

HIBROWSE for Hotels: Bridging the Gap Between User and System Views of a Database

G P Ellis, J E Finlay, A S Pollitt Centre for Database Access Research and Human Computer Interaction Research Centre, University of Huddersfield, UK

Abstract

Database theory and technology has traditionally been concerned with issues such as consistency and efficiency rather than usability. This has led to interaction styles which focus on the structure of the database, which is system-based, rather than the user's view of its content. Therefore the problem that needs to be addressed is that of bridging the gap between the user's model of the data and that of the system. The system presented here approaches this problem by presenting the user with a domain oriented view of the database. Access is then achieved by manipulating the contents of the database rather than the structure.

1 Introduction

Database theory and technology has traditionally been concerned with issues such as consistency and efficiency rather than usability. This is important, particularly with large databases, but has led to interaction styles which focus on the structure of the database rather than its content.

Unfortunately the ideal structure from an implementational and theoretical viewpoint may not reflect the user's view or model of the data, which is governed by knowledge of the domain rather than of the database itself. Such a mismatch between user and system models can lead to problems in accessing the data, since access methods demand an understanding of the database structure in addition to domain knowledge.

The increasing reliance on databases as tools for use in diverse applications by a range of users has led to a recognition of the need to facilitate database access. Approaches to this vary. Some recent database systems, both commercial (such as Microsoft Access™ and Quest™ from Gupta Europe) and research systems [1,2].

employ graphical user interface techniques which have the advantage of providing the user with cues to understanding the structure of the database and composing queries. While an improvement on command style query languages such systems do not address the underlying problem of the focus on the system rather than the user view.

Approaches such as Query-by-Example begin to address this issue. Here the user is presented with a view of the database structure and is able to specify "example" values for particular fields as a means of accessing the data (Figure 1).

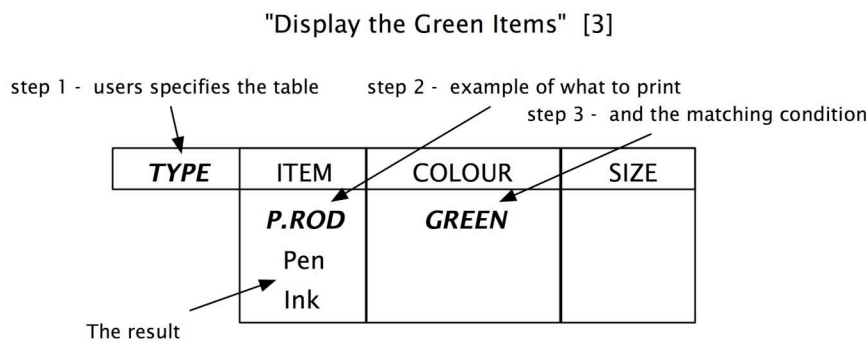


Figure 1: An example of Query-by-Example

This has proved to be successful for certain database applications but the approach still presents the user with the underlying structure of the database (which may not reflect the user's interests) and requires some understanding of this structure and of appropriate example values. This can be problematic if the user has insufficient knowledge of the database to select the necessary examples or tables or to evaluate the system's response.

In our view the problem that needs to be addressed is not simply that of making the interface more

accessible or even the structure more explicit but that of bridging the gap between the user's view of the data and that of the system. HIBROWSE, the system discussed here, approaches this by presenting a view of the database which reflects the interests of the user. Access is achieved by manipulating the displayed database contents not by queries based on the structure. This approach has several advantages for the user. Access does not require an understanding of the structure of the database, making it more intuitive. Consequently queries can be produced far more quickly than with conventional access techniques and, additionally, the user is able to browse the database contents.

HIBROWSE is designed with the principle of interface separation in mind: the application is distinct from the interface and the two are linked by a dialogue controller. This architecture has a number of advantages:

- it allows the presentation of an alternative view of the database while retaining the database application unchanged;
- it supports reusability and portability;
- it allows continued use of the existing application facilities in parallel to the new functionality provided through HIBROWSE

In the following sections we will explore the design and implementation of a prototype application of HIBROWSE, developed for the Hotel and Catering Research Centre at the University of Huddersfield, identifying issues associated with the interface, application database and dialogue control.

2 HIBROWSE for Hotels

HIBROWSE has its origins as Query-by-Menu, a system first described by Pollitt [4]. It was compared with Query-by-Example [5], and shown to be less complex for an end-user to employ in the specification of a search. The approach has been further developed and applied through a number of database applications, such as INSPEC [6] and the Hotels application considered here.

2.1 The Motivation

The Hotel and Catering Research Centre (HCRC) is based in the Department of Food, Nutrition and Hospitality Management and amongst other activities maintains a comprehensive database of up-to-date information on UK hotels and hotel companies. This includes details on over 3400 hotels which are owned by hotel groups or are members of one or more hotel consortia. A summary of the structure of the database is given in Figures 2 and 3. The HCRC publishes a paper directory, the UK Hotels Groups Directory, and also offers a consultancy service to companies with interests in the hotel industry. Clients are typically interested in receiving information on those hotels, groups or consortia which meet certain criteria (for example, 3 star AA rating and above with 200 or more bedrooms in North England and Scotland) or for information on a particular company which includes hotel details and summaries of the data by geographic region, star rating and number of bedrooms.

Prior to using HIBROWSE, the Hotels database was queried using SQL, a structured command language. This requires a knowledge of the database tables and associated fields in addition to experience of formulating queries obeying the SQL syntax. This placed an unnecessary burden on the staff, and although they usually managed to answer a client's request for specific information, the average time taken to undertake each request was half a day. Therefore the staff did not have sufficient time to process all the consultancy requests they received and it was actually considered uneconomic, in terms of the time taken, to process these requests using the existing system.

2.2 Requirements for HIBROWSE for Hotels

In addition to the primary requirement of supporting the consultancy task described above, other requirements were identified in consultation with the staff in the HCRC. One of these was for the research staff to be able to browse through the data to identify trends and statistical information. For example, an analysis of the hotel consortia based on the number of bedrooms. Another was to cater for the wide range of document and file formats requested by the clients. These include the ability to produce files for export to the client's own database, comprehensive sort and selection options and the production of cross reference data. Not only were these requirements difficult to meet using SQL but most of them required some form of post processing on the data.

2.3 The Database

The Hotels relational database is held on an ORACLE DBMS running on a Sun 670 server and is accessed over the University's campus network. The main structure and tables of the database are illustrated in Figures 2 and 3.

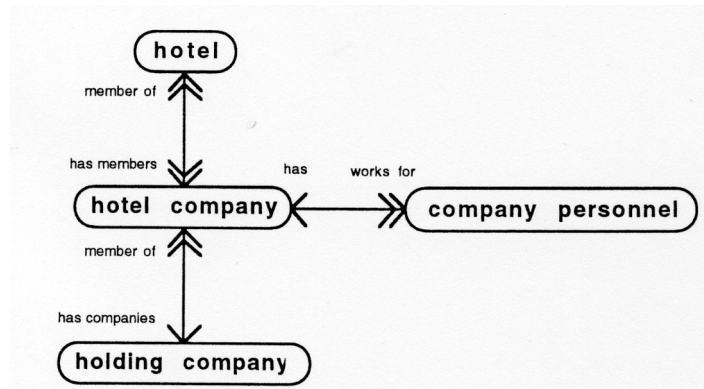


Figure 2: Entity-Relationship diagram for the Hotels database

hotel (hotel_code, name, street, city, county, country, tourist_board_area, postcode, phone, telex, fax, aa_rating, rac_rating, rooms, hotel_type)

hotel_company (hotel_company_code, company_type, holding_company_no, name, street, city, county, country, postcode, phone, telex, fax)

holding_company (holding_company_code, name, street, city, county, country, postcode, phone, telex, fax)

membership (hotel_company_code, hotel_code)

company_personnel (hotel_company_code, name, position)

Figure 3: The main tables in the Hotels database

2.4 A Typical SQL Query on the Hotels Database

As part of their consultancy, the HCRC may have a request from a client for information on hotels and the companies with interests in these hotels meeting the following criteria: "3 star AA rating and above with 200 or more bedrooms in North England and Scotland"

A) To retrieve the information on the hotels the following SQL query would be required:

```
select name, city, rooms, aa_rating
from hotel
where aa_rating in ('3','4','5')
and rooms >= 200
and tourist board area in
('BOR','CEN','DUG','FI','GRA','HI','LOT','STR','TAY','NOR','CUM','IOM','NWE','YH')
sort by name
```

B) To retrieve a summary of information on the hotel companies with interests in those hotels the following SQL query would be required:

```
select hotel_company.name, count(*) hotel, sum(hotel.rooms) rooms from hotel_company,
membership, hotel
where hotel_aa_rating in ('3','4','5')
and hotel.rooms >= 200
and hotel.tourist board area in
('BOR','CEN','DUG','FI','GRA','HI','LOT','STR','TAY','NOR','CUM','IOM','NWE','YH')
and company_type = 'C'
and hotel_company.hotel_company_code = membership.hotel_company_code
and hotel.hotel_code = membership.hotel_code
group by hotel_company.name
sort by hotel_company.name
```

It can be seen that even with this is a relatively simple query the researcher needs a good knowledge of the structure of the database (e.g. the appropriate field and table names), the various coding scheme used in the database (e.g. the tourist board area codes) and a good knowledge of formulating an SQL query (e.g. the 'group' command used in example B for producing summary information).

Bearing in mind that the data retrieved by these query statements also requires editing on a word processor into the appropriate form for the client (this often took a significant time in the HCRC), the total effort required is considerable, even for this simple example.

The screenshot shows the HIBROWSE for HOTELS interface with the following data in its summary windows:

hotels			
name	city	rooms	rating
22 Jermyn Street	London	18	U
Abbey Court	London	22	U
Abbey Grange Hotel	Llangollen	8	U
Abbey Hotel	Great Malvern - Mal...	106	3
Abbey Hotel (SALE)	Wymondham	26	2
Abbey House Hotel	Reading	22	U
Abbey Lodge Hotel	London	20	U
Abbey Park Resort Hotel	York	85	U
Abbeylea Hotel	Chesterfield	11	1
Abbot's Leigh	Filey	5	U
Abbotts Lodge Motor Inn	Seaford	70	U
Abbotts Fireside Hotel	Elham - Canterbury	5	U
3451		207927	

Tourist board areas	
hotels	name
3451	UK
33	Channel Islands
811	Midlands
638	North England
10	Northern Ireland
531	Scotland
1207	South England
220	Wales

all companies		
name	hotels	rooms
ABBEY GROUP	4	113
ABBOTTS HOTELS LTD.	4	81
ALLORA HOTELS IN SCOTLAND	11	165
ALPHOUTH HOTELS	2	40
ABBEYLEA CASTLE & INN ON THE ...	2	34
ANSSELLS HOTELS	10	349
APOLLO HOTELS	3	107
AQUARIUS HOTELS	4	268
ARISTEL HOTELS	7	422
ARISTO HOTELS	3	73
252		3929

rooms	
range	hotels
>1000	1
500-999	19
200-499	133
100-199	432
50-99	698
30-49	671
20-29	418
10-19	638
4-9	441

AA star rating	
rating	hotels
5 star	24
4 star	200
3 star	983
2 star	505
1 star	50
lodge	136
accom. only	0
unclassified	1553

Figure 4: HIBROWSE for Hotels top level

2.5 The HIBROWSE Interface

Figure 4 shows the top level screen of the HIBROWSE interface for the HCRC Hotels database. The main characteristics of HIBROWSE are that it presents a view of the contents of the database to the user and allows the user to search and browse the database by selection of the contents. The presentation of this information is achieved using a number of windows, each one presenting either

- raw data, as in the hotels window which shows the name, city, number of bedrooms and star rating values for each hotel
- summary information, as the AA star rating, rooms and tourist board areas windows
- related data, as in the companies window which shows those hotel companies which have interests in the hotels.

The summary information windows in HIBROWSE for Hotels present data from the database in different ways. The AA star rating window, shows a straightforward count of the number of hotels with each rating. The rooms window shows a count of the number of hotels within prescribed room ranges, aggregating the values in the database. The tourist board areas window presents the data based on the geographical location in the UK. This is a hierarchical view; at the top UK level it gives the number of hotels in each of the large regions such as South England, but allows the user to browse down to a lower level to get more information on the number of hotels in the actual tourist board areas (Figure 5). This presentation method is based on the MenUSE interface being developed at CeDAR [7].

It is clear from the top level screen (Figure 4) that a significant amount of information is presented to the user, without the user even asking a question of the system. For example, there is only 1 hotel with 1000 or more rooms; according to the AA star rating scheme there are 136 lodges and 24 5 star hotels; there are only 10 hotels in Northern Ireland which belong to hotel groups or consortia; and there is a hotel called "22 Jermyn Street" in London.

Additional functionality is provided by allowing the user to customise, where appropriate, the windows in order to alter the way the data is presented. For example, if the user is interested in seeing the largest hotels, according to number of bedrooms, then the user selects rooms in the hotels window and the data is sorted by rooms as shown in Figure 5. (The user could easily change the sort direction to ascending if the area of interest was in the smallest hotels). Similarly, Figure 5 shows the companies window sorted by number of hotels in the consortia, with a secondary sort on the total number of rooms (as indicated by the value 2 next to the sort direction indicator triangle). Figure 5 also shows that the summary information on star rating has been changed to RAC instead of AA. This illustrates another feature of HIBROWSE which, where appropriate, gives the user the additional flexibility of changing the view of the data.

The screenshot shows the HIBROWSE for HOTELS interface with several data tables and filters:

hotels			
name	city	rooms	rating
Royal National Hotel	London	1271	U
Forum Hotel London	London	910	3
Regent Palace Hotel	London	887	2
Cumberland Hotel	London	878	4
Copthorne Tara London	London	831	4
Excelsior Hotel	West Drayton	823	4
Tower Thistle	London	808	4
Birmingham Metropole Hotel	Birmingham	802	4
Strand Palace Hotel	London	770	3
London Metropole Hotel	London	742	U
Mount Royal Hotel	London	701	3
Novotel London Hammersmith	London	640	U
3451		207927	

tourist board areas	
hotels	name
1207	South England
270	London
269	South East
315	Southern
353	West Country

all companies		
name	hotels	rooms
CRESCENT LODGE HOTELS	2	36
THOMPSON HOTELS	2	35
AMBERLEY CASTLE & INN ON THE ...	2	34
HORLAND HOTELS	2	26
HART HABLETON HOTELS	2	23
FIRORA (KINGS CROSS) LTD.	3	909
HWATT HOTELS & RESORTS	3	623
HUIRSOLD	3	438
STARACRON HOTELS	3	320
FJB HOTELS	3	299
252	3929	

rooms	
range	hotels
>1000	1
500-999	19
200-499	133
100-199	432
50-99	698
30-49	671
20-29	418
10-19	638
4-9	441

RAC star rating	
rating	hotels
5 star	28
4 star	294
3 star	995
2 star	466
1 star	25
lodge	70
accom. only	0
unclassified	1573

Figure 5: HIBROWSE for Hotels top level showing different sort criteria and also browsing the tourist board area window to show the South of England regions

2.6 Querying the Database

The previous section described the HIBROWSE interface and how the user can customise their view of the data. This section illustrates how the user queries the database in HIBROWSE and can be compared to the SQL query given earlier to retrieve those hotels matching particular criteria i.e. "3 star AA rating and above with 200 or more bedrooms in North England and Scotland"

The user highlights the required star. ratings and room ranges and selects North England and Scotland regions (Figure 6).

The screenshot shows the HIBROWSE for HOTELS interface with search results and filters:

hotels			
name	city	rooms	rating
22 Jernyn Street	London	18	U
Abbey Court	London	22	U
Abbey Grange Hotel	Llangollen	8	U
Abbey Hotel	Great Malvern - Mal...	106	3
Abbey Hotel (SALE)	Hydonham	26	2
Abbey House Hotel	Reading	22	U
Abbey Lodge Hotel	London	20	U
Abbey Park Resort Hotel	York	85	U
Abbeylea Hotel	Chesterfield	11	1
Abbot's Leigh	Filey	5	U
Abbots Lodge Motor Inn	Seaford	70	U
Abbot's Fireside Hotel	Elham - Canterbury	5	U
3451		207927	

tourist board areas	
hotels	name
3451	UK
33	Channel islands
811	Midlands
638	North England
10	Northern Ireland
531	Scotland
1207	South England
220	Wales

all companies		
name	hotels	rooms
ABBEY GROUP	4	113
ADAM'S HOTELS LTD.	4	81
ALLORA HOTELS IN SCOTLAND	11	185
ALYMOUTH HOTELS	2	40
AMBERLEY CASTLE & INN ON THE ...	2	34
AMSELLS HOTELS	10	349
APOLLO HOTELS	3	107
AQUARIUS HOTELS	4	268
ARISTEL HOTELS	7	422
ARISTO HOTELS	3	73
252	3929	

rooms	
range	hotels
>1000	1
500-999	19
200-499	133
100-199	432
50-99	698
30-49	671
20-29	418
10-19	638
4-9	441

AA star rating	
rating	hotels
5 star	24
4 star	200
3 star	983
2 star	505
1 star	50
lodge	136
accom. only	0
unclassified	1553

Figure 6: HIBROWSE for Hotels - top level with selections

No search takes place until the down arrow is selected and a new HIBROWSE screen is presented, giving the user the view of the database matching the chosen criteria (Figure 7).

HIBROWSE for HOTELS			
hotels			
name	city	rooms	rating
Atlantic Tower Hotel	Liverpool	226	4
Caladonian Hotel	Edinburgh	239	5
Carlton Highland Hotel	Edinburgh	200	4
Central Hotel	Glasgow	221	3
Forte Crest Glasgow	Glasgow	251	4
Forte Posthouse Edinburgh	Edinburgh	200	3
Glasgow Marriott	Glasgow	298	4
Gleneagles Hotel	Ruchterarder	236	5
Holiday Inn Croome Plaza Manc...	Manchester	303	4
Hospitality Inn	Glasgow	307	4
Liverpool Moat House	Liverpool	251	4
Moat House International	Glasgow	300	4
17		4135	
tourist board areas			
hotels	name		
17 >	UK		
0	Channel Islands		
0	Midlands		
6 *	North England		
0	Northern Ireland		
11 *	Scotland		
0	South England		
0	Wales		
all companies			
name	hotels	rooms	
FLAG INTERNATIONAL HOTELS	1	221	
FORTE HOTELS	2	451	
FRIENDLY HOTELS	1	221	
HOLIDAY INN WORLDWIDE	1	303	
ILA - CHATEAUX & HOTELS	1	239	
LEADING HOTELS OF THE WORLD	2	475	
MOUNT CHARLOTTE THISTLE HOTELS	4	959	
QUEENS MOAT HOUSES HOTELS	4	1004	
RAAFORD INTERNATIONAL HOTELS &...	1	204	
SCOTT'S HOTELS LTD.	1	298	
12	20		
rooms			
range	hotels		
>1000	0		
500-999	0		
200-499	17		
AA star rating			
rating	hotels		
5 star	2		
4 star	12		
3 star	3		

Figure 7: HIBROWSE for Hotels for 3 star AA rating and above with 200 or more bedrooms in North England and Scotland

All the windows are automatically updated to reflect this and the user is free to scroll through the lists of hotels and companies as well as sorting the order of the data as required.

With a minimum of effort on behalf of the user, both of the example queries have been answered. In addition a large amount of 'extra' information has been presented. For example, of the 17 hotels only 2 have a 5 star rating, 6 are in North England and there are no hotels with 500 or more bedrooms. To see the consortia to which the hotels belong, the companies window can be easily changed (Figure 8).

HIBROWSE for HOTELS			
hotels			
name	city	rooms	rating
Atlantic Tower Hotel	Liverpool	226	4
Caladonian Hotel	Edinburgh	239	5
Carlton Highland Hotel	Edinburgh	200	4
Central Hotel	Glasgow	221	3
Forte Crest Glasgow	Glasgow	251	4
Forte Posthouse Edinburgh	Edinburgh	200	3
Glasgow Marriott	Glasgow	298	4
Gleneagles Hotel	Ruchterarder	236	5
Holiday Inn Croome Plaza Manc...	Manchester	303	4
Hospitality Inn	Glasgow	307	4
Liverpool Moat House	Liverpool	251	4
Moat House International	Glasgow	300	4
17		4135	
tourist board areas			
hotels	name		
17 >	UK		
0	Channel Islands		
0	Midlands		
6 *	North England		
0	Northern Ireland		
11 *	Scotland		
0	South England		
0	Wales		
consortia			
name	hotels	rooms	
FLAG INTERNATIONAL HOTELS	1	221	
ILA - CHATEAUX & HOTELS	1	239	
LEADING HOTELS OF THE WORLD	2	475	
3	4		
rooms			
range	hotels		
>1000	0		
500-999	0		
200-499	17		
AA star rating			
rating	hotels		
5 star	2		
4 star	12		
3 star	3		

Figure 8: HIBROWSE for Hotels for 3 star AA rating and above with 200 or more bedrooms in North England and Scotland, showing information on the consortia with members in this range.

2.7 Browsing the Database

In the previous example the user was seeking specific information. HIBROWSE also permits the user to browse the database, gradually refining the query. At each stage the user is presented with an updated view of the database which both provides an intermediate result and serves as the source for selections at the next stage. This supports the principle of equal opportunity [8] to the extent that the distinction between input and output is blurred. Instead of being forced to cycle between request and result, the user can browse the contents of the database viewing any item as input or output.

This is best illustrated through a worked example. Our client is interested in hotels in Cumbria. The user selects North England from the region window and selects the 89 hotels shown to be in Cumbria (Figure 9).

HIBROWSE for HOTELS			
hotels			
name	city	rooms	rating
Royal National Hotel	London	1271	U
Forum Hotel London	London	910	3
Regent Palace Hotel	London	887	2
Cumberland Hotel	London	878	4
Capthorne Tara London	London	831	4
Excelsior Hotel	West Drayton	823	4
Tower Thistle	London	808	4
Birmingham Metropole Hotel	Birmingham	802	4
Strand Palace Hotel	London	770	3
London Metropole Hotel	London	742	U
Houmt Royal Hotel	London	701	3
Novotel London Hammersmith	London	640	U
3451		207927	
tourist board areas			
hotels	name		
638	> North England		
89	* Cumbria		
7	Isle of Man		
208	North West		
111	Northumbria		
223	Yorkshire & Humberside		
all companies			
name	hotels	rooms	
MANSFIELD BREWERY HOTELS	1	15	
ALMOUTH HOTELS	2	40	
AMBERLEY CASTLE & INN ON THE ...	2	34	
BARTON GRANGE GROUP	2	114	
ATLAS GROUP OF HOTELS	2	180	
BEALE'S HOTELS	2	70	
BONNINGTON HOTELS	2	249	
BUDGOTEL	2	163	
BROWNS HOTELS & LEISURE INTER...	2	71	
BURY ST. EDMUNDS HOTEL COMPANY	2	62	
252		3929	
rooms			
range	hotels		
>1000	1		
500-999	19		
200-499	133		
100-199	432		
50-99	698		
30-49	671		
20-29	418		
10-19	638		
4-9	441		
RAC star rating			
rating	hotels		
5 star	28		
4 star	294		
3 star	995		
2 star	466		
1 star	25		
lodge	70		
accom. only	0		
unclassified	1573		

Figure 9: HIBROWSE for Hotels top level with Cumbria selected

The resulting HIBROWSE screen is shown in Figure 10. The user has sorted the hotels by city and observes that there are three in Ambleside.

HIBROWSE for HOTELS			
hotels			
name	city	rooms	rating
Nent Hall Country House Hotel	Rilston	17	2
Waterhead Hotel	Ambleside	27	3
Salutation Hotel	Ambleside	29	3
Kent House	Ambleside	5	U
Turton Arms	Appleyby-in-Westmorl...	19	3
Appleyby Manor Country House	Appleyby-in-Westmorl...	30	3
Royal Oak Inn	Appleyby-in-Westmorl...	7	2
Castle Inn Hotel	Bassenthwaite - Kes...	36	3
Pheasant Inn	Bassenthwaite Lake ...	20	U
Ellenbank Hotel	Birkby - Maryport	26	2
Old England Hotel	Bowness-on-Winderma...	77	4
Beisfield Hotel	Bowness-on-Winderma...	64	3
89		3157	
tourist board areas			
hotels	name		
89	> North England		
89	* Cumbria		
0	Isle of Man		
0	North West		
0	Northumbria		
0	Yorkshire & Humberside		
all companies			
name	hotels	rooms	
COAST & COUNTRY HOTELS	1	75	
FEATHERS HOTEL GROUP	1	20	
FORTE TRAVELODGE	1	31	
GRANADA LODGES	1	39	
MACDONALD HOTELS	1	54	
NORTH BRITISH TRUST HOTELS	1	83	
PREMIER HOUSE	1	30	
REGAL HOTEL GROUP	1	96	
PRIDE OF BRITAIN HOTELS	1	14	
WYVAFABER INNS LTD.	1	15	
31		97	
rooms			
range	hotels		
>1000	0		
500-999	0		
200-499	0		
100-199	1		
50-99	21		
30-49	20		
20-29	10		
10-19	21		
4-9	16		
RAC star rating			
rating	hotels		
5 star	0		
4 star	3		
3 star	33		
2 star	13		
1 star	2		
lodge	1		
accom. only	0		
unclassified	37		

Figure 10: HIBROWSE for Hotels showing information on the hotels in the Cumbria tourist board area

Selecting one of these, the Waterhead Hotel, the user is presented with further information (Figure 11). It can be seen that this hotel is a member of ENGLISH LAKES HOTELS. To see what other hotels are in this company, the user simply highlights this from the list shown in the companies window and selects the down arrow to activate the search. The new HIBROWSE screen (Figure 12) shows the four hotels associated with the company. Note that three of these hotels are also members of BEST WESTERN HOTELS.

HIBROWSE for HOTELS			
hotels		tourist board areas	
name	city	rooms	rating
1	Waterhead Hotel	17	2
address			
Lake Road			
Ambleside			
Cumbria			
LA22 0ER			
tel: 05394 32566 fax: 05394 31255			
member of		ENGLISH LAKES HOTELS	
		BEST WESTERN HOTELS	
all companies		rooms	
name	hotels	rooms	
1	ASSOCIATION OF LOGIS OF GREAT...	13	220
	BEST WESTERN HOTELS	8	327
	CORST & COUNTRY HOTELS	1	75
	CONSORT HOTELS	10	444
	ENGLISH LAKES HOTELS	4	191
	EXECHOTELS & INNS	4	70
	FEATHERS HOTEL GROUP	1	20
	FORTE HOTELS	5	309
	FORTE TRAVEL LODGE	1	31
	GRANADA LODGES	1	39
	31	97	
		range	hotels
		>1000	0
		500-999	0
		200-499	0
		100-199	1
		50-99	21
		30-49	20
		20-29	10
		10-19	21
		4-9	16
		RAC star rating	
		rating	hotels
		5 star	0
		4 star	3
		3 star	33
		2 star	13
		1 star	2
		lodge	1
		accom. only	0
		unclassified	37

Figure 11: HIBROWSE for Hotels showing additional information for the Waterhead Hotel in Ambleside

HIBROWSE for HOTELS			
hotels		tourist board areas	
name	city	rooms	rating
1	Waterhead Hotel	27	3
	Wild Boar Hotel	36	3
	Low Wood Hotel	99	3
	Royal Hotel	29	2
4		191	
all companies		rooms	
name	hotels	rooms	
1	BEST WESTERN HOTELS	3	162
	ENGLISH LAKES HOTELS	4	191
2		7	
		range	hotels
		>1000	0
		500-999	0
		200-499	0
		100-199	0
		50-99	1
		30-49	1
		20-29	2
		10-19	0
		4-9	0
		RAC star rating	
		rating	hotels
		5 star	0
		4 star	0
		3 star	3
		2 star	1
		1 star	0
		lodge	0
		accom. only	0
		unclassified	0

Figure 12: HIBROWSE for Hotels showing in Cumbria which are members of ENGLISH LAKES HOTELS

HIBROWSE for HOTELS			
hotels		tourist board areas	
name	city	rooms	rating
1	Angal & Royal Hotel	30	3
	Angal Hotel	29	2
	Rtholl Palace Hotel	84	3
	Avonmouth Hotel	41	3
	Bear Hotel	42	3
	Bear of Roaborough Hotel	47	3
	Bedford Hotel	31	3
	Bell Hotel	42	3
	Belsfield Hotel	64	3
	Berystede Hotel	91	4
	Beverley Arms Hotel	55	3
	Black Lion Harvester Hotel	11	U
248		26603	
groups		rooms	
name	hotels	rooms	
1	FORTE HOTELS	248	26603
1		248	
		range	hotels
		>1000	0
		500-999	6
		200-499	15
		100-199	71
		50-99	86
		30-49	38
		20-29	25
		10-19	6
		4-9	1
		RAC star rating	
		rating	hotels
		5 star	5
		4 star	44
		3 star	176
		2 star	12
		1 star	0
		lodge	0
		accom. only	0
		unclassified	11

Figure 13: HIBROWSE for Hotels showing information on the hotels belonging to the FORTE HOTELS group

A valuable feature of HIBROWSE for Hotels is the ease with which a summary of information on a particular hotel company can be produced. Figure 13 shows information on FORTE HOTELS. It can be immediately seen that the majority of FORTE HOTELS are of 3 star RAC rating and that most have between 50 and 200 rooms. It is also apparent that most of the hotels in North England are in the North West and Yorkshire & Humberside tourist board areas.

2.8 The Dialogue Control

All the information presented to the user is retrieved from the ORACLE database server and is independent of the client computer.

The application has been developed in HyperCard 2.1 on the Macintosh and uses ORACLE SQL *Net, ORACLE's HyperCard XCMD and MacTCP to access the Sun 670 database server over the University's campus network.

Database structure has not been altered to accommodate HIBROWSE. The only additional database table is a lookup table which gives the tourist board area codes, used in the original database, for the regions shown in the tourist board area window.

The functionality of HIBROWSE is achieved by generating and sending SQL type requests to ORACLE and parsing the data which is returned. For each new HIBROWSE screen, a database 'view' is created based on the current selections made by the user. Each window is then updated using this 'view' together with the current sort criteria for that particular window. This approach reduces the length of SQL queries which have to be sent to the DBMS.

2.9 The System in Practice

HIBROWSE for Hotels was developed with the cooperation of the HCRC. The system has been evaluated using an approach based on cooperative evaluation [9]. This has involved the users of the system "walking through" common tasks in HIBROWSE and "thinking aloud", describing their actions and their reactions to the new system. This led to the installation of the first version in March 1993 which has been used successfully since then with only minor modifications.

The main responses from the users can be summarised as follows:

- i. The learning time was very short even for users with no previous knowledge of the Hotels database.
- ii. The rapid response to consultancy requests was impressive. The substantial reduction in time even permitted the HCRC staff to respond immediately to requests over the telephone.
- iii. The ability to browse the database was found very useful for the research staff especially when preparing commentaries on hotel companies.
- iv. Users made far fewer errors than with SQL, where syntax errors were common. In HIBROWSE the user is protected from this type of error and any errors that occur in browsing are easily recovered from through altering the selections made and backtracking.
- v. Although not illustrated in this paper, the flexible document production options associated with HIBROWSE for Hotels, used together with the sort criteria for the hotel and companies windows, provided the HCRC with an expanded consultancy market, as they could produce computer files in many different formats suitable for importing to the clients' own databases.

3 The Future for HIBROWSE

Response from users in initial trials and the longer term use of HIBROWSE for Hotels suggests that this mode of database access does bring substantial gains both in productivity and user satisfaction. The view the users have of the database reflects their existing domain knowledge and allows them to manipulate data and perform searches in terms of the domain rather than in terms of the underlying database.

Various usability issues have yet to be resolved including:

- i. How the system should deal with the arrangement of windows, especially if there are too many to fit on the screen at one time.
- ii. The problem of presenting many-to-many relationships in that it has to be obvious to the user that the contents of one window reflects the selections made in another.
- iii. Direct access to a hotel by perhaps entering the first characters of its name. This also applies to regions when the user is not sure in which area of the UK it is located.

The use of separation as a paradigm for the design has been beneficial in a number of ways. It avoids the need to alter the underlying database application which means that existing databases can be provided with the functionality of HIBROWSE without modification. It also means that the approach is portable and can in theory be applied to any relational database. Other example HIBROWSE applications have been developed for various databases, for example INSPEC and EPOQUE (European Parliament Online Query System) to illustrate this principle [6]. Current work is concentrating on the development of a toolkit to support the rapid generation of HIBROWSE applications for relational databases.

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