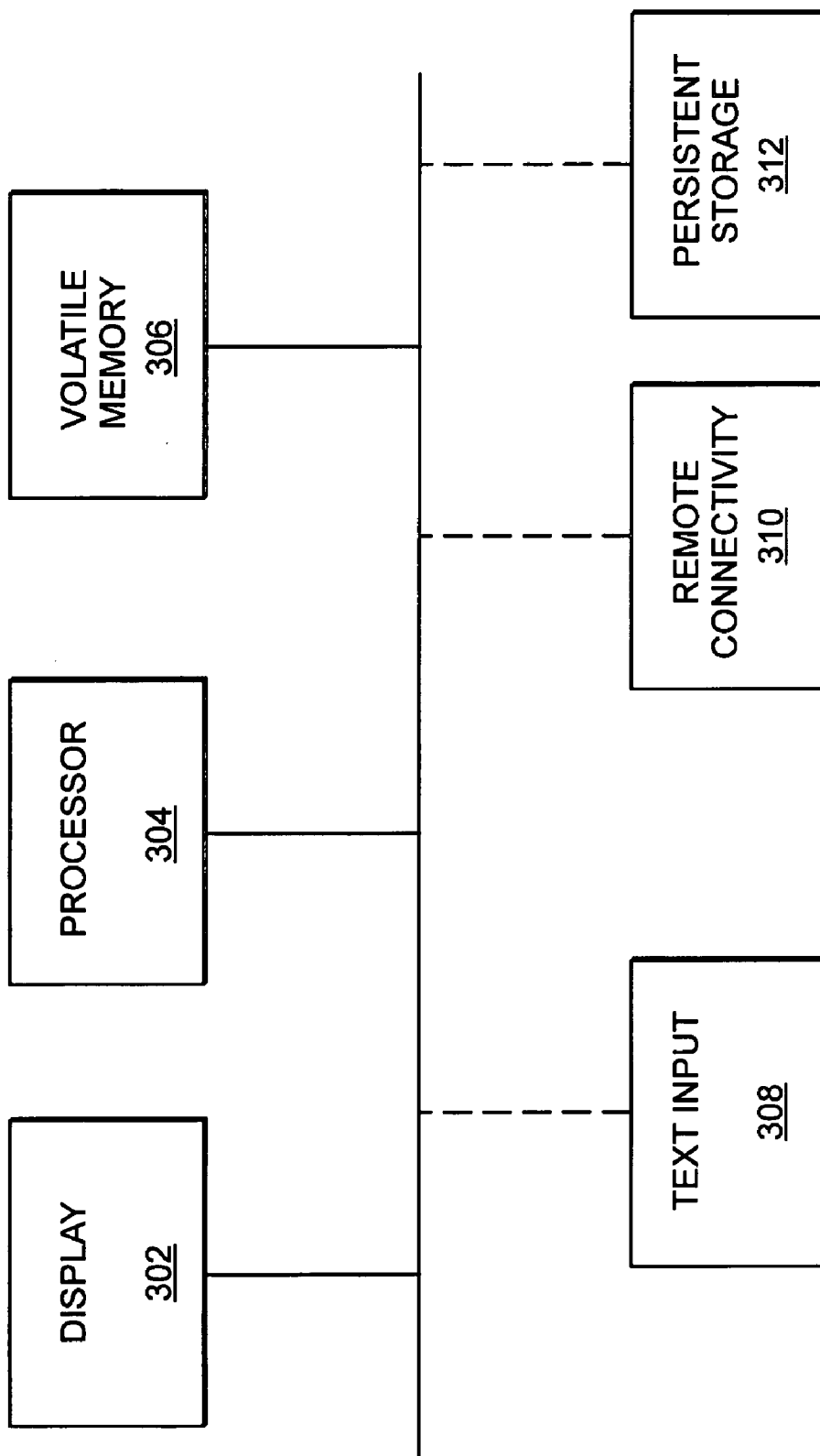


FIG. 3

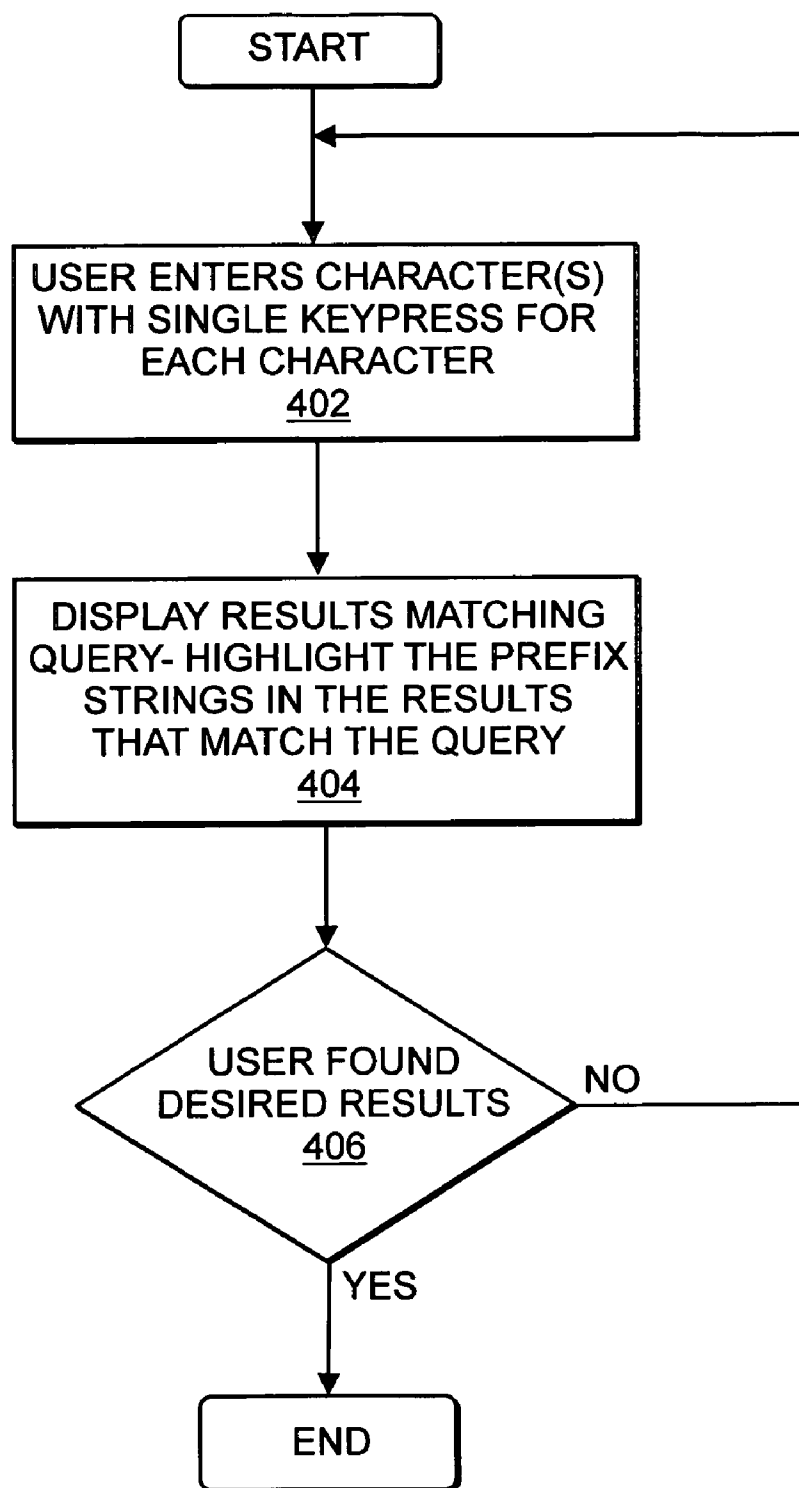


FIG. 4



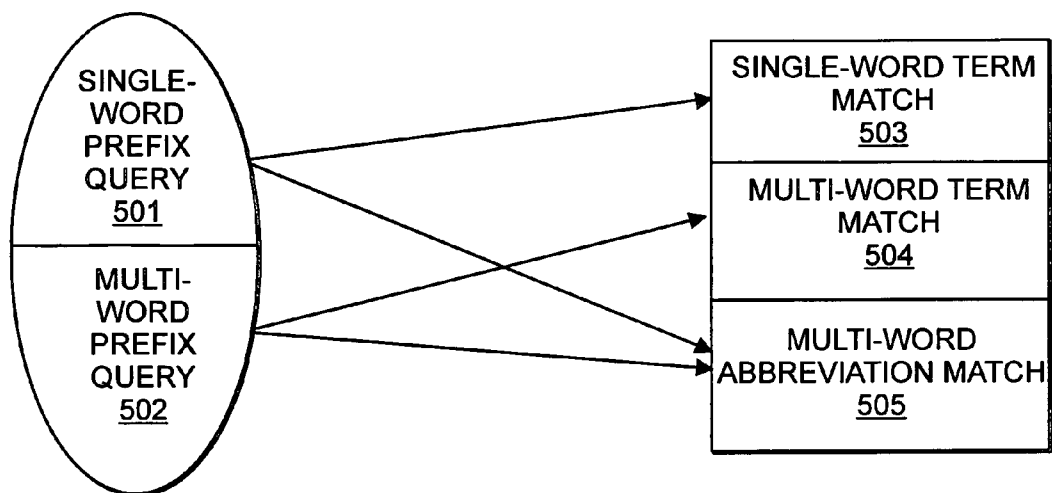


FIG. 5A

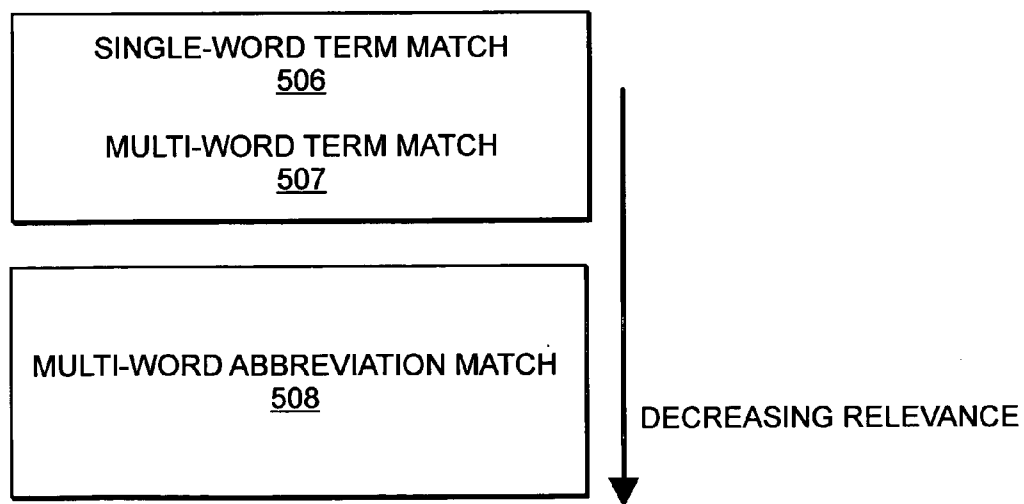
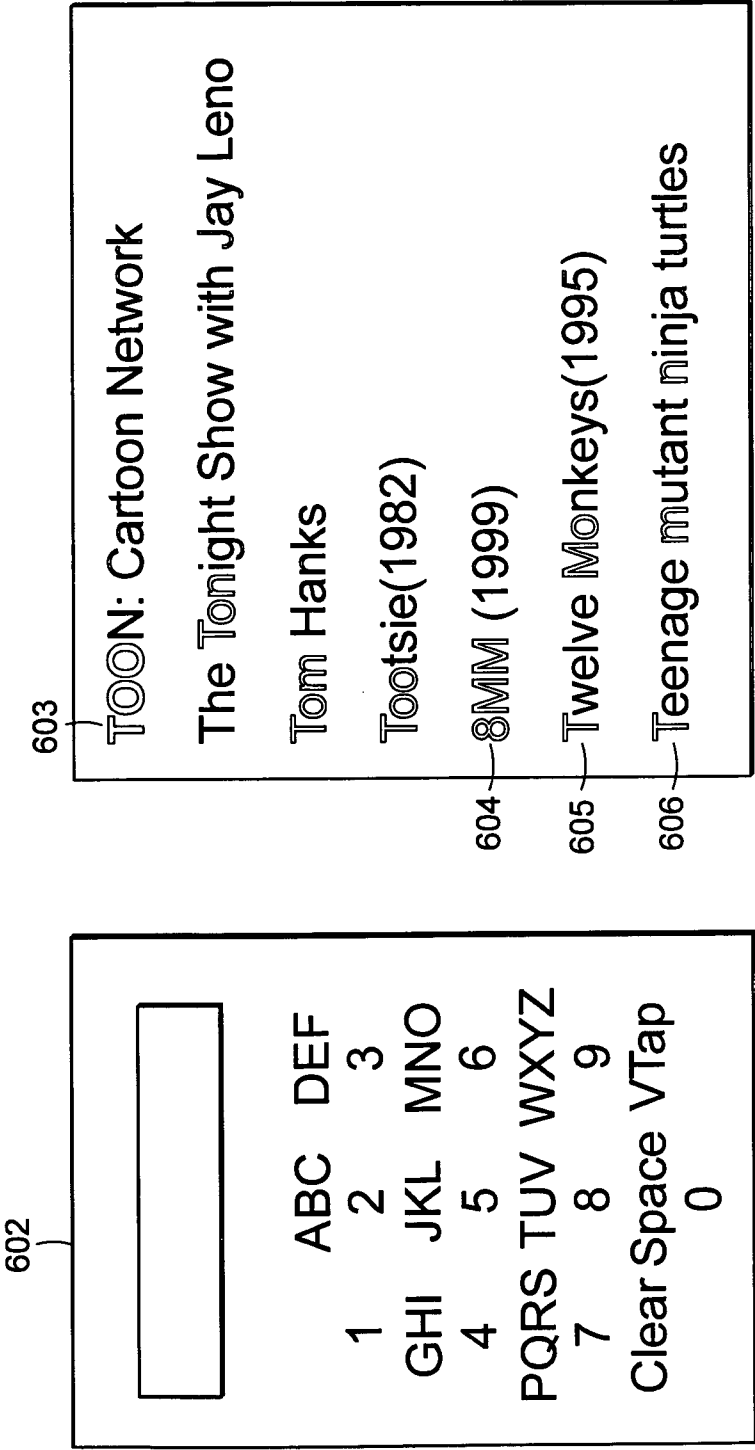


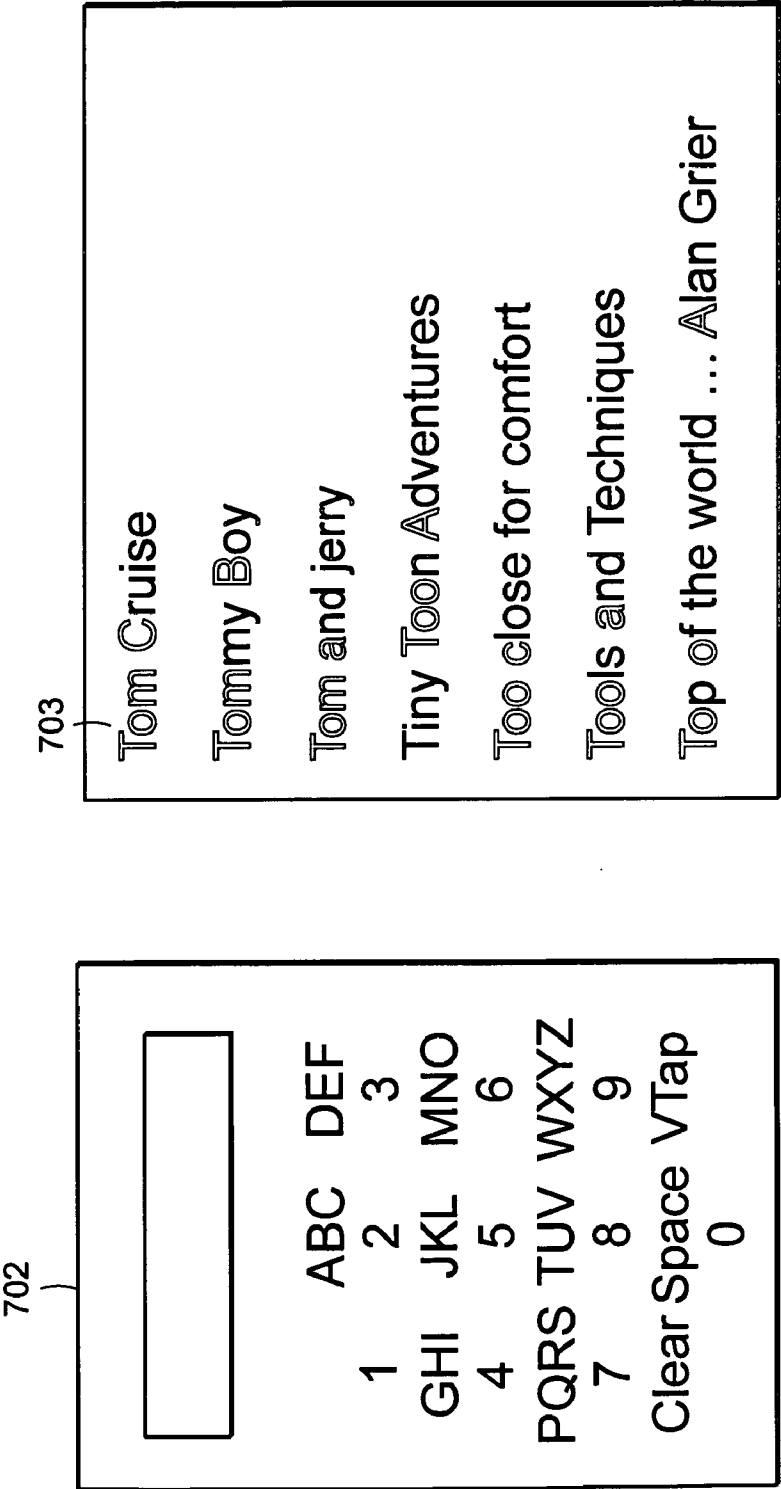
FIG. 5B



USER INPUT: 866

FIG. 6A

FIG. 6B



USER INPUT: 866 2

FIG. 7A

FIG. 7B

1

# METHOD AND SYSTEM FOR DYNAMICALLY PROCESSING AMBIGUOUS, REDUCED TEXT SEARCH QUERIES AND HIGHLIGHTING RESULTS THEREOF

## RELATED APPLICATIONS

The present invention is based on and claims priority from U.S. Patent Application No. 60/711,866, filed Aug. 26, 2005, and entitled "A Dynamic Highlighting Interface of Multi Word Prefixes of Results Obtained by Incremental Search with Reduced Text Entry on Television and Mobile Devices Using a Keypad with Overloaded Keys," and U.S. Patent Application Ser. No. 60/716,101, filed Sep. 12, 2005, and entitled "Method And System For Incremental Search With Reduced Text Entry Using A Reduced Keypad With Overloaded Keys," both of which are incorporated by reference herein in their entirety.

## BACKGROUND OF THE INVENTION

### 1. Field of Invention

The present invention generally relates to processing search queries and, more particularly, to methods and systems for processing ambiguous, reduced text, search queries and highlighting results thereof.

### 2. Description of Related Art

There are many user-operated devices such as mobile phones, PDAs (personal digital assistants), and television remote control devices that have small keypads, which a user can use for text entry. In many of these devices, largely because of device size constraints, the keypad is small and has only a small number of keys, which are overloaded with alpha-numeric characters. Text input using these keypads is cumbersome.

FIG. 1 illustrates a common twelve-key keypad interface found in many cell phones and other mobile devices, and also increasingly in devices like television remote control devices. The keypad 10 includes twelve keys 12, most of which are overloaded with multiple alpha-numeric characters or functions. The same key can be pressed to enter different characters. For instance, the "2" key can be used to enter the number "2" and the letters "A", "B" and "C". Text entry using such a keypad with overloaded keys can result in an ambiguous text entry, which requires some type of a disambiguation action. For instance, with a so-called multi-press interface, a user can press a particular key multiple times in quick succession to select a desired character (e.g., to choose "B", the user would press the "2" key twice quickly, and to choose "C", the user would press the key three times quickly). Alternatively, text entry can be performed using the so-called T9 and other text input mechanisms that provide vocabulary based completion choices for each word entered. Neither of these methods is however particularly suitable for use in performing searches because of the number of steps needed to get to the result. One deficiency of the multi-press interface is that too many key strokes are needed. A drawback of applying a vocabulary based word completion interface is the need for the additional step of making a choice from a list of all possible word matches generated by the ambiguous text input. Furthermore vocabulary based word disambiguation systems are designed typically for composition applications (as opposed to search applications) where user explicitly disambiguates each word by performing a word completion action to resolve that word before proceeding to the next word in the composition. This deficiency is even more apparent for a multi-word search system where results could ideally be obtained by the entry of

2

just a few characters. These methods suffer from the fact that the fewer the number of characters entered, the greater the ambiguity of the input. (The ambiguity decreases as the input character count increases.) This has the undesirable consequence of reducing the usefulness of a search engine that has the potential to retrieve results with just a few input characters.

## BRIEF SUMMARY OF EMBODIMENTS OF THE INVENTION

In accordance with one or more embodiments of the invention, a method and system are provided of processing a search query entered by a user of a device having a text input interface with overloaded keys. The search query is directed at identifying an item from a set of items. Each of the items has a name comprising one or more words. The system receives from the user an ambiguous search query directed at identifying a desired item. The search query comprises a prefix substring of at least one word in the name of the desired item. The system dynamically identifies a group of one or more items from the set of items having one or more words in the names thereof matching the search query as the user enters each character of the search query. The system also orders the one or more items of the group in accordance with given criteria. The names of the one or more items of the identified group are output to be displayed on the device operated by the user as ordered with the characters of the one or more words in the names corresponding to the prefix substring of the search query being highlighted.

These and other features will become readily apparent from the following detailed description wherein embodiments of the invention are shown and described by way of illustration. As will be realized, the invention is capable of other and different embodiments and its several details may be capable of modifications in various respects, all without departing from the invention. Accordingly, the drawings and description are to be regarded as illustrative in nature and not in a restrictive or limiting sense with the scope of the application being indicated in the claims.

## BRIEF DESCRIPTION OF THE DRAWINGS

For a more complete understanding of various embodiments of the present invention, reference is now made to the following descriptions taken in connection with the accompanying drawings in which:

FIG. 1 illustrates a keypad with overloaded keys in accordance with the prior art.

FIG. 2 illustrates a search system in accordance with one or more embodiments of the invention.

FIG. 3 illustrates exemplary device configuration options for various devices for performing searches in accordance with one or more embodiments of the invention.

FIG. 4 is a flow chart illustrating a method for finding and highlighting results of a reduced text, ambiguous search query made using an overloaded keypad in accordance with one or more embodiments of the invention.

FIG. 5A illustrates the different match possibilities for a single-word and multi-word prefix query in accordance with one or more embodiments of the invention.

FIG. 5B illustrates possible ordering criteria for search results in accordance with one or more embodiments of the invention.

FIGS. 6A and 6B illustrate an exemplary text input interface and a display interface, respectively. The display interface shows the results of a sample incremental search where

3

the user has entered a single-word query in accordance with one or more embodiments of the invention.

FIGS. 7A and 7B illustrate an exemplary text input interface and a display interface, respectively. The display interface shows the results of a sample incremental search where the user has entered a multi-word query in accordance with one or more embodiments of the invention.

Like reference numerals generally refer to like elements in the drawings.

#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Briefly, methods and systems are provided in accordance with various embodiments of the invention for performing searches using ambiguous text input from devices having limited text input interfaces, and highlighting results of the searches.

As described in further detail below, in accordance with various embodiments of the invention, methods and systems are provided for processing a search query entered by a user of a device having a text input interface with overloaded keys. The search query is directed at identifying an item from a set of items. Each of the items has a name comprising one or more words.

Using the text input interface, the user can enter an ambiguous search query directed at identifying a desired item. The search query comprises a prefix substring of at least one word in the name of the desired item. A prefix substring of a word is a variable length string of characters that contains fewer than all the characters making up the word.

The system dynamically identifies a group of one or more items from the set of items having one or more words in the names thereof matching said search query as the user enters each character of said search query. The group of the one or more items is displayed on the device operated by the user with the characters of the one or more words in the names corresponding to the prefix substring of the search query being highlighted. The items are preferably displayed in an order of expected interest to the user.

The user types in the prefix input query by pressing overloaded keys of the text input interface once to form each character of an ambiguous query string. In accordance with one or more embodiments of the invention, the search space containing the searchable items is initially indexed by performing a many-to-many mapping from the alphanumeric space of terms to numeric strings corresponding to the various prefixes of each alphanumeric term constituting the query string. In a numeric string, each alphanumeric character in the string is replaced by its corresponding numeric equivalent based on the arrangement of characters on the keypad, e.g., the commonly used twelve-key reduced keypad shown in FIG. 1. This mapping scheme enables the system in accordance with one or more embodiments to incrementally retrieve results matching the ambiguous alphanumeric input query, as the user types in each character of the query. The user does not have to explicitly specify the termination of each word in the query to assist the system in disambiguating the input query; instead, the user only enters an input query that includes prefix substrings from the one or more words of the query. If multiple word prefixes are entered, the system can leverage off the multiple word prefixes to disambiguate it. A multiple word prefix based disambiguation method can reduce the amount of text and steps needed to enter a multiple word input query and retrieve results.

There are various possible applications for the search techniques described herein including, e.g., assisting television

4

viewers in identifying desired television content items and channels, and assisting users of mobile devices such as cell phones and PDAs in performing searches for items in various databases (e.g., performing searches in directories of people or businesses, searching for and purchasing products/services like airline tickets, and searching for transportation schedules such as airline and train schedules, and for searching for audio and/or video content).

In the context of television systems, the term "television content items" can include a wide variety of video/audio content including, but not limited to, television shows, movies, music videos, or any other identifiable content that can be selected by a television viewer. Searching for television content items can be performed across disparate content sources including, but not limited to, broadcast television, VOD, IPTV, and PVR (local and network).

FIG. 2 schematically illustrates an overall system for performing searches with reduced text entry using various devices in accordance with one or more embodiments of the invention. The system includes a server farm or system **202**, a network **204**, and a variety of devices **206**, **208**, **210** operated by users with text input interfaces. In accordance with one or more embodiments of the invention, the server **202** processes search queries received from the user devices **206**, **208**, **210**. In other embodiments, the search queries are processed on the devices themselves. As discussed below, the server **202** can be the source of search data and relevance updates. If part of a television system, the server **202** can also be the source of or be linked to a source of at least some of the available television content (e.g., a cable or satellite television operator) from which the user can obtain content associated with search results.

The network **204** functions as the distribution framework for transmitting data from the server **202** to the devices operated by the users. The distribution network **204** could be wired or wireless connections or some combination thereof. Examples of possible networks include computer networks, cable television networks, satellite television networks, IP-based television networks, mobile communications networks (such as, e.g., wireless CDMA and GSM networks), wired telephone networks, and IP-based wired and wireless networks.

The search devices could have a wide range of interface capabilities. A device, e.g., could be a hand-held mobile communications device **206** such as a cellular phone or PDA having a limited display size and a reduced keypad with overloaded keys. Another type of search device is a television system **204** with a remote control device **208** having an overloaded keypad. Another possible search device is a desk telephone **210** with a reduced keyboard and a small display screen.

FIG. 3 illustrates multiple exemplary configurations for search devices in accordance with various embodiments of the invention. In one configuration, a search device (e.g., devices **206**, **208**, **210**) can have a display **302**, a processor **304**, volatile memory **306**, text input interface **308**, remote connectivity **310** to the server **202** through the network **204**, and a persistent storage **312**. A device configuration for a device such as the hand-held device **206** might not include local persistent storage **312**. In this case, the device **206** could have remote connectivity **310** to submit the query to the server **202** and retrieve results from it. Another configuration of the devices **206**, **208**, **210** may not have remote connectivity **310**. In this case, the search database may be locally resident on a local persistent storage **312**. The persistent storage **312** may be, e.g., a removable storage element such as SD, SmartMedia, CompactFlash card etc. In a configuration of the device

5

with remote connectivity **310** and persistent storage **312** for performing searches (e.g., a television system **208**), the device may use the remote connectivity for search relevance data update or for the case where the search database is distributed on the local storage **312** and on the server **202**. A preferred configuration in a memory constrained device is the search data residing remotely on a server. Unlike composition applications where the “most frequently used or popular terms space” are small in size and can be maintained in a local vocabulary, search spaces are typically larger inherently because people instinctively use unique word “signatures” to recall an item of interest. Hence maintaining search spaces locally may not be practical in many devices that have limited local memory, making a network based search configuration preferable.

In one exemplary embodiment, a television system **208** may have a set-top box or other device with a one-way link to a satellite network. In this configuration, all search data including relevance updates may be downloaded to the device through a satellite link to perform local searching. In this case, the set-top box preferably has sufficient storage capacity to maintain search spaces locally. Local storage is preferably large in this case to circumvent the deficiency of a one-way link.

FIG. 4 illustrates a search process in accordance with one or more embodiments of the invention. At step **402**, the user enters a character using an ambiguous text input interface, e.g., using a keypad with overloaded keys where a single key press is performed for each character entered. At **404**, an incremental search system determines and displays at least some of the results that match the input character entered at **402**. Since the input is ambiguous, the match of results would include the matches for all the ambiguous input characters represented by the single key press (including those not of interest to the user). To address this increased set of matches, an ordering scheme is preferably used to order the results to improve accessibility to results expected to be more of interest to the user. The ordering of results can be based on a variety of criteria including, e.g., temporal relevance, location relevance, popularity and personal preferences (that may have been determined implicitly or explicitly) or some combination of these criteria. (In a television application, temporal relevance can be used to favor programs whose timing may be more of interest to the viewer. For example, if the user entered NBA, then the system would list the games in order of temporal relevance such as those in progress or are scheduled to begin in the near future are listed at the higher on the list. The popularity criterion can be used to favor programs or channels that are more popular than others. The personal preference criterion can be used to favor programs or channels that the user has indicated preference for in prior user selections. For example, if a user frequently scrolls down to “CNBC” and selects it, the system would over time place CNBC higher in the list of results over a more generally popular channel such as CNN. Furthermore, identity independent time-based usage pattern learning algorithms can be applied in conjunction with personalization to apply the results ordering rules in an appropriate context. Also, e.g., when using a PDA or cell phone to search for a business, the system may use location relevance as part of the ordering criteria.)

In addition, other ordering schemes can be used in addition to or instead of the schemes indicated above such as character count based subspace biasing. In a character count based subspace biasing scheme, items in the search space do not have a constant relevance value, but rather have a relevance value that is a function of the number of characters entered so

6

far in the prefix substring. In such a scheme, the search space (i.e., set of items that can be searched for) can be divided into multiple subspaces. The relative relevance of a given subspace (and all the items contained therein) is dynamically boosted or suppressed as a function of the number of characters in the search query. As an example, a subspace containing television channel names might be boosted when the character count is one because television viewers might expect to find a channel with a single key press. Various examples of character count based subspace biasing are described in U.S. patent application Ser. No. 11/246,432 entitled “Method And System For Incremental Search With Reduced Text Entry Where The Relevance Of Results Is A Dynamically Computed Function Of User Input Search String Character Count” and filed on Oct. 7, 2005, which is assigned to the assignee of the present application and is incorporated by reference herein in its entirety.

The ordering criteria can also give preference to the results matching the search query based on a lexical match of the type of query input, e.g., in the following order of preference: single term prefixes, multiple term prefixes, and lastly abbreviation matches.

In accordance with various embodiments of the invention and as will be described below with reference to FIGS. 6B and 7B, the characters in the search result items that match the search prefix substring characters are highlighted to provide the user with a visual indication of the relationship between the key or keys pressed and the incremental match results. This facilitates identification by the user of the item of interest from the group of items displayed.

If the user does not find the desired results at **406**, he or she can continue to enter more characters to the search query at step **402**. Then at step **404**, the system will perform the search based on the cumulative substring of characters of the search query entered by the user up to that point.

In the scenario where user does not reach the result due to misspelling or due to the case of a word whose uniqueness (e.g., Tom Brown, Todd Brown) is embedded in the suffix of a word in the query (as opposed to the prefix), the user would have to either go back to the first word and enter more characters or erase one or more of the typed characters and re-enter characters to reach the desired result. The dynamic highlight of the prefix strings in the results for each character entry enables the user to recover from an error during the text entry process itself, in contrast to discovering that no results match after typing the entire text.

FIG. 5A illustrates the two broad categories of input queries and the various potential matches they could have in the results space. Input queries that do not include an explicit space or other break character form a single-word prefix query. A single-word query **501** can either match a single-word term **503** or an abbreviation representing multiple words **505**. Input queries that explicitly include a space character or other break character between character entries form a multi-word prefix query. A multi-word prefix query **502** can match a multi-word term **504** or an abbreviation presenting multiple words. In an exemplary search of a movie database, the matches could be a direct match on terms representing a title (e.g., for the search query “go mu”, a match could be the movie title Gods Must Be Crazy) or it could be matches on terms representing different types of information (e.g., if a user is searching for a movie starring Tom Hanks that features volleyball, he or she may enter the search query “to vo” to get the result: Tom Hanks Volleyball). As described earlier, these matches are then ordered in decreasing relevance, and in one or more embodiments, in the following order: single-word

7

term matches **506** and multi-word term matches **507** followed by multi-word abbreviation matches **508** as illustrated in FIG. 5B.

FIGS. 6A and 6B illustrate an example of highlighted search results in accordance with one or more embodiments of the invention. FIG. 6A illustrates an overloaded keypad interface **602**, which can in a television application, be an on-screen interface. In this example, the user has entered a single-word text input query **"866"** using the keypad **602**. The results of the search input are shown in FIG. 6B, which shows single-word term matches **603** and **604** ordered before abbreviation matches **605** and **606**. Because each key pressed by the user is overloaded and represents multiple possible search prefixes, simply displaying the text input **"866"** with the results will not provide the user sufficient information to associate his or her input with the match results. The "8" character entered initially by the user matches all items in the search database containing any word which begins with any of the alphanumeric characters "8", "T", "U" or "V". Examples of matches to the first character would be "8MM" **604** and "Star Trek" (not shown here since what is shown is the result of the query **866**, not 8). The "6" character next entered by the user limits these search results only to items containing words that begin with the alphanumeric characters "8", "T", "U" or "V" and whose second character is one of the alphanumeric characters "6", "M", "N" or "O" or to items containing words that begin with the alphanumeric characters "8", "T", "U" or "V" and that also contain subsequent words that begin with the alphanumeric characters "6", "M", "N" or "O". The earlier match, "Star Trek", would drop out of the match results when the user pressed the overloaded "6" key because the "r" following the "T" matched by the "8" character does not match "6", "M", "N" or "O" and there are no words following "Trek" to match the "6", "M", "N" or "O".

The next "6" character entered by the user as the third overloaded character further limits the search result to only those matches that also contain the alphanumeric characters "6", "M", "N" or "O" immediately following one of the matched characters for the first "6" previously entered or that contain subsequent words that begin with the alphanumeric characters "6", "M", "N" or "O". This relationship between the overloaded characters entered by the user and the match results is complicated and not necessarily intuitive to the user. In various embodiments of the invention, the characters in the search result that match the overloaded single-word search prefix characters are highlighted, providing the user with a visual indication of the relationship between the key pressed and the incremental match results. This facilitates identification by the user of the item of interest from the group of items displayed.

The term "highlighting" as used herein refers to making more prominent or otherwise making more distinct characters of interest in the search results relative to other characters. Non-limiting examples of highlighting include bolding, italicizing, coloring, underlining, or changing font of (or some combination thereof) the characters of interest relative to the others.

In another example, FIG. 7B illustrates the results for a multi-word text input **"866 2"** using a 12-key keypad **702** shown in FIG. 7A. As discussed earlier, the multi-word term matches **703** are preferably ordered ahead of multi-word abbreviation matches. The difference between the single-word search illustrated in FIG. 6B and the multi-word search illustrated in FIG. 7B is that the use of an explicit word separator in the user input (in this case a space character) before the "2" entry, further limits results of the search. Only the results of the search illustrated in FIG. 6B for prefix

8

substring **"866"** that also contain at least two words and in which a subsequent word begins with "2", "A", "B", or "C" are included in the results displayed to the user. A title such as "Tomb Raider" would not match the multi-word search even though the word "Tomb" matches the overloaded keys "8", "6", "6", "2" because the "2" must match the first letter in a subsequent word. As in the FIG. 6B example, the characters in the ordered result that match the multi-word overloaded search prefix characters are highlighted to provide the user with immediate feedback relating the key pressed to the incremental match results.

Methods of processing ambiguous search query inputs from users and highlighting results in accordance with various embodiments of the invention are preferably implemented in software, and accordingly one of the preferred implementations is as a set of instructions (program code) in a code module resident in the random access memory of a computer. Until required by the computer, the set of instructions may be stored in another computer memory, e.g., in a hard disk drive, or in a removable memory such as an optical disk (for eventual use in a CD ROM) or floppy disk (for eventual use in a floppy disk drive), or downloaded via the Internet or some other computer network. In addition, although the various methods described are conveniently implemented in a general purpose computer selectively activated or reconfigured by software, one of ordinary skill in the art would also recognize that such methods may be carried out in hardware, in firmware, or in more specialized apparatus constructed to perform the specified method steps.

Having described preferred embodiments of the present invention, it should be apparent that modifications can be made without departing from the spirit and scope of the invention.

Method claims set forth below having steps that are numbered or designated by letters should not be considered to be necessarily limited to the particular order in which the steps are recited.

The invention claimed is:

1. A method of processing unresolved keystroke entries by a user from a keypad with overloaded keys in which a given key is in fixed association with a number and at least one alphabetic character, said unresolved keystroke entries being directed at identifying an item from a set of items, each of said items being associated with information describing the item comprising one or more words, said method comprising:

indexing said items by associating subsets of said items with corresponding strings of one or more unresolved keystrokes for overloaded keys so that the subsets of items are directly mapped to the corresponding strings of unresolved keystrokes for various search query prefix substrings;

for at least one subset of items, which determining letters and numbers present in the information associated with and describing the indexed items of said subset caused said items to be associated with the strings of one or more unresolved keystrokes that are directly mapped to said subset;

subsequent to said indexing, receiving from a user a search query for desired items composed of unresolved keystrokes, said search query comprising a prefix substring for at least one word in information associated with the desired item;

in response to each unresolved keystroke, identifying and displaying the subsets of items, and information associated therewith, that are associated with the strings of one or more unresolved keystrokes received from the user

9

based on the direct mapping of strings of unresolved keystrokes to subsets of items;

in response to each unresolved keystroke, as the identified items are displayed, highlighting the letters and numbers present in the one or more words in said information describing the identified items that were determined to have caused the displayed items to be associated with the strings of unresolved keystrokes that are directly mapped to said items received so as to illustrate to the user how the unresolved keystrokes entered match the information associated with the displayed items; and ordering the displayed items in accordance with one or more given criteria.

2. The method of claim 1 wherein said alphabetical and numeric symbols are highlighted by being colored, bolded, italicized, underlined, or changed to a different font, or some combination thereof.

3. The method of claim 1 wherein said one or more given criteria include one or more of: temporal relevance, location relevance, popularity, personal preferences and character count.

4. The method of claim 1 wherein said displayed items are ordered such that items having single-word or multi-word term matches are displayed before items having single-word or multi-word abbreviation matches.

5. The method of claim 1 wherein said search query is processed by a server system remote from said user.

6. The method of claim 1 wherein said search query is processed by a device operated by said user.

7. The method of claim 1 wherein said items comprise television content items, or a product or service sought by the user.

8. The method of claim 6 wherein said device is a cell phone, desk phone, a PDA, or a remote control device for a television.

9. A system for processing unresolved keystroke entries by a user from a keypad with overloaded keys in which a given key is in fixed association with a number and at least one alphabetic character, said unresolved keystroke entries being directed at identifying an item from a set of items, each of said items being associated with information describing the item comprising one or more words, said system comprising a computer-readable medium comprising instructions for causing a computer system to:

index said items by associating subsets of said items with corresponding strings of one or more unresolved keystrokes for overloaded keys so that the subsets of items are directly mapped to the corresponding strings of unresolved keystrokes for various search query prefix sub-strings;

for at least one subset of items, which determine letters and numbers present in the information associated with and describing the indexed items of said subset caused said items to be associated with the strings of one or more unresolved keystrokes that are directly mapped to said subset;

subsequent to said indexing, receive from a user a search query for desired items composed of unresolved keystrokes, said search query comprising a prefix substring for at least one word in information associated with the desired item;

in response to each unresolved keystroke, identify and display on a display device at least one of the subsets of items, and information associated therewith, that are associated with the strings of one or more unresolved

10

keystrokes received from the user based on the direct mapping of strings of unresolved keystrokes to subsets of items;

in response to each unresolved keystroke, as the identified items are displayed, highlight on the display device the letters and numbers present in the one or more words in said information describing the identified items that were determined to have caused the displayed items to be associated with the unresolved keystrokes received so as to illustrate to the user how the strings of unresolved keystrokes that are directly mapped to said items entered match the information associated with the displayed items; and

order on the display device the displayed items in accordance with one or more given criteria.

10. The system of claim 9 wherein said alphabetical and numeric symbols are highlighted by being colored, bolded, italicized, underlined, or changed to a different font, or some combination thereof.

11. The system of claim 9 wherein said one or more given criteria include one or more of: temporal relevance, location relevance, popularity, personal preferences and character count.

12. The system of claim 9 wherein said displayed items are ordered such that items having single-word or multi-word term matches are displayed before items having single-word or multi-word abbreviation matches.

13. The system of claim 9 wherein said computer system comprises a server system remote from said user.

14. The system of claim 9 wherein said computer system is incorporated in or proximate a device operated by said user.

15. The system of claim 9 wherein said items comprise television content items, or a product or service sought by the user.

16. The system of claim 14 wherein said device is a cell phone, desk phone, a PDA, or a remote control device for a television.

17. A computer program product for processing unresolved keystroke entries by a user from a keypad with overloaded keys in which a given key is in fixed association with a number and at least one alphabetic character, said unresolved keystroke entries being directed at identifying an item from a set of items, each of said items being associated with information describing the item comprising one or more words, said computer program product residing on a computer readable medium having a plurality of instructions stored thereon which, when executed by a processor, cause the processor to: index said items by associating subsets of said items with corresponding strings of one or more unresolved keystrokes for overloaded keys so that the subsets of items are directly mapped to the corresponding strings of unresolved keystrokes for various search query prefix sub-strings;

for at least one subset of items, which determine letters and numbers present in the information associated with and describing the indexed items of said subset caused said items to be associated with the strings of one or more unresolved keystrokes that are directly mapped to said subset;

subsequent to said indexing, receive from a user a search query for desired items composed of unresolved keystrokes, said search query comprising a prefix substring for at least one word in information associated with the desired item;

in response to each unresolved keystroke, identify and display at least one of the subsets of items, and information associated therewith, that are associated with the



11

strings of one or more unresolved keystrokes received from the user based on the direct mapping of strings of unresolved keystrokes to subsets of items;

in response to each unresolved keystroke, as the identified items are displayed, highlight the letters and numbers present in the one or more words in said information describing the identified items that were determined to have caused the displayed items to be associated with the strings of unresolved keystrokes that are directly mapped to said items received so as to illustrate to the user how the unresolved keystrokes entered match the information associated with the displayed items; and order the displayed items in accordance with one or more given criteria.

18. The computer program product of claim 17 wherein said alphabetical and numeric symbols are highlighted by being colored, bolded, italicized, underlined, or changed to a different font, or some combination thereof.

19. The computer program product of claim 17 wherein said one or more given criteria include one or more of: temporal relevance, location relevance, popularity, personal preferences and character count.

12

20. The computer program product of claim 17 wherein said displayed items are ordered such that items having single-word or multi-word term matches are displayed before items having single-word or multi-word abbreviation matches.

21. The computer program product of claim 17 wherein said search query is processed by a server system remote from said user.

22. The computer program product of claim 17 wherein said search query is processed by a device operated by said user.

23. The computer program product of claim 17 wherein said items comprise television content items, or a product or service sought by the user.

24. The computer program product of claim 22 wherein said device is a cell phone, desk phone, a PDA, or a remote control device for a television.

\* \* \* \* \*

UNITED STATES PATENT AND TRADEMARK OFFICE  
**CERTIFICATE OF CORRECTION**

PATENT NO. : 7,779,011 B2  
APPLICATION NO. : 11/312908  
DATED : August 17, 2010  
INVENTOR(S) : Sashikumar Venkataraman et al.

Page 1 of 1

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

In the Claims:

At column 8, claim 1, line 53, "which determining letters" should read --determining which letters--.

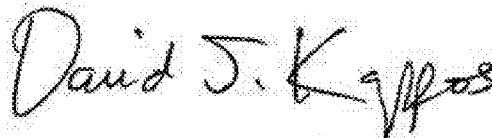
At column 9, claim 1, line 9, "mapped to said items received so" should read --mapped to said items so--.

At column 9, claim 9, line 52, "which determine letters" should read --determine which letters--.

At column 10, claim 17, line 54, "which determine letters" should read --determine which letters--.

At column 11, claim 17, line 10, "mapped to said items received so" should read --mapped to said items so--.

Signed and Sealed this  
Fifteenth Day of February, 2011

A handwritten signature in black ink that reads "David J. Kappos". The signature is written in a cursive, flowing style.

David J. Kappos  
*Director of the United States Patent and Trademark Office*