WILLIAM H. MISCHO
Engineering Librarian
Beckman Institute Librarian
University of Illinois at Urbana-Champaign

MELVIN G. DeSART
Assistant Engineering Librarian
Assistant Professor of Library Administration
University of Illinois at Urbana-Champaign

An End User Search Service with Customized Interface Software

Libraries have provided online access to bibliographic databases via commercial vendors since the late 1960s. Until recently, the direct interaction with these systems has been almost the exclusive province of trained intermediaries. However, in the past several years library services offering end user or direct searching by patrons of bibliographic databases have grown dramatically. To a large extent, this increased activity has been technology-driven caused by the introduction and rapid growth of online catalogs, the continuing proliferation of online databases, the introduction of new online services, the increased availability of microcomputer workstations, and the development of optical information technologies. These rapidly evolving technologies have combined to make end user searching an attractive and viable service option for libraries.

One highly visible end user searching tool is the online catalog. Online catalog user studies have revealed, among other findings, that catalog users have the most difficulty with subject searching and place the highest priority for improvements on various subject search enhancements. In addition, users approach online catalogs expecting to find enhanced access to a broader range of materials—in particular periodicals—than the coverage provided in the traditional card catalog (Markey, 1983; Hildreth, 1985). While the online catalog use studies indicate an overwhelming acceptance by users and high user satisfaction, they have also been interpreted as a mandate for enhanced subject access (Markey, 1984).

The provision of enhanced online access to periodical information has received a great deal of attention. Brett Butler (1984) has noted: "We face a seamless, or undifferentiated, demand from our library patrons. That is, our users are likely to be indifferent to the form—book or periodical—in which the information they desire is packaged" (p. 1). The card catalogs of the late nineteenth century provided access to periodical articles via 3 inch by 5 inch cards supplied by vendors or prepared in-house. There is a renewed interest in shaping the modern online catalog into an "analytic" catalog capable of providing the same function (Potter, 1987).

Libraries are presently investigating three methods of providing enhanced online access to periodical information. These are: (1) mounting commercially produced bibliographic databases in local online systems, often using the same software employed in the online catalog; (2) making available fixed-cost searching utilizing optical disc (CD-ROM) databases; and (3) providing an end user searching service utilizing front-end search software and/or the less expensive after-hours commercial vendor systems. Many academic libraries are exploring all three options. There are economic, service, and retrieval advantages associated with each approach. Clearly, the most comprehensive access to the periodical and report literature is through the commercial database vendors with their broad "information supermarkets" and sophisticated retrieval software. This continues to be particularly true in the sciences which possess numerous large and complex databases which have not readily lent themselves to optical storage and retrieval technologies.

This article describes a project at the University of Illinois at Urbana-Champaign Library that has focused on the third option described earlier—i.e., providing enhanced access to the periodical literature through an end user searching service which utilizes the commercial database vendors. This demonstration project employs customized microcomputer interface software designed to facilitate the search process for end users. The service offers controlled end user searching as an option within an online catalog interface.

End User Searching Studies

A comprehensive review of studies and trends connected with end user searching of bibliographic databases can be found in the 1987 *Annual Review of Information Science and Technology* (Mischo & Lee, 1987). It is clear that a number of factors have contributed to the increased interest in end user searching services. These include:

—the continued exponential growth of information and the increasingly obvious value of online retrieval skills;

—the wide availability of online full-text databases (such as LEXIS) directed at professional users;

—heightened awareness by end users of database services because of articles in the popular and professional literature and promotional activities by vendors at professional conferences touting the value of online searching;

—the development of research and commercial front-end and gateway software packages to facilitate online searching by untrained users;

—the inauguration of nonpeak-time, less expensive, more user-friendly search systems by BRS, DIALOG, and STN;

—the proliferation of microcomputer workstations with telecommunication capabilities in the workplace and home settings;

—the emphasis on computer literacy in education, office automation, professional occupations, and recreational activities;

—the growing familiarity of library users with online catalogs and, by extension, with online bibliographic retrieval in general.

Experience with establishing search centers, training end users, and providing follow-up assistance to users has given the library community some insights into the process of end user searching. In summary, an analysis of end user searching activities and services reveals:

—Users are very enthusiastic about performing searches in easy-to-use, inexpensive systems but have difficulty in performing effective searches.

—Users have serious problems with Boolean logic and search strategy formulation.

—Users resist formal training sessions and printed instructions, preferring computer-assisted instruction (CAI) and direct one-to-one instruction from library staff and peers.

—The services are very staff-intensive for libraries and require additional library (reference) personnel to assist users with logon and machine procedures, database selection, and search strategy formulation and modification.

—Users have difficulty with the simpler interfaces provided for after-hours services.

—Searches performed with intermediaries still yield better retrieval results.

—Most end users of online bibliographic systems search infrequently and never progress beyond the naïve user stage.

These results appear to hold for online catalogs, remote database searching, and optical disc systems.

Library end user searching services have used two approaches in offering access to remote search services: (1) training users in command mode searching, and (2) making available software search aids as interfaces

to commercial systems. In this project, customized microcomputer inter-face software was developed to provide end user access to periodical cita-tion databases.

Project Description

This project focused on the design and development of a microcom-puter interface for searching remote bibliographic databases. The interface addresses the identified problems of end user searching in command mode and facilitates direct patron searching of periodical citation databases. The customized interface software permits searches of commercial vendor data-bases to be performed as a search option within the University of Illinois Online Catalog. From a public online catalog terminal (microcomputer), library users are provided with effective access to the periodical literature and a mechanism to link their search results with local holdings and availability information.

The University of Illinois at Urbana-Champaign Online Catalog is comprised of the LCS (developed at Ohio State University) short-record circulation system and a full bibliographic record search capability using the WLN (Western Library Network) search software. The online catalog is accessed via a microcomputer interface. Because the online catalog uses microcomputers as terminals, the capability exists to develop front-end and gateway software to access other off-site bibliographic data, including periodical citations available on the commercial database vendors. This project has been supported by an IBM equipment grant to the University of Illinois and a complementary grant from the Council on Library Resources.

This project was designed to investigate four areas of development: (1) interface design features that will expedite subject retrieval in biblio-graphic database systems; (2) enhanced subject access to periodical litera-ture within an online catalog environment; (3) the automatic linking of retrieved database search references with online catalog holdings and availability information; and (4) the policy and service issues associated with enhanced subject access techniques. These remain important issues in bibliographic control.

This interface to remote bibliographic databases is designed to support fairly straightforward searches. More complex searches requiring the use of the full set of vendor software features or comprehensive searches still must depend on the assistance of a human intermediary. The system is designed to address the identified problems end users experience with database search strategy formulation and Boolean operators and to provide more effective searches within the constraints of online costs and staffing

demands. The software utilized here controls the search process, minimizing connect time and controlling printing, resulting in essentially fixed-cost or upper-limit costing on the searching service.

While this project focuses primarily on an interface design for a commercial vendor system, the techniques identified and tested in this project are applicable to other online bibliographic searching environments, including online catalogs and optical disc systems. As Borgman (1986) has pointed out, users of both bibliographic retrieval systems and online catalogs exhibit similar behavior patterns and have the same types of mechanical and conceptual difficulties. In a situation where the two types of systems are linked, and, indeed, as the two types of systems evolve and become more similar, it is incumbent on the interface to assist nonlibrarian searchers in learning both the structure of the database organizaion and the mechanics of the systems.

Description of the Interface

There is evidence that software interfaces built around expert system techniques can facilitate database searching by untrained users (Marcus & Reintjes, 1981; Belkin et al., 1987). The interface design utilized in this project is based on an approach suggested by Marcus (1982). It also incorporates elements of other front-end packages.

The present demonstration system was tested in spring 1987 and has been offered to library users at selected departmental library sites under the rubric of the Self-Service Database Service (SSDS) since June 1987. The service utilizes the BRS/After Dark and regular BRS systems. An evaluation is ongoing.

The initial design criteria for the project interface called for a simplified menu-driven interface utilizing off line storage of search strategy, automatic logon procedures, and software-controlled navigated searching techniques. Following the practice of some other gateway or front-end software (e.g., OASIS, EasyNet, Search Helper), this interface is designed to minimize online connect time and printing options. After reviewing other end user projects, it was determined that the interface needed to address identified areas of user difficulty, particularly in the construction of search strategy.

Early tests of the initial software design verified the problems identified in previous end user searching studies and challenged the implicit assumption that the after-hours database services were sufficiently simplified to allow end users to perform effective searches. It was clear that the interface must assist users in search strategy formulation and manipulation of search results while not requiring any direct user knowledge of Boolean logic.

The project has developed and tested methods of dynamically linking retrieved periodical citations with local holdings and availability information in the online catalog. The interface presently allows users, after completing a database search, to "switch" over to the online catalog to retrieve call numbers and holdings information. Software has been developed to modify and link the already existing online catalog interface with the end user database search interface at both the initial menu and at the conclusion of an online database search.

The present configuration allows the user the menu option of searching either the online catalog for known-item and monographic subject information or external databases for articles within periodicals (see options 1 and 2 of Figure 1). After completion of a database search, users are offered the option of modifying the strategy and repeating the search and/or accessing the online catalog for availability and holdings information.

After the selection of the database search option, the ensuing search session follows a series of steps. First, the user chooses the subject field of interest from a customized menu. Next, multiple-term facets or concept groups representing the user's search topic are constructed. The interface assists the user in this search strategy formulation through the use of online tutorials and suggestive prompts. The search strategy construction requires no knowledge of Boolean operators and no operators are explicitly presented. The search strategy is formulated offline with the user given opportunities to modify the strategy as it is constructed. Stopwords are screened and a table of "go-words" (allowing substitution of preferred terms or added terms for one already) entered can be constructed.

The software then automatically logs on to the system, accesses the database, and executes the prestored search strategy to determine citation postings for each concept group. The resultant concept postings sets are manipulated by the software using a combinatorial algorithm which broadens or narrows the search in an effort to obtain the optimum search results. Finally, a selected number of retrieved citations are downloaded, capture of the search history and automatic logoff takes place, and the downloaded citations undergo postprocessing and printing.

Sample Search for Periodical Citations

A series of screen displays are presented to illustrate a sample search session. While these static screen "snapshots" are unable to capture the interactive nature of a search session, they serve to illustrate the process carried on in a search. These figures do not convey the use of highlighting and screen contrast visible to the user.

UNIVERSITY OF ILLINOIS ENHANCED ONLINE CATALOG SEARCH OPTIONS:

1. SEARCH ONLINE CATALOG FOR ITEMS IN THE LIBRARY SYSTEM:
   Look for books, journals, theses, etc. by author, title, author/title, subject, call number.
2. SEARCH FOR CURRENT ARTICLES IN JOURNALS AND MAGAZINES:
   Self-service database search of an index (e.g. Engineering Index) to retrieve references to articles on a topic.

CHOOSE 1 or 2: 2

Figure 1

CHOOSE THE SUBJECT AREA YOU WISH TO FIND INFORMATION IN:

1. Electrical and Computer Engineering
2. Physics
3. Computer Science (research journals)
4. Computer Science (microcomputer and data processing journals)
5. Materials Science (Physics/EE)
6. Materials Science (Engineering)
7. Civil Engineering
8. Mechanical Engineering and Engineering Mechanics
9. Aerospace Engineering
10. Nuclear Engineering
11. Bioengineering (consider also Elec. Engr. for Bioacoustics)
12. Chemical Engineering (see also Chemistry for Chem Abstracts)
13. General Engineering
14. Chemistry (Chem Abstracts
15. Popular Magazines--Time, Newsweek, Aviation Week, Science, etc.

TYPE A NUMBER, THEN PRESS ENTER: 15

Figure 2

PLEASE READ THE NEXT TWO INSTRUCTION SCREENS
CAREFULLY

The most important part of a database search is putting together the search strategy. The search strategy consists of a series of words or phrases entered by the searcher to describe the search topic.

The search system used here will retrieve references using the terms in the search strategy. These terms will appear in article titles, descriptors or keywords, or abstracts (summarizes).

TYPICAL SEARCH TOPICS:
    1. Numerical techniques in fluid dynamics on supercomputers.
    2. Microcomputers used in CAD/CAM.

**Note that these search topics are phrased like an article title.

**The terms in the search can be grouped into separate concepts.
        In the first example above the 3 concept groups are:
1) numerical techniques; 2) fluid dynamics; 3) supercomputers.
    In the second example, there are 2 concept groups:
1) microcomputers; 2) CAD/CAM.

**A search will typically have from 1 to 3 separate concept groups.
        PRESS ANY KEY TO CONTINUE

Figure 3

Figure 1 shows the initial menu used in the interface. After selection of option 2 from the initial menu, the user is asked to select the subject area of interest from a menu such as the one shown in Figure 2. This menu is customized for each departmental library site. One advantage in utilizing the large commercial vendors is that over 200 databases in all subject areas are readily available and accessible via a single search language. The database is software selected from the user's choice.

Figures 3 and 4 constitute the basic instructional phase of the program. Here, users are asked to read information screens that are designed to assist them in search strategy formulation. The model strategies presented are tailored to each departmental library site.

In Figure 5 the user is asked to enter a title-like description of the search topic to help identify the search concept terms (in this example, end-user searching with microcomputers). The use of natural language topic descriptions can be found in other expert-based interfaces, including the OAK front-end software package (Meadow, 1986).

The next screen (see Figure 6) repeats the previously entered title and prompts the user for a term to describe the first or primary concept of the

In the first example search on the previous screen, there are three concept groups;

    1) Numerical techniques;
    2) Fluid dynamics;
    3) Supercomputers.

Other words or phrases may be synonyms or alternative phrases for each of the concepts. For example, for "numerical techniques", the terms "numerical methods" or "finite difference" could be added. For the concept "fluid dynamics", the searcher might also be interested in articles with the terms "fluid flow" or "supersonic flow".

Using additional terms within each concept, the search strategy can be expressed in the form:

CONCEPT 1	CONCEPT 2	CONCEPT 3
Numerical Techniques	Fluid Dynamics	Supercomputers
Numerical Methods	Fluid Flow	Cray
Finite Difference	Supersonic Flow	Cyber 205
Finite Element		
Numerical Solutions		

***The search will retrieve references that contain at least one term from EACH COLUMN or concept.

        PRESS ANY KEY TO CONTINUE

Figure 4

YOU WILL NOW BE ASKED TO ENTER THE CONCEPT TERMS FOR YOUR SEARCH.

The terms making up the separate concept groups will be used to find references to journal articles and reports.

**To help identify your concept terms, please begin by typing a one-sentence title of an imaginary (or real) article that would best meet your information needs.

This title will not be directly searched. Rather, it should help focus on a specific topic and help to identify concept terms.

    (TYPE ARTICLE TITLE BELOW, FOLLOWED BY ENTER KEY)
End-user searching with microcomputers

Figure 5

Your search title:
End-user searching with microcomputers.

You will be asked to enter the words in this title as separate search concepts.

You will be able to enter up to three concept groups.

Type below a term (word or phrase) describing concept 1 of your search request.

Type the word or phrase followed by the ENTER key.

Concept 1 should be the central or most important topic of your search.
 For a search title like 'Microcomputers used in CAD/CAM', concept 1
 would be entered as: CAD/CAM

If you need to use chemical formulas, check with a site attendant.
Concept 1 (word or phrase): end-users

Figure 6

search. Note that all of the data entry and search argument formulation is done offline. Because of the assumed primacy of the first concept group, the postings set from this concept will be included in all set combinations done later online. The software allows the substitution of preferred terms for user-entered terms. These "go-words" with the preferred forms are stored in a table. Vendor system stopwords are removed and the software contains an additional mechanism to add nonsystem stopwords to the list.

In Figure 7 the user is asked to enter any additional terms to express the concept. Note that the user is instructed to look at a specific thesaurus or subject heading list to provide additional controlled vocabulary terms.

Figure 8 summarizes the search strategy up to that point and allows the user to go back and re-enter the concept terms if they are deemed inappropriate or inaccurate. The software employs a truncation algorithm patterned after Porter's (1980). At this point, earlier versions of the interface presented the user with the entered concept terms in native command mode in the form they were to be sent to the vendor system. It was determined that the native mode commands and operators are not understood and very few users were modifying their searches in response. However, this element does prove useful to site attendants in judging the efficacy of the truncation routine.

At this point, the search history is displayed and the user is prompted for terms making up concept 2. In the same manner as mentioned earlier, users are then asked to enter additional terms for the concept group. After completing the entering of the final search concept group (maximum of

You should now enter any:
    --synonyms (dual phase steel, two phase steel),
    --alternate spellings (sulphur, sulfur),
    --abbreviations or full spellings (NMR, TEM),
    --related or alternative terms (titanium, aluminum, niobium)
  for concept 1: end-users.

You may wish to consult the red Subject Headings in Engineering or the
  green INSPEC Thesaurus of terms on the table next to you.

Enter both general terms ('heavy metals') and specific terms ('cadmium').
The program will supply both singular and plural forms of words.

To exit, edit, or go on to the next concept, press the ENTER key only.

Type below any additional terms for concept 1: end-users.
Enter one term (word or phrase) at each prompt--one per line.
Additional term for concept 1: patron searching
Additional term for concept 1:

Figure 7

For your title:
End-user searching with microcomputers
The terms making up concept 1 are:
end-users; patron searching

Look at the terms in this concept group. Check the spellings.
  You do not need to enter plurals.
These terms should relate to the same topic. Different topics need to be put in
  separate concept groups.
If you need to re-enter this concept group, type NO and press ENTER.

Press only the ENTER key to go on with the search.

Figure 8

The search strategy is displayed below.

Concept 1	Concept 2	Concept 3
end-users	online searching	microcomputers
patron searching	database searching	personal computers
	searching	IBM PC
		Macintosh
		PS/2

***This search will retrieve reference that contain at least one term from each concept group.

Please examine these search terms.
   If you wish to stop the search and begin entering the strategy again type NO and press ENTER.

   Press only the ENTER key to continue the search.

Figure 9

three), the user is presented with the screen shown in Figure 9. The strategy is displayed in tabular form and the user is given a final chance to modify the search before going online.

After making the telecommunications connection and logging on, the software presents some database information to the user and begins uploading the search strategy which was formulated offline (see Figure 10). As can be seen in the example presented, for a search of the National Agricultural Library database on "aflatoxin in corn storage" the terms comprising each concept group (combined in an OR relationship) are searched over all database records online and document postings are obtained. The next screen (Figure 11) repeats the concept group postings and begins combining the postings sets in an algorithmic manner to obtain the optimum search result. In this example, the three sets are combined in an AND operation, and, because the resulting postings (numbering 20) are below a threshold value, no more combinations are made. The final set is limited to English language items.

After downloading of the designated references and logging off, a printout (see Figures 12 and 13) is generated. The user-entered search title and concept terms are printed along with a sample record and the retrieved citations. The actual search arguments and command history from the session are also printed. The user is given information needed for modifying and repeating the search and is asked if local call number and location information is desired. If this is so indicated, the online catalog interface is

You will now be connected to the National Agricultural Library database.
 This database contains primarily references to journal articles, but may also
 include conference papers and reports.
 The database covers 1980 to the present.
 You will not need to type until the search results have been printed.
Each concept group will first be entered separately, then combined in differ-
 ent ways in order to yield the best search results.

Now searching search concept 1:
corn; wheat; rye

  The terms in concept 1 appear in 38849 references.

Now searching search concept 2:
aflatoxins; molds

  The terms in concept 2 appear in 3908 references.

Now searching search concept 3:
storage; silos

  The terms in concept 3 appear in 11996 references.

Figure 10

The terms in concept 1 appear in 38849 references.
The terms in concept 2 appear in 3908 references.
The terms in concept 3 appear in 11996 references.
  Now determining the number of English language articles.

The retrieved references from each concept group will now be compared to
 determine which of the references have terms from all concept groups.

Now searching for articles that have at least one term from each concept
 appearing somewhere in the title, descriptors, or abstract.

There are 20 references that contain terms common to all concepts.

The most recent (up to 20) of these references will be first transferred to floppy
disk and then printed.

Figure 11

loaded which contains the option of escaping to perform a search for journal articles.

Preliminary Evaluation

The evaluation component of this project utilizes a site monitor form and a user questionnaire. In addition, transaction logs are obtained of the user input strings, the manipulated search command arguments (with truncation and operations), the search history including the navigated search protocols, and the resulting downloaded citations.

A preliminary analysis of the data gathered from nearly 400 patron searches reveals: (1) the system is regarded very favorably by users and rated as easy to use; (2) the system is regarded as better than (or complementary to) searching printed indexes for information; (3) over 50 percent of the retrieved citations are, in the majority of cases, rated as relevant; (4) users have trouble locating call number information and want call numbers and holdings included with periodical citations; and (5) users have overwhelmingly indicated a desire to see the self-service system continued as a regular library service, but at a minimal cost to users. The early results of the study indicate a very positive user response and validate the approach taken by the interface. Several minor software changes have been instituted in response to the test questionnaires, while other changes will wait for later implementations.

Several insights have been gleaned from an analysis of the site monitor forms and transaction logs. These include: (1) users are often modifying their search strategies and repeating searches after examining the results of a previous search (an average of 1.8 searches are being performed at each session); (2) users do not understand set theoretic concepts and some fundamental principles of natural language information retrieval; (3) a fairly large percentage of users enter very specific search terms, requiring the system to do searches utilizing free-text searching capabilities over titles, descriptors, and abstracts; (4) terminology selection plays an important role in search success; and (5) students with specific and well-defined search topics tend to perform the most effective searches.

Analysis of the transaction logs has indicated that the use of several vendor software features in the construction of search strategies can optimize retrieval performance. For example, there is evidence to indicate that the use of a less restrictive WITH operator (to retrieve terms appearing in the same sentence regardless of word order) is preferred to the ADJ operator (which compels words to appear immediately adjacent to each other in the specified order). This allows retrieval, for example, of both "TCP/IP" and "IP/TCP" and also the phrase "construction industry accidents" when the

This is the printout from your online search of the National Agricultural Library database.

The title used to describe your search topic:
Problems of Aflatoxin in corn storage

Your search concepts and terms were:
Concept 1:
 corn; wheat; rye
Concept 2:
 aflatoxins; molds
Concept 3:
 storage; silos

Below is a sample printed reference to illustrate the format. Note the paragraph tags (AN, AU, TI, DE, ID, etc.) in the sample reference.

This database search will retrieve references (citations) to articles in periodicals (journals and magazines), conference papers and reports.

Below is a sample of a retrieved reference from the March 1987 IEEE Computer Journal.

AN (Accession number) From the printed index, used to find abstract.
AU (Author(s) names) Smith, John A.
TI (Article title) Finite Difference Techniques for Supercomputers.
SO (Source Journal) IEEE Computer Journal; volume 9, #, pp. 43-65, March, 1987.
YR (Year) 1987.
CT (Conference Title) International Conference on Numerical Analysis.
DE (Descriptors; Subject Headings) Finite-Difference-Methods. Software. Numerical-Techniques. Supercomputers.
ID (Identifiers or Keywords) Cray X-MP. Astrophysics Software. Fluid Dynamics. Finite Element Methods. Cedar Project.
AB (Abstract) Most citations include a short abstract or summary.

THIS SEARCH HAS RETRIEVED THE MOST RECENT REFERENCES ON YOUR SEARCH TOPIC.
A MAXIMUM OF THIRTY REFERENCES CAN BE PRINTED.
CONSULT THE LIBRARY STAFF FOR A MORE COMPREHENSIVE SEARCH.

***LOOK VERY CAREFULLY AT THE TERMS IN THE 'DE' AND 'ID' PARAGRAPHS.
 THESE TERMS CAN BE USED TO MAKE THE SEARCH MORE SPECIFIC OR MORE GENERAL.

***THIS SEARCH CAN BE DONE AGAIN WITH ADDED TERMS IN A CONCEPT GROUP OR WITH SOME TERMS OR EVEN ENTIRE CONCEPT GROUPS ELIMINATED.
***IF YOU HAVE ANY QUESTIONS ABOUT THE SEARCH RESULTS, PLEASE CONTACT A SITE ATTENDANT OR LIBRARY STAFF MEMBER.

Figure 12

```
          1
AN ACCESSION NUMBER: ADL87040053. 8707.
AU AUTHORS: Blaney-B-J.
TI TITLE: Mycotoxins in water-damaged and mouldy *wheat* from
    temporary bulk stores in Queensland.
SO SOURCE: Aust J Agric Res, Melbourne: Commonwealth Scientific and
    Industrial Research Organization, 1986. volume 37 issue 6, pages 561-565.
DE DESCRIPTORS: queensland. *wheat.* *bulk-storage.*
    temporary-buildings. aspergillus-flavus. *aflatoxins.* ochratoxin.
    sterigmatocystin. *molds.* damage.
-END OF DISPLAY REQUEST-

RETURNING TO SEARCH
ENTER SEARCH TERMS, COMMAND, OR H FOR HELP
SEARCH 7-->


Strategy used in online search.
                                                                    *

          CAIN              SCREEN        1 OF         1*
CAIN 1980 - JUL 1987
    1 (CORN OR MAIZE OR ZEA) OR WHEAT$1 OR RYE$1
      RESULT                                    38849
    2 AFLATOXIN$1 OR MOLD$1
      RESULT                                     3908
    3 STORAGE$1 OR SILO$1
      RESULT                                    11996
    4 EN.LG.
      RESULT                                   731814
    5 1 AND 2 AND 3
      RESULT                                       20
    6 5 AND 4
      RESULT                                       16
          **** END OF DISPLAY ****
PRESS ENTER TO CONTINUE OR ENTER COMMAND-->
```

Figure 13

user-entered search term is "construction accidents." It is quite clear that
the suffix stripping algorithm and truncation routine play an important
role in the retrieval process. The truncation algorithm employed in the
project appears to perform adequately. In addition, the software manipu-
lation techniques performed on concept postings sets (such as the elimina-
tion of a concept group in response to a null combination) are invoked
quite frequently.

Future Enhancements

Several needed modifications in the interface software have been suggested by the evaluation process. The capability of interactively modifying the search online using a user feedback mechanism is being developed. While this will result in increased online time and costs, it will save in print costs and reduce the number of search sessions in which multiple discrete searches are performed by a single user.

The adoption of a fixed cost pricing relationship with database vendors and producers needs to be investigated. Clearly, if this type of service could be budgeted on a reasonable fixed cost searching basis, it would remove some of the advantages associated with CD-ROM products.

The capability of performing author searches, in addition to subject searching, will be added. Also being explored is the implementation of several methods of automatically linking the citations from a database search with online catalog holdings and availability information.

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