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"AUTOMATED APPAREL SPECIFICATION RETRIEVAL SYSTEM"
UNCLASSIFIED

C-DLA-900-87-D-0017/0020

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This research investigated an information management program that was used to provide access to garment specifications. In particular, the requirements for producing and evaluating a military shirt were used to explore the potential of hypermedia for providing immediate access to related segments of shirt construction and evaluation specifications. In addition, a hypermedia program was used to investigate the efficacy of augmenting the written requirements with graphics.

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Automated Apparel Specification Retrieval System

Final Report

**A Short Term Research and Development Task
Proposed Under DLA900-87-D-0017
Delivery Order #0020**

1 June 1990 - 30 June 1991

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1.0 Introduction, Background and Research Objectives

1.1 Introduction

In an increasingly information driven field such as apparel manufacturing, the smooth flow of that information from one stage of processing to another is intensely important. In apparel manufacturing, the flow begins with a planning stage that transforms a fashion design into garment specifications. These specifications may detail the materials requirements as well as the layout, cutting, assembly and packaging that are necessary. Often the requirements are interrelated, and they may also be linked to either civil or military standards.

The intricacy of the interrelationships gives rise to a complex network of requirements that can be difficult to grasp. Nevertheless, the implications of each relevant segment of a specification must be clearly understood before an appropriate manufacturing bid can be made. This research investigated an information management program that was used to provide access to garment specifications. In particular, the requirements for producing and evaluating a military shirt were used to explore the potential of hypermedia for providing immediate access to related segments of shirt construction and evaluation specifications. In addition, a hypermedia program was used to investigate the efficacy of augmenting the written requirements with graphics.

1.2 Background

Frequently, the details conveyed in one section of a document may affect the way requirements that appear elsewhere are interpreted. A web of related requirements may be found that stretches through several parts of multiple documents. This complicated situation arises when requirements are assembled into a written document. When one organizes a information hierarchically, as illustrated in Fig. 1, an attempt is made to collect correlated specifications in the various sections. Unfortunately, the tree-like organizational structure associated with a hierarchy does not always permit related requirements to be located near each other in the text (and possibly not even in the same document). Consequently, when



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the document must be interpreted, in order to assure that all of the requirements are met, one must pursue the references that the text makes to itself and to other specifications as well. Consequently, one needs not only the ability to review specifications linearly (page-after-page, as illustrated in Fig. 2), but also nonsequentially.

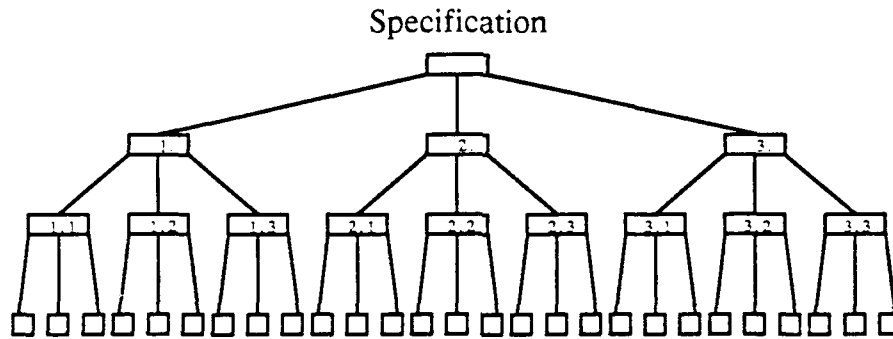


Fig. 1. Hierarchical Organization

Consider, for example, the Army uniform specification MIL-S-44041B(GL) [6] for a short sleeve man's shirt. This document details the requirements for materials, construction, packaging and *some* quality evaluation of the shirt. Nevertheless, it does not include certain important quality evaluation criteria such as the proper alignment of pocket flap buttonholes with the corresponding front buttonhole. This requirement is part of MIL-STD-1492C [7] that describes provisions for evaluating the quality of the garment. Consequently, to be aware of the requirement, one must be cognizant a separate document.

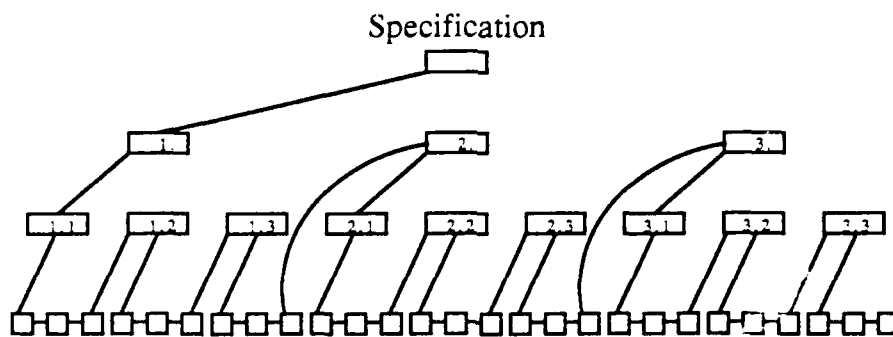


Fig. 2. Linear (Written) Organization

In addition to the organizational complexities of written specifications are the difficulties that may be associated with interpreting those specifications. Frequently, specifications contain few, if any, figures to illustrate the requirements. In particular, the shirt specification

MIL-S-44041B(GL) contains only one figure. The related quality evaluation specification MIL-STD-1492C, with more than 20 pages of visual defect grading criteria, contains only 3 illustrations. Nevertheless, both documents contain numerous requirements that could be clarified by illustration.

A third problem associated with the way that specifications are commonly presented is that they are typically in printed form. Since specifications periodically require updating and printed forms do not lend themselves to revision, it is difficult to maintain a current version of the requirements. Indeed, one may find versions of specifications in use that are literally pasted pieces of revisions to the requirements. Failure to acquire useable revisions in a timely fashion can severely interfere with the competitiveness of a contractor.

1.3 Research Objectives

The primary goals of this project were to investigate the feasibility of developing an automated apparel specification retrieval system and the utility of augmenting it with graphical supplements. Both of these objectives were addressed using existing hardware and data management programs. An electronic version of the specifications MIL-S-44041B(GL) [6] and MIL-STD-1492C [7] was produced and used to study the potential of a hypermedia database program to provide the data linkages and image display flexibility needed.

2.0 The Approach

2.1 Choosing a Medium for Presenting Specifications

Electronic media offer capabilities to address several problems directly. Information can be stored and access to it can be constructed so that the data can be retrieved rapidly even if the order of the retrieval is nonsequential. In addition, placing a specification in an electronically manageable form enables one to revise it conveniently. Revisions that are textual, graphical or structural may be made without manually reconstructing the document, and the resulting updated version can be readily disseminated using magnetic or optical disks.

While representing a specification electronically may enable one to modify it easily, to present graphics and to use internal links, the task of building a program to provide such

functionality from scratch is formidable. Fortunately, there already exist a number of programs that provide many of the functions needed to build such an information management system. These programs transform the computing platform into data management machine that is capable of manipulating various forms information.

2.2 Hypermedia for Information Presentation

2.2.1 Hypermedia Defined

“Hypermedia” is a term used to describe an information base, containing any computer manipulable form of data, that is randomly accessible and nonsequentially presentable. The word is derived from “hypertext” which Nelson [4] used to describe a randomly accessible collection of data. The use of hypermedia has been described as a significant paradigm shift in information management systems [1]. It has been applied to organize and present EPA regulations for underground storage tanks [2]. In addition, Schneiderman and Kearsley [5] cite applications of hypermedia to such diverse areas as dictionaries, encyclopedias, medical texts, catalogs, interactive fiction, religious documents and museum exhibits.

In its purest form, a hypermedia database may consist of text, graphics, audio or video, and may be accessed by going from topic to related topic in any desired order. Figure 3 illustrates potential linkages that could reflect references of a database to other sections of itself. Notice that hypermedia organization provides not only the capabilities of hierarchical or linear organization, but also the capacity for retrieving data in arbitrary orders. Since the information can be retrieved in arbitrary order, only what is necessary to one’s current objectives needs to be accessed. One may bypass large segments of information and extract only those items that are pertinent.

2.2.2 Developing Hypermedia Presentations

Hypermedia application development programs allow one to store information on an electronic analog of index cards. These cards may be assembled into a group, known as a stack, that typically contains information along a common theme. The cards in a stack may

be linked together in arbitrary combinations so that when the stack is reviewed, the cards may be displayed in an arbitrary order.

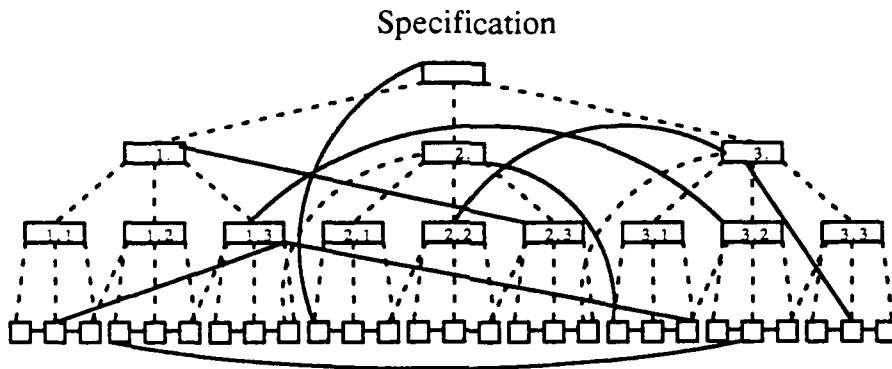


Fig. 3. Hypermedia Organization

The four most commonly used components of a hypermedia project are text, graphics, menus and buttons. Text represents the written portion of a project and in our case embodies the bulk of the shirt specifications. Graphics may be generated using the drawing tools provided by the software one uses to build a stack. Graphics may also be imported from other programs such as those one might use with an image scanner. Menus may be constructed to offer the stack user a list of alternative actions. With the hypermedia program used for this project, menus are presented at the top of the display screen and they are opened by depressing a mouse input button when the mouse pointer is positioned over the menu name. A menu action may then be selected by moving the pointer down the menu until the name of the desired action is highlighted and then releasing the mouse button.

In addition to menus, a stack developer may provide the stack user the option of selecting possible actions by means of hypermedia buttons. A hypermedia button is activated by "clicking" the mouse button when the pointer is located in a specific area of a card. The action associated with the button may be as simple as revealing additional information on a card, or it may be as complex as playing an animation sequence or audio recording. The most common use for a button is to provide a user the ability to browse through the stack by crossing links from card to card.

The card area associated with a button is marked using an icon. In the card shown in Fig. 5, the **prev** and **next** icons represent buttons that are used to review cards sequentially. In order to provide visual activity and variety, other button icons, such as arrows or hands pointing left or right, were also used. The house icon appears on every card and links each one to the "home" card (shown in Fig. 4) which, in turn, serves as a known starting point for perusal of the stack.

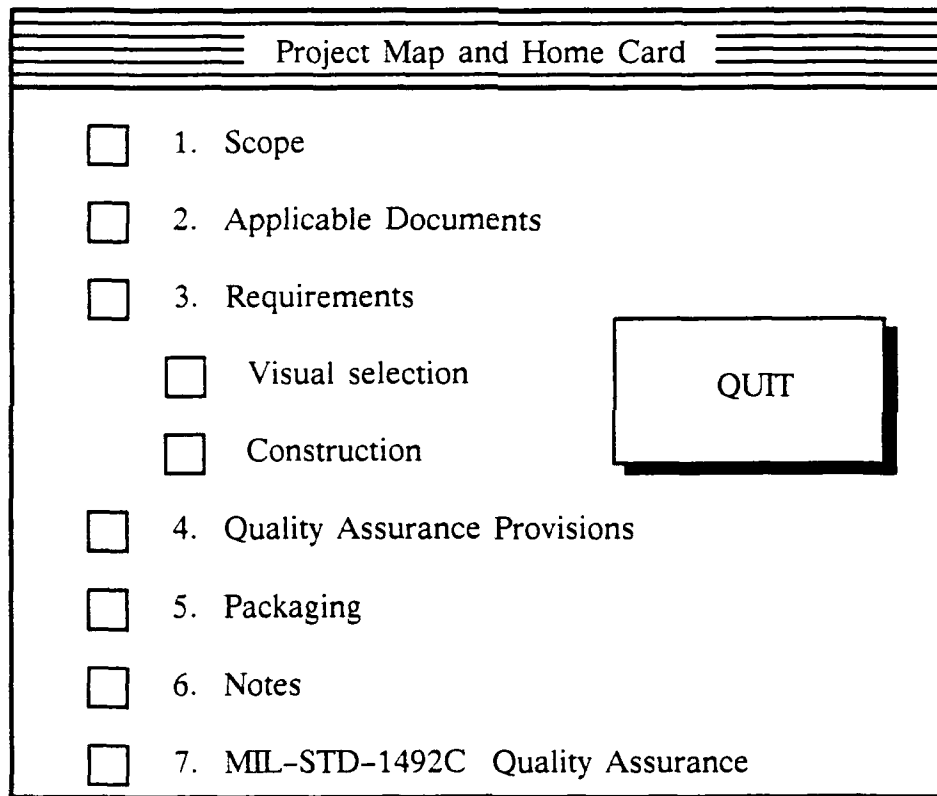


Fig. 4. The "Home" Card

The shirt graphic in Fig. 5 is actually comprised of several button icons that permit a more visually oriented selection of additional information on shirt features such as sleeves, buttons, buttonholes, pockets, collars and epaulets. By pointing to the component of interest and clicking the mouse button, the user can display relevant information. An example of stack perusal using the button and menu tools is described next.

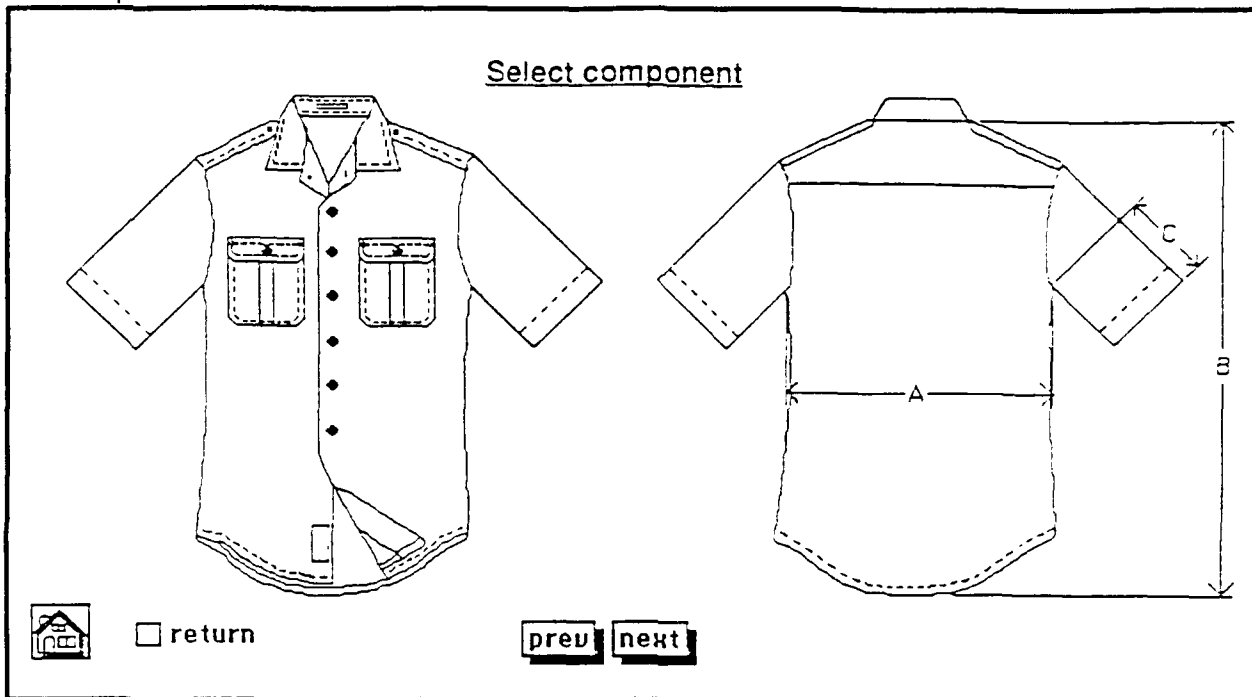


Fig. 5. Hypermedia Buttons

2.2.3 Example: Hypermedia Presentation of MIL-STD-1492C and MIL-S-44041B(GL)

Figure 6 illustrates a sequence of card selections executed by someone interested in collar details. The sequence was initiated by clicking on the collar in the graphic shown in Fig. 5. The subsequent cards were selected by clicking on the "Requirements" arrow, the "see 4.4.1.1" and the "Table IV" buttons in Figs. 6 a, b and c, respectively. One may surmise from the card captions referencing sections 3.3.2.2, 4.4.1.1 and Table IV that the information shown is not closely positioned in the written form of the specification.

2.2.4 Supercard--A Hypermedia Development Program

Supercard is a hypermedia applications program developed by Silicon Beach Software, Inc. Its design extends the flexibility that is present in Apple Computer's well-known hypermedia program Hypercard by allowing multiple cards to be viewed simultaneously. As suggested by the illustration in Fig. 7, the ability to display more than one card at a time can ease the burden of evaluating the significance of related requirements by enabling the reviewer to see them simultaneously.

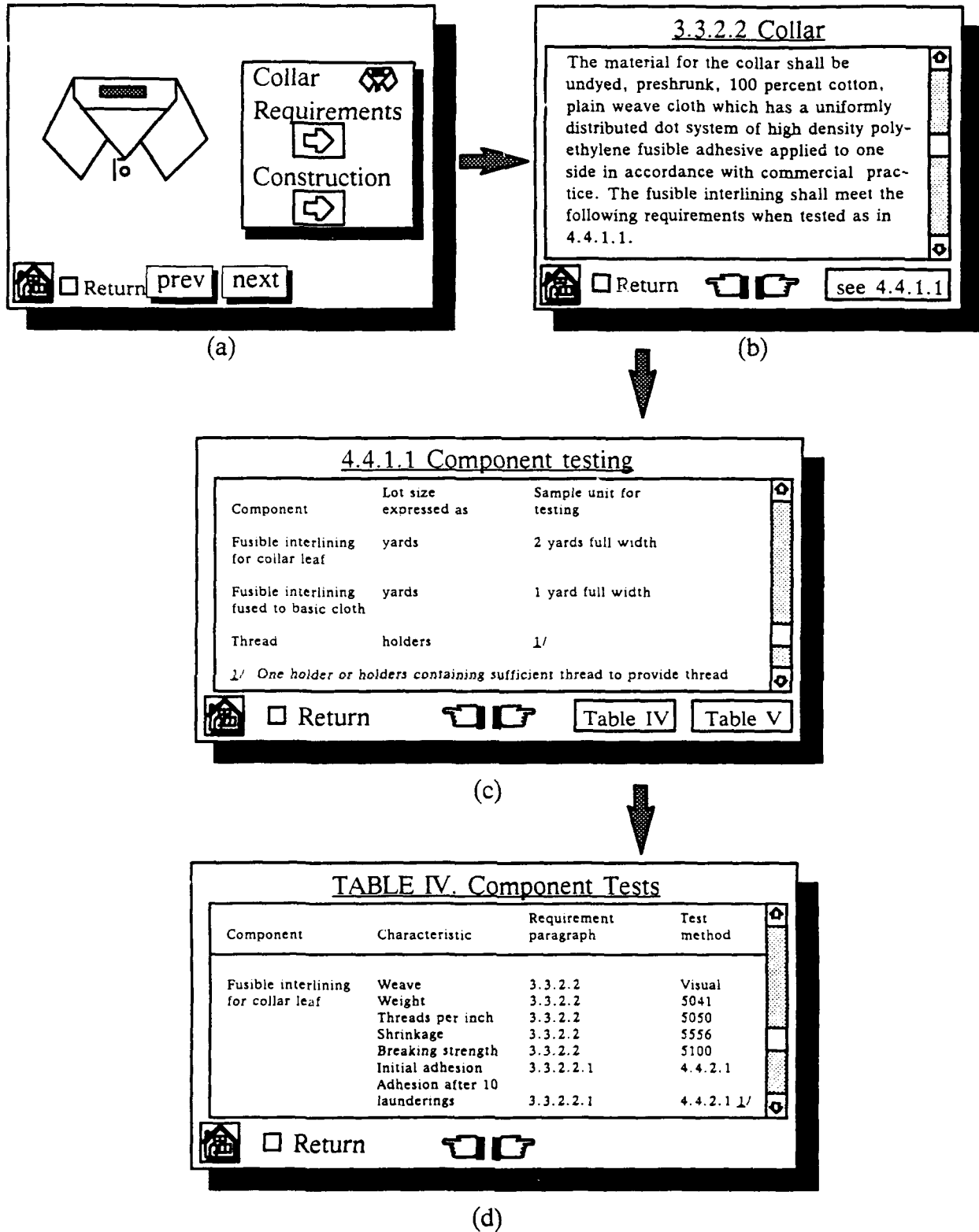


Fig. 6. A Chain of Collar Requirements Cards

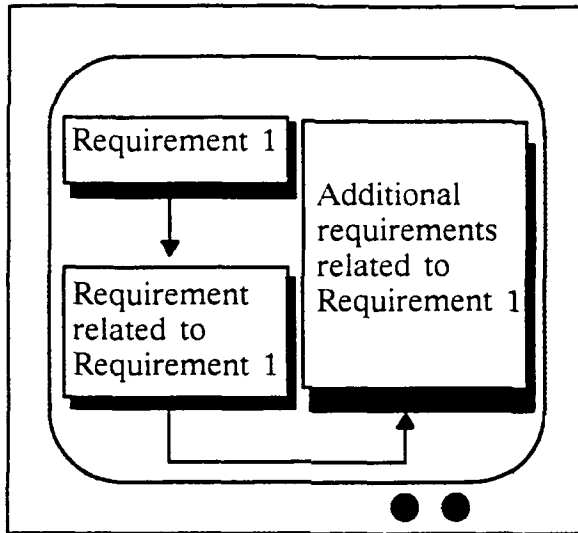


Fig. 7. Multiple Card Display

In addition, Supercard allows one to create a stack which can be used in a standalone mode. This means that the programs that are required to present the stack can be attached to the stack so that it can be reviewed without using the Supercard program directly. In this way, a stack designer can produce stacks that can be used by those who do not own the Supercard stack development software. Furthermore, Supercard supports both animation and color graphics. It also allows additional software to be used to control peripherals such as a video disc player or sound generator. These alternative media may be used in future work to amplify and clarify the textual information in the specifications.

While Supercard possesses many desirable features that led to its use in the development of the prototype hypermedia application described here, it is not currently available for computing platforms other than the Apple Macintosh. In addition, other hypermedia development programs, with functionality similar to Supercard, have now become available for IBM-PCs and compatibles, as well as for other computers. As hypermedia presentations of specifications are developed in the future, these alternative development programs should be evaluated.

3.0 Project Details

The system allows the user to review the specifications in the linear order that corresponds to the printed manuscripts, in the hierarchical order that is reflected by the respective tables of contents or in arbitrary orders that arise from pursuing threads of related requirements. Both specifications, MIL-STD-1492C and MIL-S-44041B(GL), have been stored in hypermedia form and related segments within them are linked. The project has also linked related requirements lying in differing segments of both of these documents.

Graphics to support the text were developed. At present, in order to provide a tool that is useful to the widest possible audience, monochrome drawings provide the basis for illustrating the specifications. In addition to the graphics that were created to support the hypermedia presentation, the figures that are a part of the original specifications were included in the stack. The figures that were a part of the original specification were scanned into a hypermedia stack that was later embedded in the specifications stack.

The hypermedia version of the specifications (including all the linkage and indexing information) occupies slightly more than half a megabyte of storage. This fits easily onto a single 3.25" high-density, floppy diskette. Because it incorporates the programs that are necessary to present the hypermedia project, the stand-alone version of the project is substantially larger, but it can be reviewed without acquiring the stack development programs. The stack developed during this investigation includes more than 200 cards presented using a variety of card formats and graphics.

4.0 Conclusions

Apparel manufacturers, material vendors, specification writers and quality assurance inspectors should each benefit from the use of hypermedia apparel specifications. Manufacturers will benefit from having accessible, linked, up-to-date versions of the specifications available while bids are being formulated and during production. Material vendors will be able to access the requirements that are pertinent to their individual products without plowing through extraneous requirements. Specification authors will possess powerful tools that

permit requirements to be linked and audio-visual supplements to be integrated so that the goals of the specifications can be more effectively communicated. In addition, inspectors, who must be knowledgeable of the requirements for a wide variety of defense acquisitions, will be able quickly to review the exact specifications each item must meet; hence, the inspector's role in quality assurance will be supported.

5.0 Future Extensions

Compact disk (CD) technology is rapidly finding application in the computer marketplace as a vehicle for mass storage. It is now possible to present an entire encyclopedia; text, images, and even audio recordings and video sequences using only a fraction of the capacity of a compact disk. Applying this technology to the presentation of requirements could enable one to include television quality audio and video to illustrate construction, packaging and inspection operations. A hypermedia presentation of inspection requirements, for example, might be deployed using a microcomputer with a CD player located at a depot so that an inspector could review the specifications prior to certifying compliance. In addition, a larger collection of applicable documents, together with the indices and the linkages necessary to incorporate them into the hypermedia database, would give an inspector full access to relevant information.

Another extension to this research would involve migrating the existing hypermedia database to an IBM-PC compatible computing environment. As indicated previously, when this prototype project was begun, the best known hypermedia programs were available for Apple computers. Since that time, several other development programs have become widely available (some even allowing cross-platform stack development). These hypermedia programs need to be evaluated and their potential for use in presenting specifications and quality assurance information needs to be determined.

A third extension to the existing project would accelerate the process of searching the hypermedia database for references to a specific topic. The specifications make numerous explicit references to themselves and these references have been represented as hypermedia

links that can be followed manually. It would be useful to be able to perform an automatic search through documents for related reference material. Such references might be associated by a key word or phrase that could be formulated analogously to a database query. While this capability is not a part of the existing stack capabilities, it would be a powerful extension to it.

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