



US007937394B2

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

(10) **Patent No.:** **US 7,937,394 B2**
(45) **Date of Patent:** ***May 3, 2011**

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

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

(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 0 days.

This patent is subject to a terminal dis-
claimer.

(21) Appl. No.: **12/848,432**

(22) Filed: **Aug. 2, 2010**

(65) **Prior Publication Data**

US 2010/0299358 A1 Nov. 25, 2010

Related U.S. Application Data

(63) Continuation of application No. 11/312,908, filed on
Dec. 20, 2005, now Pat. No. 7,779,011.

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

(51) **Int. Cl.**

G06F 7/00 (2006.01)

G06F 17/30 (2006.01)

(52) **U.S. Cl.** **707/741; 707/742; 707/753**

(58) **Field of Classification Search** **707/741,**
707/742, 753, 999.005

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

1,261,167 A 4/1918 Russell
4,045,777 A 8/1977 Mierzewski et al.

(Continued)

FOREIGN PATENT DOCUMENTS

EP 1050794 A2 11/2000

(Continued)

OTHER PUBLICATIONS

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

(Continued)

Primary Examiner — Robert Timblin

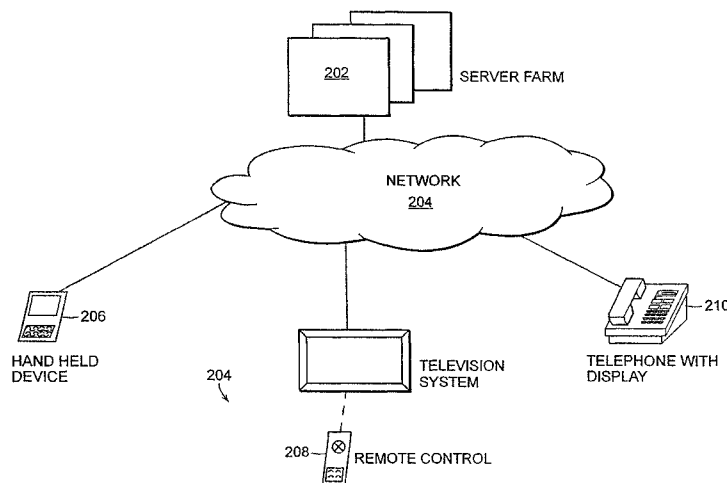
Assistant Examiner — Mariela Reyes

(74) *Attorney, Agent, or Firm* — Wolf, Greenfield & Sacks,
P.C.

(57) **ABSTRACT**

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 including 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. They 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.

11 Claims, 7 Drawing Sheets



U.S. PATENT DOCUMENTS				
4,453,217 A	6/1984	Boivie	7,213,256 B1	5/2007 Kikinis
4,760,528 A	7/1988	Levin	7,225,180 B2	5/2007 Donaldson et al.
4,893,238 A	1/1990	Venema	7,225,184 B2	5/2007 Carrasco et al.
5,224,060 A	6/1993	Ma	7,225,455 B2	5/2007 Bennington et al.
5,337,347 A	8/1994	Halstead-Nussloch et al.	7,269,548 B2	9/2007 Fux et al.
5,369,605 A	11/1994	Parks	7,293,231 B1	11/2007 Gunn et al.
5,487,616 A	1/1996	Ichbiah	7,487,151 B2	2/2009 Yamamoto
5,532,754 A	7/1996	Young et al.	7,536,384 B2	5/2009 Venkataraman et al.
5,623,406 A	4/1997	Ichbiah	7,594,244 B2	9/2009 Scholl et al.
5,635,989 A	6/1997	Rothmuller	2002/0002550 A1	1/2002 Berman
5,745,889 A	4/1998	Burrows	2002/0042791 A1	4/2002 Smith et al.
5,774,588 A	6/1998	Li	2002/0052873 A1	5/2002 Delgado et al.
5,802,361 A	9/1998	Wang et al.	2002/0059621 A1	5/2002 Thomas et al.
5,805,155 A	9/1998	Allibhoy et al.	2002/0083448 A1	6/2002 Johnson
5,818,437 A	10/1998	Grover et al.	2002/0133481 A1	9/2002 Smith et al.
5,828,420 A	10/1998	Marshall et al.	2002/0144267 A1	10/2002 Gutta et al.
5,828,991 A	10/1998	Skiena et al.	2002/0152190 A1	10/2002 Biebesheimer et al.
5,835,087 A	11/1998	Herz et al.	2002/0184373 A1	12/2002 Maes
5,859,662 A	1/1999	Cragun et al.	2002/0188488 A1	12/2002 Hinkle
5,880,768 A	3/1999	Lemmons et al.	2002/0199194 A1	12/2002 Ali
5,912,664 A	6/1999	Eick et al.	2003/0005452 A1	1/2003 Rodriguez
5,937,422 A	8/1999	Nelson et al.	2003/0005462 A1	1/2003 Broadus et al.
5,945,928 A	8/1999	Kushler et al.	2003/0011573 A1	1/2003 Villet et al.
5,945,987 A	8/1999	Dunn	2003/0014753 A1	1/2003 Beach et al.
5,953,541 A	9/1999	King et al.	2003/0023976 A1	1/2003 Kamen et al.
6,005,565 A	12/1999	Legall et al.	2003/0037043 A1	2/2003 Chang et al.
6,005,597 A	12/1999	Barrett et al.	2003/0037333 A1	2/2003 Ghashghai et al.
6,006,225 A	12/1999	Bowman et al.	2003/0046698 A1	3/2003 Kamen et al.
6,009,459 A	12/1999	Belfiore et al.	2003/0051240 A1	3/2003 Schaffer et al.
6,011,554 A	1/2000	King et al.	2003/0066068 A1	4/2003 Gutta et al.
6,041,311 A	3/2000	Chislenko et al.	2003/0066079 A1	4/2003 Suga
6,047,300 A	4/2000	Walfish et al.	2003/0084270 A1	5/2003 Coon et al.
6,075,526 A	6/2000	Rothmuller	2003/0103088 A1	6/2003 Dresti et al.
6,133,909 A	10/2000	Schein et al.	2003/0217121 A1	11/2003 Willis
6,169,984 B1	1/2001	Bogdan	2003/0226146 A1	12/2003 Thurston et al.
6,184,877 B1	2/2001	Dodson et al.	2003/0229900 A1	12/2003 Reisman
6,189,002 B1	2/2001	Roitblat	2003/0237096 A1	12/2003 Barrett et al.
6,223,059 B1	4/2001	Haestrup	2004/0013909 A1	1/2004 Shimizu et al.
6,260,050 B1	7/2001	Yost et al.	2004/0021691 A1	2/2004 Dostie et al.
6,266,048 B1	7/2001	Carau, Sr.	2004/0024777 A1	2/2004 Schaffer
6,266,814 B1	7/2001	Lemmons et al.	2004/0046744 A1	3/2004 Rafii et al.
6,269,361 B1	7/2001	Davis et al.	2004/0049783 A1	3/2004 Lemmons et al.
6,286,064 B1	9/2001	King et al.	2004/0054520 A1	3/2004 Dehlinger et al.
6,292,804 B1	9/2001	Ardoin et al.	2004/0073926 A1	4/2004 Nakamura et al.
6,307,548 B1	10/2001	Flinchem et al.	2004/0078815 A1	4/2004 Lemmons et al.
6,307,549 B1	10/2001	King et al.	2004/0078816 A1	4/2004 Johnson
6,377,945 B1	4/2002	Risvik	2004/0078820 A1	4/2004 Nickum
6,438,579 B1	8/2002	Hosken et al.	2004/0083198 A1	4/2004 Bradford et al.
6,438,751 B1	8/2002	Voyticky et al.	2004/0093616 A1	5/2004 Johnson
6,466,933 B1	10/2002	Huang et al.	2004/0111745 A1	6/2004 Schein et al.
6,529,903 B2	3/2003	Smith et al.	2004/0128686 A1	7/2004 Boyer et al.
6,564,213 B1	5/2003	Ortega et al.	2004/0139091 A1	7/2004 Shin
6,564,313 B1	5/2003	Kashyap	2004/0143569 A1	7/2004 Gross et al.
6,594,657 B1	7/2003	Livovsky	2004/0163032 A1	8/2004 Guo et al.
6,600,496 B1	7/2003	Wagner et al.	2004/0194141 A1	9/2004 Sanders
6,614,455 B1	9/2003	Cuijpers et al.	2004/0216160 A1	10/2004 Lemmons et al.
6,615,248 B1	9/2003	Smith	2004/0220926 A1	11/2004 Lamkin et al.
6,631,496 B1	10/2003	Li et al.	2004/0221308 A1	11/2004 Cuttner et al.
6,721,954 B1	4/2004	Nickum	2004/0261021 A1	12/2004 Mittal et al.
6,732,369 B1	5/2004	Schein et al.	2005/0015366 A1	1/2005 Carrasco et al.
6,757,906 B1	6/2004	Look et al.	2005/0071874 A1	3/2005 Elcock et al.
6,766,526 B1	7/2004	Ellis	2005/0086234 A1	4/2005 Tosey
6,772,147 B2	8/2004	Wang	2005/0086691 A1	4/2005 Dudkiewicz et al.
6,785,671 B1	8/2004	Bailey et al.	2005/0086692 A1	4/2005 Dudkiewicz et al.
6,801,909 B2	10/2004	Delgado et al.	2005/0174333 A1	8/2005 Robinson et al.
6,839,702 B1	1/2005	Patel et al.	2005/0192944 A1	9/2005 Flinchem
6,839,705 B1	1/2005	Grooters	2005/0210020 A1	9/2005 Gunn et al.
6,850,693 B2	2/2005	Young et al.	2005/0210383 A1	9/2005 Cucerzan et al.
6,865,575 B1	3/2005	Smith et al.	2005/0210402 A1	9/2005 Gunn et al.
6,865,746 B1	3/2005	Herrington et al.	2005/0223308 A1	10/2005 Gunn et al.
6,907,273 B1	6/2005	Smethers	2005/0240580 A1	10/2005 Zamir et al.
6,965,374 B2	11/2005	Villet et al.	2005/0246311 A1	11/2005 Whelan et al.
7,013,304 B1	3/2006	Schuetze et al.	2005/0267994 A1	12/2005 Wong et al.
7,117,207 B1	10/2006	Kerschberg et al.	2005/0278175 A1	12/2005 Hyvonen
7,130,866 B2	10/2006	Schaffer	2005/0283468 A1	12/2005 Kamvar et al.
7,136,854 B2	11/2006	Smith	2006/0010477 A1	1/2006 Yu
7,146,627 B1	12/2006	Ismail et al.	2006/0013487 A1	1/2006 Longe et al.
7,149,983 B1	12/2006	Robertson 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.
2006/0173818	A1	8/2006	Bersts et al.
2006/0190308	A1	8/2006	Janssens et al.
2006/0195435	A1	8/2006	Laird-McConnell et al.
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.
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.
2008/0086704	A1	4/2008	Aravamudan
2008/0114743	A1	5/2008	Venkataraman et al.
2008/0209229	A1	8/2008	Ramakrishnan et al.

FOREIGN PATENT DOCUMENTS

EP	1143691	A1	10/2001
EP	1338967	A2	8/2003
EP	1463307	A2	9/2004
WO	WO 00/70505	A1	11/2000
WO	WO 2004/010326	A1	1/2004
WO	WO 2004/031931	A1	4/2004
WO	WO 2005/033967	A2	4/2005
WO	WO 2005/084235	A2	9/2005

OTHER PUBLICATIONS

Complaint in *Veveo, Inc. v. Verizon Services Corp., Verizon Communications Inc., and Verizon Data Services India Pvt. Ltd.*, U.S. District Court Southern District of New York, Civil Action No. 10-CIV-6709 (JFK), filed Sep. 9, 2010, pp. 1-14.

First Amended Complaint in *Veveo, Inc. v. Verizon Services Corp., Verizon Communications Inc., and Verizon Data Services LLC*, U.S. District Court Southern District of New York, Civil Action No. 10-CIV-6709 (JFK), filed Nov. 16, 2010, 16 pages.

Verizon's Answer to First Amended Complaint and Counterclaims in *Veveo, Inc. v. Verizon Services Corp., Verizon Communications Inc., and Verizon Data Services LLC*, U.S. District Court Southern District of New York, Civil Action No. 10-CIV-6709 (JFK), filed Dec. 9, 2010, pp. 1-17.

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.

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>.

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

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

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).

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

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.

Matthom, "Text Highlighting in Search Results", Jul. 22, 2005. Available at 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).

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>.

Press Release From TEGIC Communications, TEGIC Communications 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.sub.--view.html?release.sub.--num=55254242>.

Review of Personalization Technologies: Collaborative Filtering vs. ChoiceStream's Attributized 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).

Silverberg 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.

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.

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

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>.

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

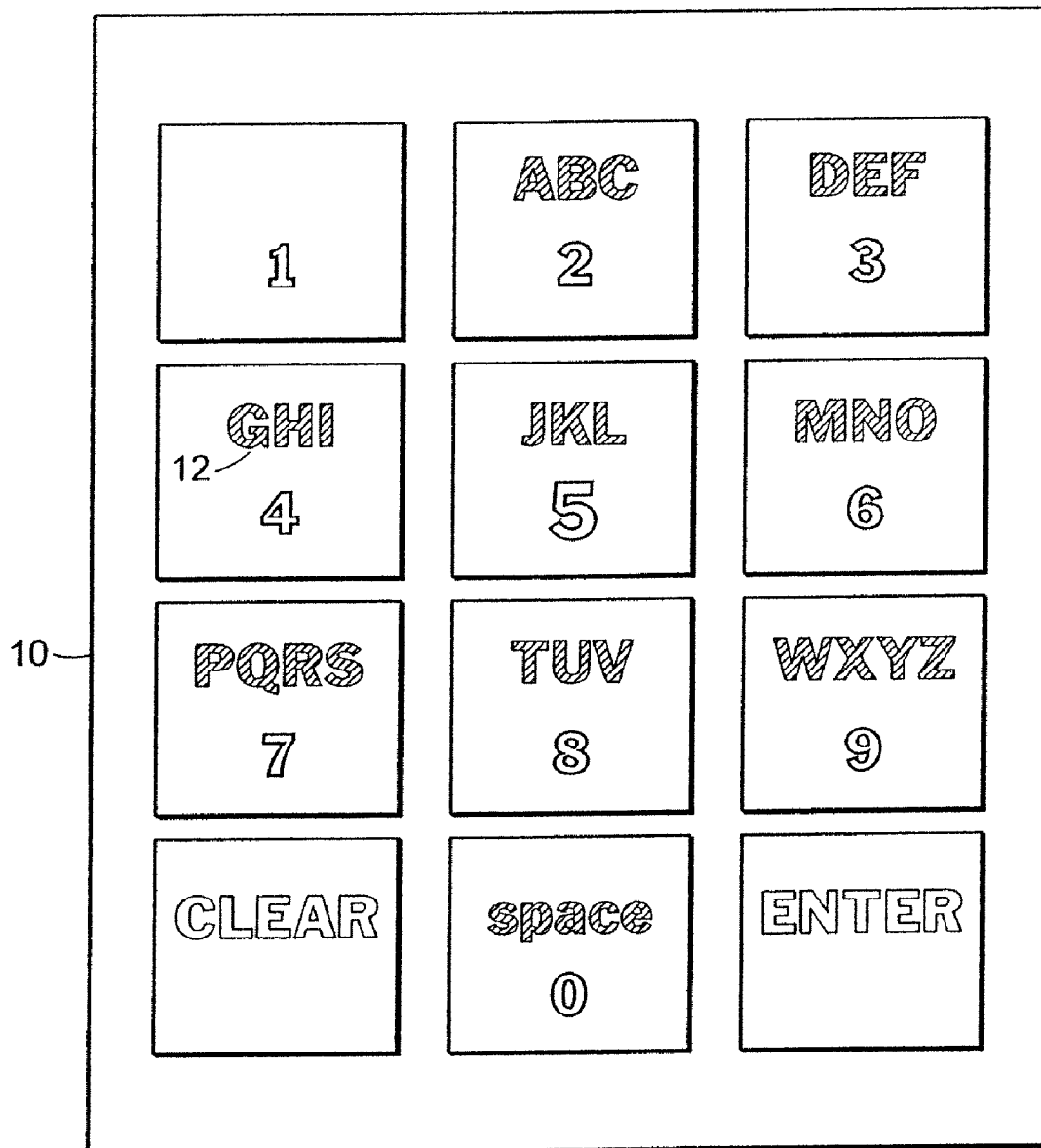
Written Opinion of the International Searching Authority, International Application No. PCT/US06/33258, mailed Mar. 26, 2008 (4 pages).

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).

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



PRIOR ART
FIG. 1

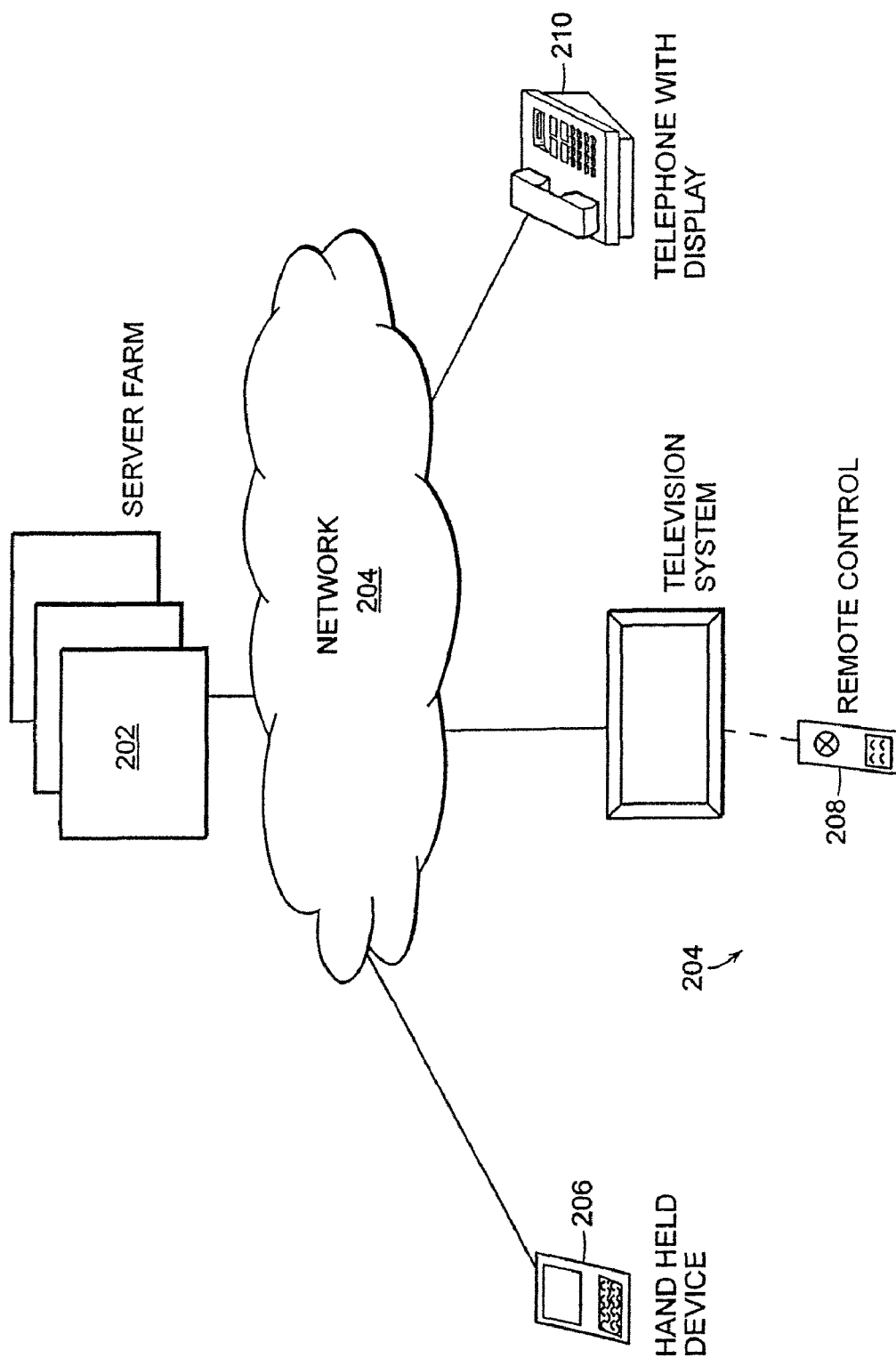


FIG. 2

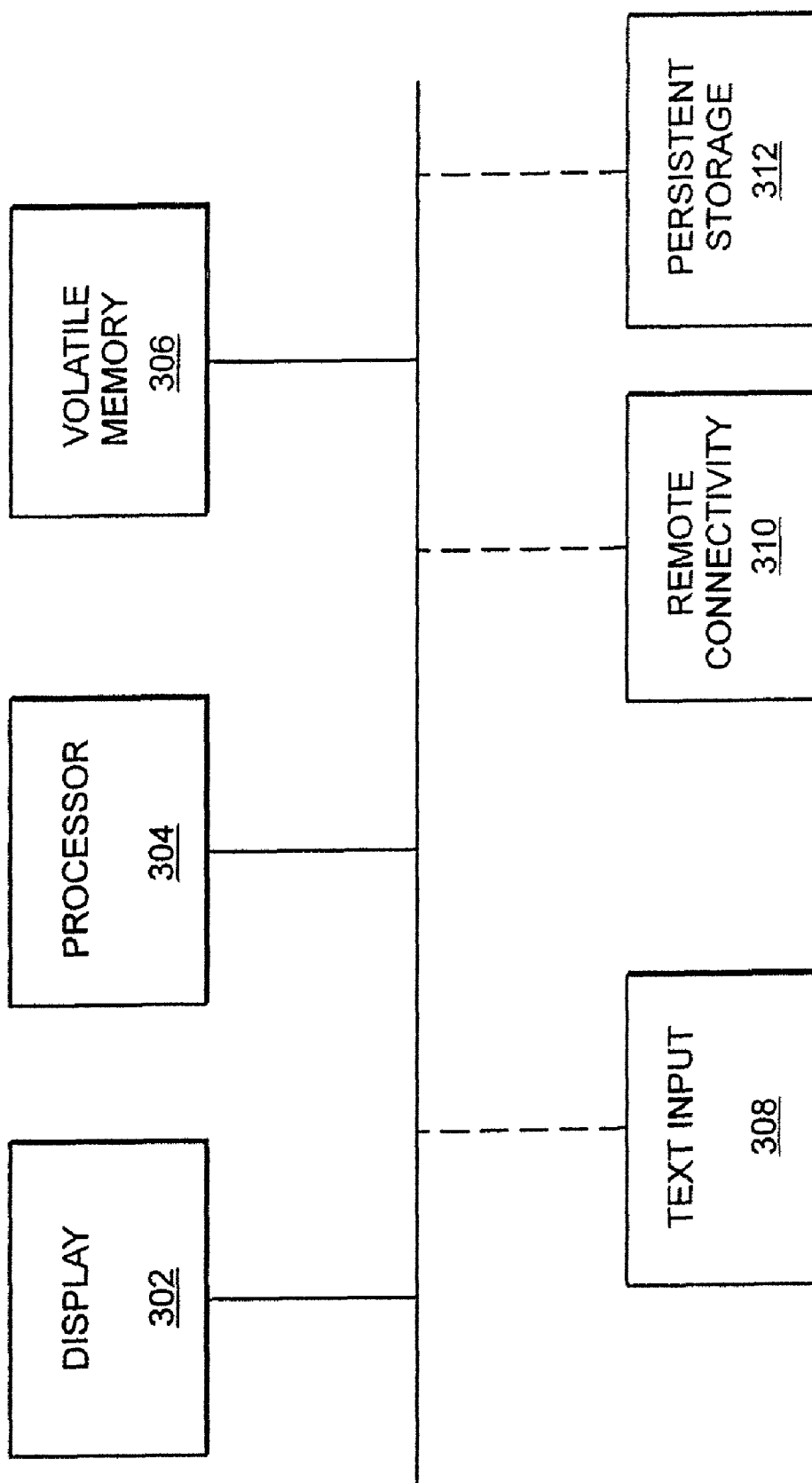


FIG. 3

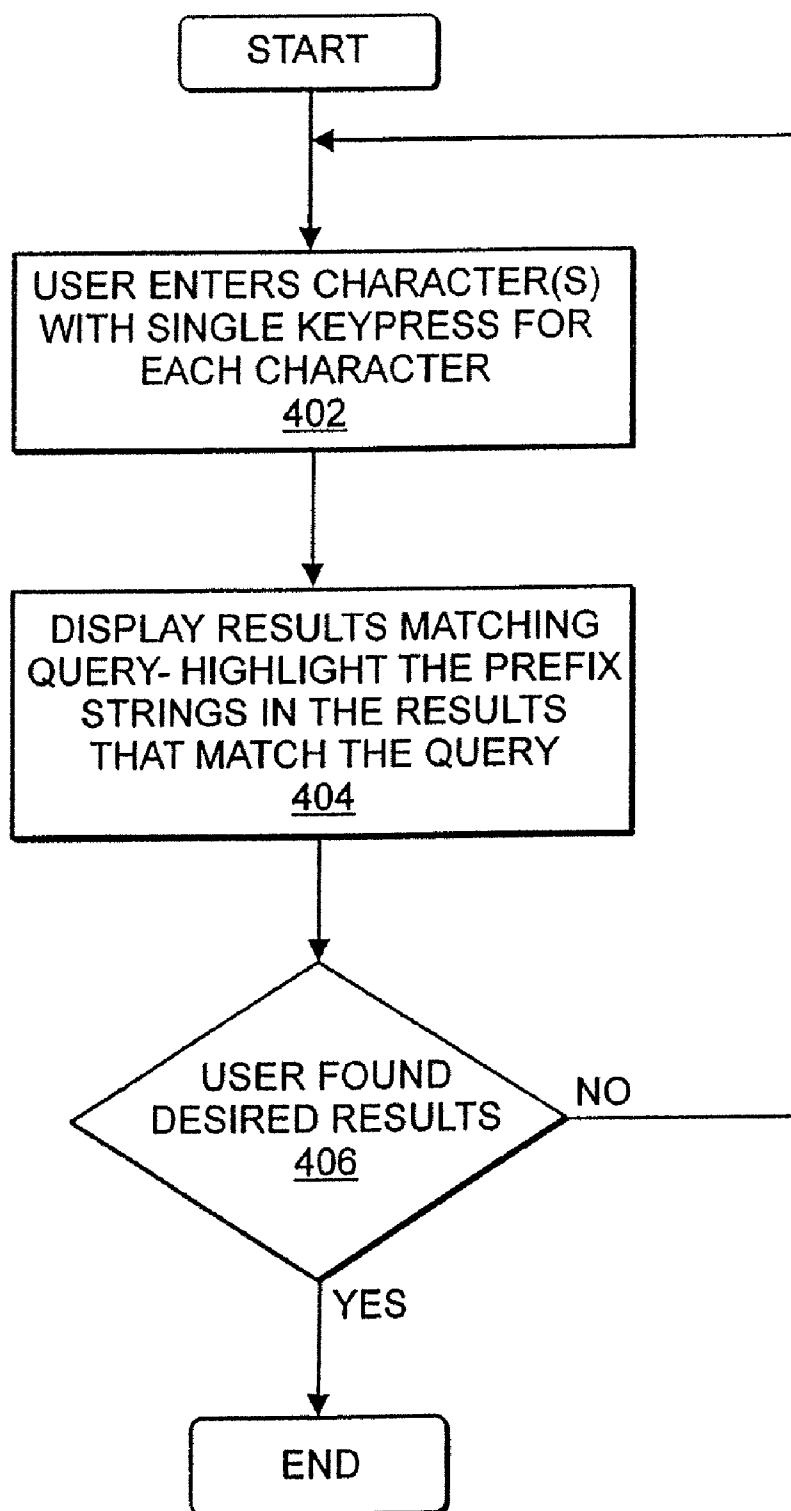


FIG. 4

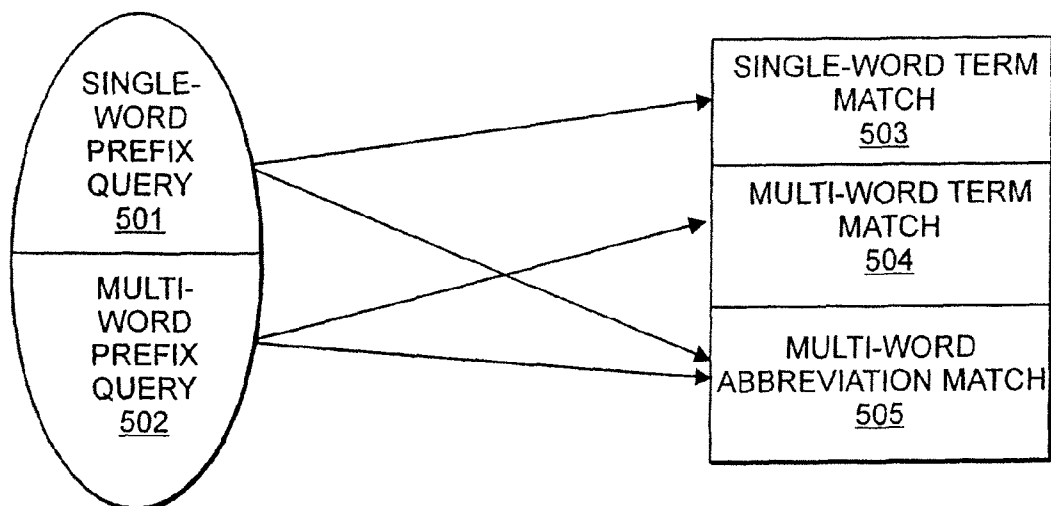


FIG. 5A

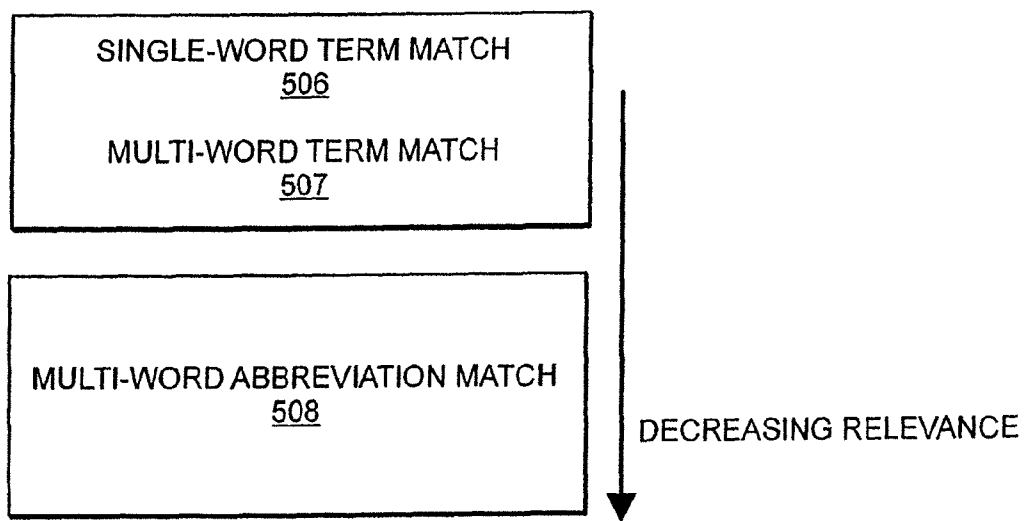
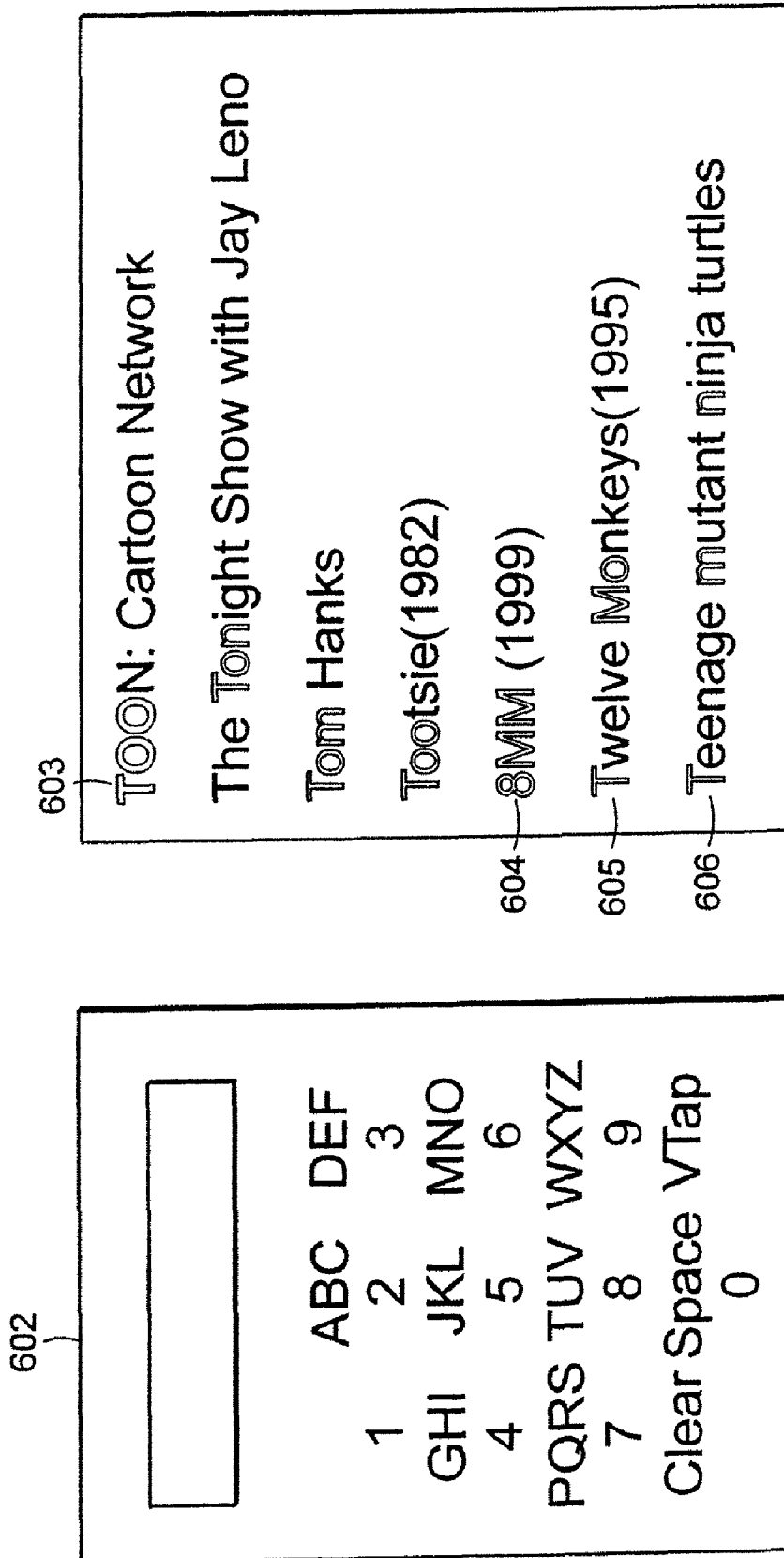


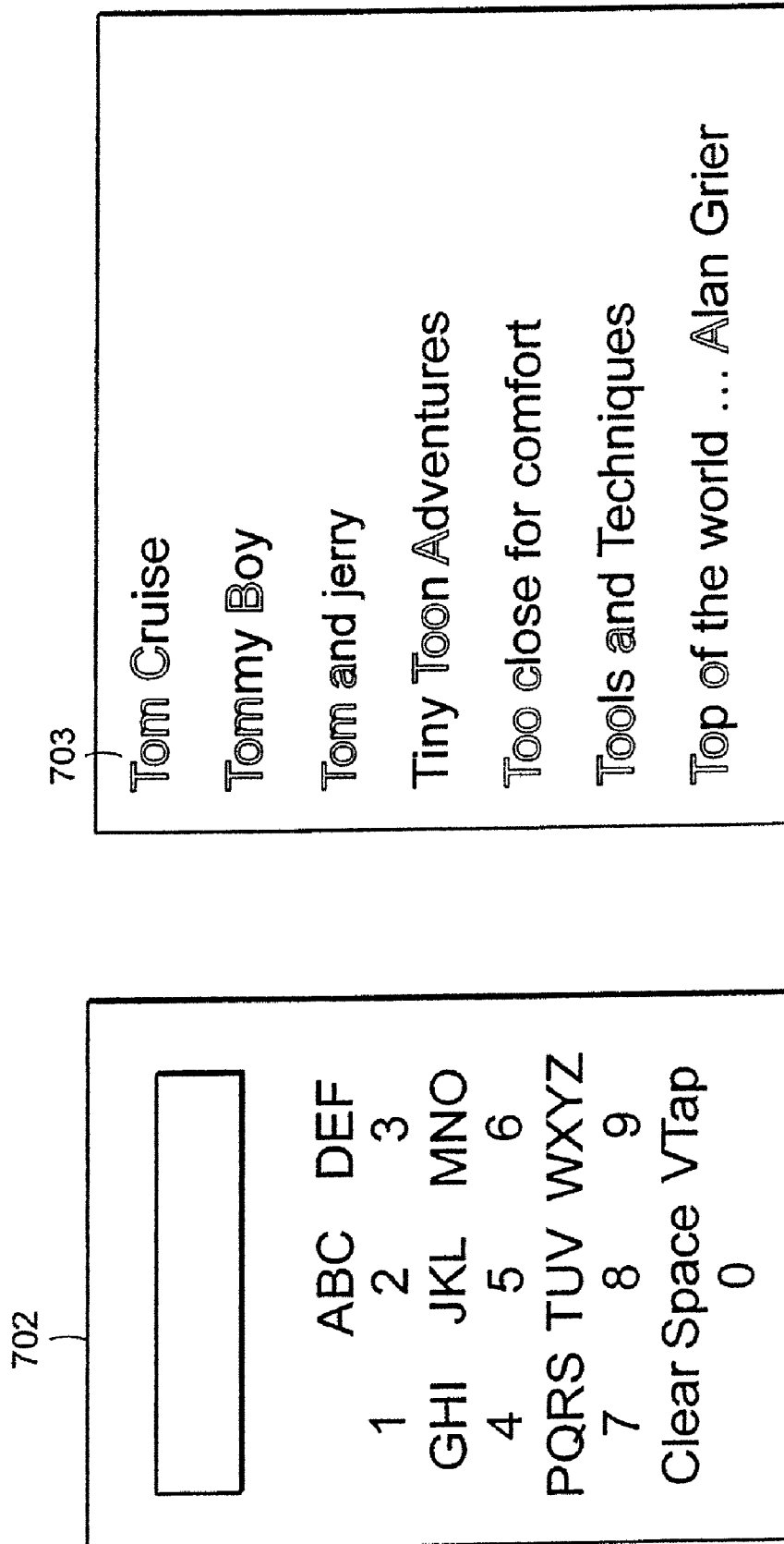
FIG. 5B



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

CROSS-REFERENCE TO RELATED APPLICATIONS

The application is a continuation of U.S. patent application Ser. No. 11/312,908, entitled Method And System For Dynamically Processing Ambiguous, Reduced Text Search Queries And Highlighting Results Thereof, filed Dec. 20, 2005, now U.S. Pat. No. 7,779,011, which claims the benefit under 35 U.S.C. §119(e) of U.S. Provisional 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. Provisional Patent Application 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, all of which are incorporated herein by reference in their entirety.

BACKGROUND OF THE DISCLOSURE

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

2

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 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 SEVERAL VIEW 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.

3

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 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 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

4

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 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

5

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 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.)

6

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 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

7

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 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-

8

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 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.

What is 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, the unresolved keystroke entries being directed at identifying an item from a set of items, each of the items being associated with information describing the item comprising one or more words, the method comprising:

providing access to an index of the items, the index having an association between subsets of the items and 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, determining which letters and numbers present in the information associated with and describing the indexed items of the subset caused the items to be associated with the strings of one or more unresolved keystrokes that directly mapped to the subset;

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

9

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

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 the 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 the items so as to illustrate to the user how the unresolved keystrokes entered match the information associated with the displayed items.

2. The method of claim 1, wherein highlighting the letters and numbers comprises highlighting by coloring, bolding, italicizing, underlining, or changing to a different font, or some combination thereof.

3. The method of claim 1, wherein the items of the subsets of items displayed are ordered when displayed such that items having single-word or multi-word term matches between the

10

information associated with and describing those items and the unresolved keystrokes of the search query received from the user are displayed before items having single-word or multi-word abbreviation matches.

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

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

6. The method of claim 5, wherein the device is a cell phone.

7. The method of claim 5, wherein the device is a desk phone.

8. The method of claim 5, wherein the device is a remote control device for a television.

9. The method of claim 1, wherein at least some items of the set of items are television content items.

10. The method of claim 1, wherein at least some items of the set of items are product items.

11. The method of claim 1, wherein identifying and displaying the subsets of items comprises identifying the subsets of items by reference to the index of the items.

* * * * *