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DESIGN CRITERIA FOR A PC-BASED

COMMON USER INTERFACE TO REMOTE

INFORMATION SYSTEMS

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ABSTRACT

A set of design criteria are presented which will allow the implementation of an interface to multiple remote information systems on a microcomputer. The focus of the design description is on providing the user with the functionality required to retrieve, store and manipulate data residing in remote information systems through the utilization of a standardized interface system. The intent is to spare the user from learning the details of retrieval from specific systems while retaining the full capabilities of each system. The system design includes multi-level capabilities to enhance usability by a wide range of users and utilizes microcomputer graphics capabilities where applicable. A data collection subsystem for evaluation purposes is also described.

KEYWORDS

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I. INTRODUCTION

The rapid expansion in the volume of information available through online information storage and retrieval systems and the increasing breadth of this information has created an expectation among many diverse groups of professionals that this information will be readily available to them. A parallel development has been the increasing awareness among these professionals of the advantages of conducting their own searches rather than receiving information extracted through an intermediary [Caruso, 81]. These two factors have created a demand for interactive user interfaces which are easy to use by non-programmers who, in general, will not access the system frequently enough to retain proficiency in its use. The standard interfaces provided by designers of online information systems are simply not adequate. Frequent problems are encountered by users attempting to merely

establish initial contact with the system [Penniman, 84; Cooper, 83] and the ability of infrequent users to extract complete information from these systems is very limited [Fenichel, 81].

II. THE CASUAL USER

The infrequent (casual) user classification represents over 70% of the population of users of information systems [Penniman, 84] and it is likely that many more users would like to access these systems directly but are inhibited by the necessity of learning query languages. Training programs designed to teach users the specifics of a query language for a given system are limited in their effectiveness. A user who learns a system language once and then uses that system infrequently is doomed to a cycle of relearning each time he accesses the system. This is a costly process both in wasted user time and in unproductive online system time and is instrumental in discouraging many professionals from conducting their own searches. This situation has resulted in the common use of information specialists as intermediaries in the search process. These specialists are proficient in the use of a particular system and usually conduct searches for a number of clients. They will therefore utilize the system frequently enough to acquire and maintain proficiency in its use. Several problems with this

approach are immediately apparent. Interposition of an extra person between the user and the information he desires is certain to result in some loss of clarity in the definition of the information to be extracted. Additional loss of efficiency can be expected as a result of the information specialist's lower level of expertise in the specific area of knowledge which is the subject of the search. The information specialist does not possess the knowledge required to make dynamic decisions during the search process which could refine the queries and result in extraction of a greater volume of relevant material. These types of dynamic modifications can only be made by the professionals themselves since they possess an intimate detailed knowledge of the subject matter. The basic situation then, can be described as one in which the skills necessary to extract optimum benefit from online information systems are not generally possessed by a single individual. The full potential of these systems for the dissemination of information is therefore not being realized and will not be realized until a better solution is available.

The effectiveness of online information storage and retrieval systems in supplying an information dissemination service is obviously dependent upon the ability of the interfaces of these systems to interact effectively with the end users of this information. It is important that the design of such an interface be based upon an understanding of the characteristics

of the user population. The class of users who would be the
primary beneficiaries of the fulfillment of the promise of the
information revolution will generally possess the following
characteristics which are relevant to their interaction with
information system interfaces:

1) No desire to attempt memorization of large amounts of
   information concerning command language syntax and
   utilization.

2) Very limited knowledge of computer programming.

3) Unfamiliarity with specifics of any system command
   language.

4) Uses system infrequently (less than once per week).

5) Unfamiliar with the structure of any information system.

6) Possesses extensive knowledge of a specific subject
   field.

7) Performance of job function does not _require_ use of the
   system.

8) Performance of job function could be significantly enhanced by immediate access to information concerning the latest developments in the field.

III. INTERFACE REQUIREMENTS

The class of individuals described above requires a number of characteristics in an information system interface in order to interact effectively with it. They need a system which allows them to move quickly into the process of information extraction without wasting time attempting to recall procedures from memory (and most likely spending expensive system resources with trial and error learning procedures) or reading manuals in order to relearn these procedures. The system must also allow these individuals to move as quickly as possible into a routine which allows them to extract the required information without unnecessary system prompting or other intervention. Finally, the system must ensure that these individuals are allowed to get the maximum advantage from their extensive knowledge of the subject area.

3.1 Problem Definition

It is necessary in the design of such an interface to walk a tightrope between the provision of ease of access and interaction and the retention of all system and user capabilities in order to

provide efficient interaction between the user and the information contained in the system. The desirability of ease of access will often be in conflict with the desirability of exploiting the full capabilities of the system. Providing ease of access by interposing a layer of software between the user and the system command language interface may prevent the user from becoming proficient in use of the system [Caruso, 81]. Conversely, providing the user with full access to system capabilities usually means requiring the user to learn the system command language and dealing with the associated problems.

These problems are compounded when the user requires access to multiple systems. The proliferation of information systems and the increasing breadth of the information contained therein ensures that multiple system access will become increasingly desirable in the future. The provision of a casual user interface by a single information system, no matter how well-designed, becomes an invalid solution as this situation evolves. It is also unreasonable to expect a wide spectrum of information systems to standardize on one interface any time in the near future. A more likely occurrence would be for the user to be faced with accessing a number of superficially similar interfaces. This may seem to be a minor problem at first glance but, in fact, the utilization of very similar interfaces is more likely to result in errors than the use of totally dissimilar interfaces. This

phenomenon is a by-product of the associative nature of human memory and the interference effects which are created in memory when attempting to recall semantically similar command sequences which perform similar, but not identical, functions [Card, 83]. The lack of standardization in these systems and the difficulties involved in learning multiple systems create seemingly insurmountable problems for the user and it is unlikely that a single user will be able to access multiple systems efficiently utilizing the interfaces provided by the systems themselves. Apparent standardization can be achieved if some capability is available to the user for interpretation of information system interface languages into some common format with which he is familiar. This is obviously possible only if the user possesses some sort of local processing capability.

3.2 Personalizing the Interface

The optimum position for an interface, then, seems to be as close as possible to the user (i.e., at the user's location). An interface thus situated can provide maximum flexibility for fulfilling the needs of the individual user and provide maximum potential for allowing the user to develop a sufficiently high level of expertise with his system. Some vendors of information system services have attempted to implement system-specific interface functions at the user location with specialized

terminals which allow the user to utilize function keys for frequently-used commands. This may be a useful solution for individual system access but is not a reasonable solution for multiple system access since a separate terminal may be required for access to each system. Some of the more sophisticated terminals may be used to access multiple systems whose interfaces will dynamically program the terminal function keys to facilitate user access. This may provide the user of such a terminal with the capability of efficiently accessing several systems but again standardization becomes a problem and it is unlikely that all systems a user would like to access will possess the capability of programming the function keys of his particular terminal. The basic requirement for a truly flexible interface is the capability of dynamic adjustment to the terminal/system communications configuration of any system to which the user desires access. It is also desirable for the interface to possess additional capabilities for the proccessing of information. Some such capabilities are available in the more intelligent terminals but they are somewhat limited and the addition of new capabilities as required by an individual user is generally not feasible.

The logical tool for the implementation of this interface is the personal computer. The rapidly decreasing cost/performance ratio of these machines has increased the feasability of their

use as interfaces to remote information systems and they may, in many cases, already be available at the site desiring information system access. The processing capabilities and ever-increasing memory capacities of the personal computer should allow the development of a powerful interface system which will provide the user with the capabilities necessary for effective interaction with multiple information systems through a standardized interface.

IV. GOALS AND OBJECTIVES OF SYSTEM DESIGN

The general goals of the design of such an interface system may be summarized as follows:

GOAL 1: Design a system which allows ease of access to multiple information systems to both the casual user and the experienced user.

GOAL 2: Design a system which is helpful to the casual user and provides capabilities for allowing these users to progress to greater levels of proficiency while also providing the experienced user with a set of tools commensurate with his experience.

GOAL 3: Design a system which provides the user with sufficient guidance and interactive capability to maximize the utilization of his subject knowledge in the development of system search strategies.

GOAL 4: Design a system which utilizes state-of-the-art interface design tools available for personal computers while retaining maximum portability.

GOAL 5: Provide monitoring and evaluation tools as integral parts of the system design.

GOAL 6: Define future system enhancements.

These goals represent a broad, general description of the concepts which will guide the proposed design of a Personal Computer-based Multiple Information System Interface (PC/MISI). The actual design of the system will entail the development of implementation specifications for the following list of objectives:

OBJECTIVE 1: Provide Ease of Access to Multiple Systems. The system should allow the user to simply choose the information system he wishes to

access and PC/MISI should perform all necessary procedures required to establish communications. (Note: This process will also involve security problems which will have to be resolved).

OBJECTIVE 2: Provide for Addition of New Systems.

PC/MISI should have a modular design which will facilitate the addition of new information systems or new processing systems as the need arises.

OBJECTIVE 3: Develop System Documentation

The system user manuals and other documentation should be developed in concert with the system design in order to ensure clarity and relevance.

OBJECTIVE 4: Provide Multilevel Capabilities.

PC/MISI should have interfaces designed for use by users with different levels of expertise and should provide smooth transition from one level to another as the user's level of expertise

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changes. The user should also be able to choose his own level if he so desires.

OBJECTIVE 5: Maintain User Orientation.

PC/MISI should keep the user informed at all times of his location within the system as well as other pertinent information. The system design should include the definition of all information which should be available to the user and the methods of providing such information.

OBJECTIVE 6: Utilize User's Knowledge.

PC/MISI should provide users with "advice" on how to develop search strategies to best utilize their specific subject knowledge. This should be an integral part of the highest level user interface and also available on request to the more experienced user.

OBJECTIVE 7: Facilitate Downloading of Information.

PC/MISI should provide simple procedures for allowing users to store information from remote systems in the storage units of their personal

computers, edit this information as desired, and print the information on their local printers.

OBJECTIVE 8: Provide Batch Processing Capabilities.

PC/MISI should provide the capability of designing an entire search sequence prior to accessing the remote system and then uploading the entire sequence to the remote computer and executing it. The user should also have the choice of running this as an interactive process or as an offline absentee procedure (assuming remote system support for this procedure).

OBJECTIVE 9: Provide Error Handling Capabilities.

The error messages within PC/MISI should be designed to guide the user to the correct procedure. PC/MISI should provide an interpretation of remote system error messages where necessary and provide the user with additional information and assistance where required.

OBJECTIVE 10: Extract Maximum Benefit from Display Capabilities.

The interface design should make use of graphical and screen management capabilities in order to maintain user interest and assist the user in his search efforts. Care must be taken, however, to ensure maximum portability when using these tools. Concepts of information processing psychology should also be incorporated into design decisions regarding the utilization of these tools in order to provide naturally usable interface formats and maximize user information processing capabilities.

OBJECTIVE 11: Identify Necessary Data for Evaluation.

The information to be collected for monitoring and evaluation will be defined and the analyses to be conducted on this information will be identified.

OBJECTIVE 12: Design Data Collection Tools.

The data collection system will be described. This will include software monitors as well

as user evaluation forms.

OBJECTIVE 13: Identify Uses of Artificial Intelligence for Future Enhancements.

The possible uses of artificial intelligence and knowledge bases as tools for enhancement of user interaction should be identified and necessary system design decisions will be made to allow the future incorporation of these tools.

OBJECTIVE 14: Identify Multi-User Conversion Possibilities.

The original system design will be oriented toward a single user. The possible future incorporation of multi-user capabilities will be discussed as well as factors associated with the incorporation of the system into a distributed workstation environment.

OBJECTIVE 15: Maximize Flexibility.

The system design should provide the capability of easily implementing changes which may be required by modifications to any supported remote system.

V. SUMMARY

There is no reason why a user should have to interact with an information storage and retrieval system in the language of that system. The necessity of interacting in that way has proven to be a roadblock preventing the widespread and rapid dissemination of information to the end users of that information. The processing capabilities of microcomputers create the possibility of providing the user with one familiar and easy to use system which is used to access any machine-readable information that he desires and that he has authorization to access. A carefully designed interface should appear to the user as a single system which contains all of the information and information processing capabilities which he desires. The messy and tedious details involved with the actual access of the information from the source machine should be handled by the user's machine and the user's time can then be allocated to the planning of his search strategy instead of the mechanics of the search operation.

The guidelines presented in this document provide a framework for the design of a system which will utilize the capabilities of the personal computer to provide such an interface. The final design should describe a system which will provide access to a wide range of information for a casual user

or an experienced user and also maintain the flexibility to evolve as new development tools become available. The personal computer promises to become a valuable tool in the effort now in progress to establish online information systems as an integral and indispensable part of our society. The fulfillment of that promise requires a careful analysis of all factors involved in the interaction between the user and the system and the incorporation of the results of such an analysis into the design of an interface system. These guidelines are the initial step in a process which will result in the development of design criteria for a system which will meet the goals identified herein.

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16. Abstract

A set of design criteria are presented which will allow the implementation of an interface to multiple remote information systems on a microcomputer. The focus of the design description is on providing the user with the functionality required to retrieve, store and manipulate data residing in remote information systems through the utilization of a standardized interface system. The intent is to spare the user from learning the details of retrieval from specific systems while retaining the full capabilities of each system. The system design includes multi-level capabilities to enhance usability by a wide range of users and utilizes microcomputer graphics capabilities where applicable. A data collection subsystem for evaluation purposes is also described.

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