

[54] **INTERACTIVE DATABASE QUERY SYSTEM AND METHOD FOR PROHIBITING THE SELECTION OF SEMANTICALLY INCORRECT QUERY PARAMETERS**

[75] Inventor: **Steven P. Shwartz**, Orange, Conn.

[73] Assignee: **Software AG**, Germany

[21] Appl. No.: **217,099**

[22] Filed: **Mar. 24, 1994**

[51] **Int. Cl.⁶** **G06F 17/30**; G06F 17/27

[52] **U.S. Cl.** **395/604**; 395/922; 395/757; 364/274.2; 364/275.4; 364/283.3; 364/DIG. 1; 364/972.2; 364/974.6; 364/DIG. 2

[58] **Field of Search** 395/600, 922; 364/419.01, 419.07, 974.6, 972.2, 274.2, 274.7, 275.1, 275.4, 283.3, 282.1

[56] **References Cited**

U.S. PATENT DOCUMENTS

| | | | |
|-----------|---------|------------------------|-----------|
| 4,506,326 | 3/1985 | Shaw et al. | 364/300 |
| 4,688,195 | 8/1987 | Thompson et al. | 364/300 |
| 4,689,737 | 8/1987 | Grant | 364/200 |
| 4,736,296 | 5/1988 | Katayama et al. | 364/419 |
| 4,811,207 | 3/1989 | Hikita et al. | 364/200 |
| 4,829,423 | 5/1989 | Tennant et al. | 364/200 |
| 4,839,853 | 6/1989 | Deerwester et al. | 364/900 |
| 4,914,590 | 3/1990 | Loatman et al. | 364/419 |
| 4,930,071 | 5/1990 | Tou et al. | 364/300 |
| 4,931,935 | 5/1990 | Ohira et al. | 364/419 |
| 4,943,933 | 7/1990 | Miyamoto et al. | 364/513 |
| 4,974,191 | 11/1990 | Amirghodsi et al. | 364/900 |
| 4,994,967 | 2/1991 | Asakawa | 364/419 |
| 5,099,426 | 3/1992 | Carlgren et al. | 364/419 |
| 5,175,814 | 12/1992 | Anick et al. | 395/161 |
| 5,197,005 | 3/1993 | Shwartz et al. | 395/600 |
| 5,204,947 | 4/1993 | Bernstein et al. | 395/157 |
| 5,237,502 | 8/1993 | White et al. | 364/419 |
| 5,255,386 | 10/1993 | Prager | 395/600 |
| 5,265,014 | 11/1993 | Haddock et al. | 364/419 |
| 5,265,065 | 11/1993 | Turtle | 395/600 |
| 5,349,526 | 9/1994 | Potts, Sr. et al. | 364/419.1 |
| 5,386,556 | 1/1995 | Hedim et al. | 395/600 |

FOREIGN PATENT DOCUMENTS

| | | | |
|-----------|---------|-------------------------|------------|
| 0287310 | 10/1988 | European Pat. Off. | G06F 15/40 |
| 0387226 | 9/1990 | European Pat. Off. | G06F 15/38 |
| 63-219034 | 9/1988 | Japan | G06F 7/28 |

OTHER PUBLICATIONS

Wu, "A Knowledge-Based Database Assistant With A Menu Based Natural Language User-Interface" 10 Oct. 1993, IEICI: Trans. Inf. & Syst. V. E76-D N. 10 pp. 1276-1287.

(List continued on next page.)

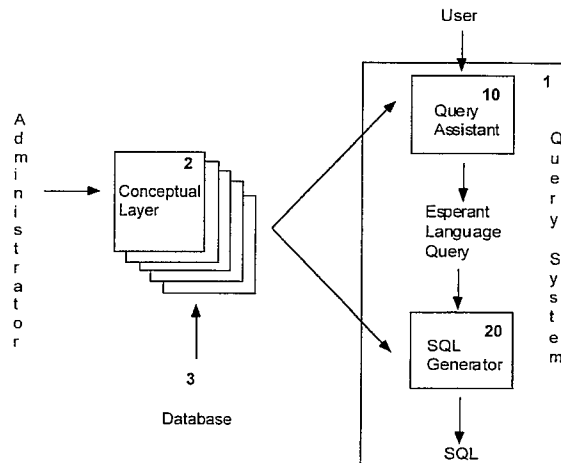
Primary Examiner—Wayne Amsbury
Assistant Examiner—Jack M. Choules
Attorney, Agent, or Firm—Howrey & Simon; C. Scott Talbot; Thomas G. Woolston

[57] **ABSTRACT**

A database query system includes a query assistant that permits the user to enter only queries that are both syntactically and semantically valid (and that can be processed by an SQL generator to produce semantically valid SQL). Through the use of dialog boxes, a user enters a query in an intermediate English-like language which is easily understood by the user. A query expert system monitors the query as it is being built, and using information about the structure of the database, it prevents the user from building semantically incorrect queries by disallowing choices in the dialog boxes which would create incorrect queries. An SQL generator is also provided which uses a set of transformations and pattern substitutions to convert the intermediate language into a syntactically and semantically correct SQL query.

The intermediate language can represent complex SQL queries while at the same time being easy to understand. The intermediate language is also designed to be easily converted into SQL queries. In addition to the query assistant and the SQL generator, an administrative facility is provided which allows an administrator to add a conceptual layer to the underlying database making it easier for the user to query the database. This conceptual layer may contain alternate names for columns and tables, paths specifying standard and complex joins, definitions for virtual tables and columns, and limitations on user access.

27 Claims, 26 Drawing Sheets



OTHER PUBLICATIONS

- Wu et al, "KDA: A Knowledge-Based Database Assistant With Query Guiding Facility" 5 Oct. 1992, pp. 443-453, IEEE Transactions On Knowledge & Data Eng. V. 4 N. 5.
- Cha, "Kaleidoscope: A Cooperative Menu Guided Query Interface (SQL Version)," 1990, IEEE, Artificial Intelligence Applications.
- Whitaker and Bonnell "Functional Modelling Of Intelligent Systems Using A Blackboard Model" 1992, pp. 1 to 12, The Journal Of Knowledge Eng. V 5, N. 1.
- Winston, P., "Language Understanding," *Artificial Intelligence*, 9:291-334 (1984).
- Rich, E., "Natural Lanugage Interfaces," *Computer*, pp. 39-47 (Sep. 1984).
- Manferdelli, J. L., "Natural Language Interfaces: Benefits, Requirements, State of the Art and Applications," *AI East*, Oct. 1987.
- Schank, R. C., et al, "Inside Computer Understanding: Five Programs Plus Miniatures," 14:354-372, LEA, Publishers, Hillsdale, NJ (1981).
- Hendrix, G., "The Lifer Manual: A Guide to Building Practical Natural Language Interfaces" (Technical Note 138); SRI International, Feb. 1977.
- Hendrix, G., "Human Engineering for Applied Natural Language Processing" (Technical Note 139); SRI International, SRI Project 740D32 CTC, Feb 1977.
- Kao, M., et al, "Providing Quality Responses with Natural Language Interfaces: The Null Value Problem," *IEEE* 14:7, 959-984, Jul., 1988.
- Chapter 6, "Queries," *Building Access Z Applications*, 1995.
- Chapter 8, "Using Query by Example," *Using Access 2 for Windows*, Sp. Ed.
- Chapter 9, "Querying Your Data," *Inside Paradox 5 for Windows*, 1994.
- Cinque, L., et al, "An Expert Visual Query System," *J. Vis. Lang. and Comp.*, 2:101-113 (1991).
- Meng, W., et al. "A Theory of Translation From Relational Queries to Hierarchial Queries," *IEEE Transactions on Knowledge and Data Engineering*, 7:2, 228-245, Apr. 1995.
- Jakobson, G., et al, "CALIDA: A System for Integrated Retrieval from Multiple Heterogeneous Databases," Proceedings of the 3rd Int'l Conf. on Data and Knowledge Bases: Improving Usability and Responsiveness, Jun. 28-30, Jerusalem, Israel.

| CUSTOMERS | | | | | | | |
|-----------------|---------------------------|--------------|-------|--------------|------------------|------------------|---------|
| CUSTO- MER # | NAME | CITY | STATE | ZIP_ CODE | SALES PERSON# | CREDIT_ LIMIT | BALANCE |
| 1 | American Butcher Block | New Haven | CT | 16516 | 1 | 65000 | 85000 |
| 2 | Barn Door Furniture | New York | NY | 11019 | 1 | 50000 | 75000 |
| 3 | Bond Dinettes | Boston | MA | 22827 | 1 | 50000 | 500 |
| 4 | Carroll Cut-Rate | Los Angeles | CA | 23019 | 2 | 50000 | 0 |
| 5 | Porch and Patio | SanFrancisco | CA | 24082 | 3 | 65000 | 0 |
| 6 | Railroad Salvage | Bridgeport | CT | 26444 | 4 | 30000 | 750 |
| 7 | Sheffield Showrooms | Brooklyn | NY | 12018 | 5 | 50000 | 12050 |
| 8 | Spector Furniture | New Bedford | MA | 22451 | 5 | 50000 | 100 |
| 9 | Vista Designs | Stamford | CT | 26565 | 5 | 30000 | 4300 |
| 10 | Milford Furniture | Milford | CT | 26460 | 5 | 50000 | 0 |

FIG. 1A

| PRODUCTS | | | | | | | |
|---------------|--------------------------------|--------------|-------------|--------------|-------|-------------|---------------------|
| PRO- DUCT# | NAME | GROUP_ ID | TYPE_ ID | ABC_ CODE | PRICE | VENDOR # | ALT_ VENDOR # |
| 1 | Executive Desk | 100 | 300 | A | 4995 | 1 | 2 |
| 2 | Colonial Bedroom Set | 100 | 600 | B | 3495 | 1 | |
| 3 | Children's Bedroom Set | 100 | 300 | C | 1195 | 2 | 3 |
| 4 | 5 Pc. Living Room Set | 100 | 500 | A | 4895 | 2 | 4 |
| 5 | Crib / Dresser Set | 100 | 400 | B | 985 | 3 | 3 |
| 6 | Bunk Bed | 100 | 400 | C | 795 | 3 | |
| 7 | 3 Pc. Dining Room Set | 100 | 500 | A | 3995 | 4 | |
| 8 | 4 Pc. Office Set | 200 | 300 | B | 2995 | 4 | 2 |
| 9 | Child's Desk | 100 | 400 | C | 899 | 5 | 1 |
| 10 | 4 Pc. Occasional Tables Set | 100 | 500 | B | 1299 | 5 | 1 |

FIG. 1B

| VENDORS | | |
|---------|-----------------------|--------------|
| VENDOR# | NAME | PHONE |
| 1 | Chapel Hill Furniture | 412-748-2929 |
| 2 | Barnet Furniture | 314-345-6789 |
| 3 | Basset Inc. | 218-324-9288 |
| 4 | Seal Corporation | 509-929-2222 |
| 5 | Juvenile Warehouse | 413-345-5656 |

FIG. 1C

| SALESPEOPLE | | |
|--------------|---------------|-------|
| SALESPERSON# | NAME | STATE |
| 1 | Paul Williams | NC |
| 2 | Bill Smith | KY |
| 3 | Wendy Jones | MA |
| 4 | Pam Johnson | CT |
| 5 | Sam Rogers | NY |

FIG. 1D

| CODES | |
|---------|------------------------|
| CODE_ID | CODE_TEXT |
| 100 | Home Furnishings |
| 200 | Office Furnishings |
| 300 | Desks |
| 400 | Juvenile Furnishings |
| 500 | Occasional Furnishings |

FIG. 1E

| ORDERS | | | | | | | |
|---------|-------------|-------------|----------------|------------------|-----------------|------------|--------|
| ORDER # | CUSTO -MER# | ORDER_ DATE | ORDER_ DOLLARS | FREIGHT_ DOLLARS | SALES- PERSON # | SHIP_ DATE | STATUS |
| 1000001 | 1 | 1992-1-5 | 36115 | 124 | 1 | 1992-1-15 | |
| 1000002 | 1 | 1992-4-5 | 7514 | 124 | 1 | 1992-10-24 | |
| 1000003 | 1 | 1992-7-5 | 39540 | 124 | 1 | 1992-7-15 | |
| 1000004 | 2 | 1992-2-15 | 47320 | 124 | 2 | 1992-2-24 | B |
| 1000005 | 2 | 1992-5-15 | 76195 | 124 | 2 | 1992-5-15 | B |
| 1000006 | 2 | 1992-8-15 | 6010 | 124 | 2 | 1992-9-15 | |
| 1000007 | 3 | 1992-3-25 | 3225 | 124 | 3 | 1992-3-27 | |
| 1000008 | 3 | 1992-6-25 | 12005 | 124 | 3 | 1992-7-2 | |
| 1000009 | 3 | 1992-9-25 | 36240 | 0 | 3 | 1992-10-15 | |
| 1000010 | 4 | 1992-2-5 | 8115 | 62 | 4 | 1992-2-15 | |
| 1000011 | 4 | 1992-5-15 | 20150 | 124 | 4 | 1992-5-24 | |
| 1000012 | 4 | 1992-8-25 | 25110 | 124 | 4 | 1992-8-29 | |
| 1000013 | 5 | 1992-3-4 | 72115 | 124 | 4 | 1992-3-22 | B |
| 1000014 | 5 | 1992-6-14 | 83550 | 124 | 4 | 1992-6-28 | |
| 1000015 | 5 | 1992-9-24 | 67015 | 124 | 4 | 1992-10-10 | |
| 1000016 | 6 | 1992-4-2 | 12105 | 124 | 1 | 1992-4-10 | |
| 1000017 | 6 | 1992-7-12 | 18105 | 124 | 1 | 1992-7-29 | |
| 1000018 | 6 | 1992-10-22 | 7350 | 124 | 1 | 1992-11-12 | |
| 1000019 | 6 | 1992-5-1 | 2660 | 124 | 1 | 1992-5-15 | |
| 1000020 | 6 | 1992-8-11 | 45250 | 124 | 1 | 1992-8-22 | |
| 1000021 | 7 | 1992-11-11 | 21500 | 124 | 2 | 1992-11-22 | |
| 1000022 | 7 | 1992-6-5 | 6150 | 62 | 2 | 1992-6-25 | |
| 1000023 | 7 | 1992-8-15 | 73595 | 124 | 2 | 1992-8-25 | |
| 1000024 | 9 | 1992-11-16 | 6100 | 124 | 3 | 1992-11-24 | |
| 1000025 | 9 | 1992-1-20 | 3250 | 124 | 3 | 1992-1-24 | |
| 1000026 | 9 | 1992-4-22 | 28190 | 124 | 3 | 1992-4-26 | |
| 1000027 | 9 | 1992-7-25 | 24250 | 124 | 3 | 1992-7-29 | |
| 1000028 | 10 | 1992-2-7 | 3620 | 124 | 5 | 1992-2-27 | B |
| 1000029 | 10 | 1992-5-17 | 107620 | 62 | 5 | 1992-5-26 | |

FIG. 1F

Explore Litigation Insights

Docket Alarm provides insights to develop a more informed litigation strategy and the peace of mind of knowing you're on top of things.

Real-Time Litigation Alerts



Keep your litigation team up-to-date with **real-time alerts** and advanced team management tools built for the enterprise, all while greatly reducing PACER spend.

Our comprehensive service means we can handle Federal, State, and Administrative courts across the country.

Advanced Docket Research



With over 230 million records, Docket Alarm's cloud-native docket research platform finds what other services can't. Coverage includes Federal, State, plus PTAB, TTAB, ITC and NLRB decisions, all in one place.

Identify arguments that have been successful in the past with full text, pinpoint searching. Link to case law cited within any court document via Fastcase.

Analytics At Your Fingertips



Learn what happened the last time a particular judge, opposing counsel or company faced cases similar to yours.

Advanced out-of-the-box PTAB and TTAB analytics are always at your fingertips.

API

Docket Alarm offers a powerful API (application programming interface) to developers that want to integrate case filings into their apps.

LAW FIRMS

Build custom dashboards for your attorneys and clients with live data direct from the court.

Automate many repetitive legal tasks like conflict checks, document management, and marketing.

FINANCIAL INSTITUTIONS

Litigation and bankruptcy checks for companies and debtors.

E-DISCOVERY AND LEGAL VENDORS

Sync your system to PACER to automate legal marketing.