Applying Hypertext Methods for the Effective Utilization of Standards

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Abstract

Standards documents contain a wealth of useful information, both for people who must follow standards, and for people interested in the area of application of the standards. In this paper, we describe how hypertext methods, using the rich internal structure of standards documents can promote the effective utilization of standards. We describe a system that allows interactive browsing, keyword searching, annotation, and report generation of selected parts of a particular standards document (one used for designing user interface software). We conclude that standards documents are made more useful by having them online and supporting the structural retrieval operations of hypertext methods, and that computer standards should pave the way for how standards in general are disseminated and used in the future.

1. Introduction

Independent of the debates over the content and enforcement of standards, standards contain information valuable to many potential users, including standards authors, readers who must adhere to standards, and people interested in the subject area of the standards. A major problem with standards documents is their size, which makes access to information difficult. Generally, standards documents are large because their domain of application is complex, not because standards authors are evil and try to impose their will in large, opaque tomes. The common enemy of authors and readers is the information overload of the large, highly structured reference document (IEEE Spectrum, 1987). Any help in aiding the communication of standards information from authors to readers will aid the effective utilization of standards.

Before discussing hypertext methods and how they can be applied to standards, we will first discuss the methods commonly used to aid the transfer of standards information. Standards are almost always distributed in paper form, restricting authors and readers to communication by the methods of information presentation used on paper. These include structuring with sections, sub-sections, paragraphs, etc., and using spatial layout and varied fonts to convey information structure. In addition to the main body of text, there are auxiliary aids for retrieval, such as tables of contents, indexes, and cross-references. Finally, there are supplementary sources of information, such as reference lists and glossaries. These are proven methods for creating more usable documents, but they can be improved with hypertext methods.

Hypertext is more than just online text, although many of the benefits of hypertext come from simply having text in a computer. Informally, hypertext is any online system that makes use of the structure of a document. The term was first coined by Ted Nelson, and has become a buzzword with many meanings. A related term, hypermedia, refers to systems that incorporate media other than just text: graphics, voice, video, etc., in addition to text. Such combinations of media are common and becoming more important to convey complex information. For example, the NASA 3000 standard uses videotape and information stored in a database. We will use the term hypertext to refer to all online uses of the structure of information in any medium.

There are several benefits of having standards online. One is that keywords can be used to search through the text. Another is that parts of the text can be cut out electronically and pasted elsewhere, such as to document conformance to a part of a standard. However, neither of these uses takes advantage of the extensive structuring effort typically found in standards documents.

There are many possible hypertext extensions to a flat-file use of an online standard. An important extension to flat file search, which usually shows just lines that match a search key, is that searches can match keywords attached to paragraphs or sections, the units of text of real interest to readers. Another benefit of hypertext is having interactive control over the level of detail that is shown. Readers can search through a table of contents or index, and when a title or keyword of interest is found, the referenced part can be expanded immediately, optionally in a separate window. Cross-references can be followed similarly. References to outside literature, or keywords in a glossary, can be temporarily expanded in place to provide more detail, and in a comprehensive hypertext system, such references can be followed to other documents. A survey of hypertext methods and experimental systems can be found in Conklin (1987).

2. A Hypertext Interface to a Standards Document

To demonstrate the benefits of hypertext methods applied to standards, we developed a hypertext interface to the MITRE report "Guidelines for Designing User Interface Software," compiled by Smith & Mosier (1986). This hypertext system, whose prototype version is called SAM, after its authors Smith, Aucella, and Mosier, runs on IBM PC's and compatibles. The commercially available version is called NaviText SAM. The Guidelines report is a large text file (750,000 characters occupying close to 500 printed pages) with a rich structure (six major sections, divided into 70 functional areas, containing 944

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guidelines). There are several tables of contents of different levels of detail, a subject index, about 500 references to about 200 outside reference sources, and over 1000 internal cross-references. It is required reading for many government software contractors, and makes over 200 references to the military standard MIL-STD-1472C (1983) for human engineering. The report is the single most comprehensive source of information for designers of user interfaces.

SAM supports several hypertext activities:

- Hierarchical Browsing
- Expansion/Concealment
- Cross-Reference Browsing
- Inverted-Reference Browsing
- Keyword Searching
- Marking/Gathering
- Report Generation
- Attaching Ratings and Annotation
- Setting Options and Saving State

These are described below.

2.1. Hierarchical Browsing

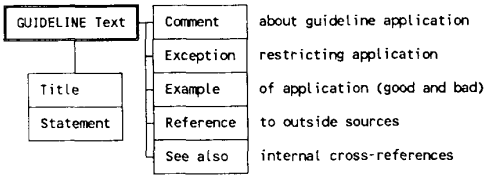
When SAM starts, it displays a table of contents with the six major sections of the Guidelines report:

1 DATA ENTRY
2 DATA DISPLAY
3 SEQUENCE CONTROL
4 USER GUIDANCE
5 DATA TRANSMISSION
6 DATA PROTECTION

Users can see more detail in the table of contents by moving the cursor to a title and "poking" it with the EXPAND command. Immediately, the table of contents is expanded to show the section's functional areas, indented under the section title, as is customary in a table of contents. Other sections and functional areas can be expanded to show more detail, down to the level of individual guidelines. Scrolling, paging, and keyword search allow the user to move around the hierarchical table of contents. When a guideline title is expanded, its text is shown in a separate text-reader window, which is also used for reading long introductory information for sections and functional areas.

2.2. Expansion/Concealment

We have discussed expansion of subordinate structure, and the inverse, concealment works much the same way. When a reader decides that the detail is no longer necessary, it can be removed by a CONCEAL command. A special form of concealment is used for individual guidelines, which have their own structure. Guidelines have a title, a one-sentence statement of the guideline, and optional Comment, Exception, Example, Reference, and See also (cross-reference) paragraphs, shown more graphically, below:



Users can control which of these paragraphs become visible when a guideline is expanded by setting options. For example, when looking for guidelines relevant to error messages, examples might be displayed, while references to literature, on which the guidelines are based, might not.

2.3. Cross-Reference Browsing

When a relevant guideline is found, it may contain cross-references to other guidelines. The reader can follow the cross-references by poking them with an EXPAND command to see if they are useful. Instead of following the cross-references, readers can have SAM display a bit more detail than is shown in the printed Guidelines report.

2.4. Inverted-Reference Browsing

When a reader finds a guideline with references to outside literature, it is sometimes useful to know which other guidelines refer to those references, because such guidelines are likely to be related. Many books have such an inverted search aid, an author index, but the Guidelines report does not. In SAM, an author index can be generated dynamically, and users can poke a reference to mark all the guidelines referring to it, for later review.

2.5. Keyword Searching

An important technique for finding information relevant to some aspect of design is keyword search. In SAM, the guideline titles can be searched for combinations of keywords, and those matching are saved for later review. A special feature of SAM is that keywords from the subject index of the printed Guidelines report were added to special keyword sections of guidelines to make it easier to find relevant guidelines. If some keywords in the printed index would have led a reader to a guideline, then so will the special keywords.

2.6. Marking/Gathering

As we have mentioned, there are commands in SAM to mark guidelines into a gathered set. Gathering guidelines is important, because for any aspect of system design, there may be dozens of guidelines that are relevant. In defining a set of rules for how a particular system will be designed, it is useful to have a set of guidelines supporting each. For dozens of aspects of design, there would be dozens of dozens of guidelines, which would need to be organized. SAM allows each set of guidelines to be saved to and retrieved from files.

2.7. Report Generation

When a set of guidelines has been gathered, the system designer may want to study them carefully. People read more easily on paper (Gould et al, 1987) so SAM contains a report generation feature. SAM will take a set of guidelines gathered through the techniques above, and generate a report, expanding only those paragraphs that the user wants to study. Information is expanded according to options, so the report could be as short as a list of guideline titles, or as long as the whole Guidelines report.

2.8. Attaching Ratings and Annotation

SAM can be used to evaluate conformance to the Guidelines report. If some guidelines are used in designing a system, then a system can be evaluated with respect to how well it achieved the goal of each guideline. SAM allows users to attach importance ratings to individual guidelines, and to rate conformance (how well a guideline was followed). Reports can be generated by sorting by importance and conformance, so that glaring violations of important guidelines can be brought to the designer's or an independent evaluator's attention.

2.9. Setting Options and Saving State

Using a standards document like the Guidelines report is not easy, because a lot of information is needed for user interface design, and the design and evaluation of a complex system can span months or even years. To accommodate this, SAM was designed so that it could save and restore its internal state of display options and gathered guidelines, thereby allowing designers to suspend and later resume design tasks.

3. SAM's Task Oriented Windows

SAM uses several windows that help divide the screen into task-specific workspaces. These tasks all begin with finding guidelines relevant to an area of design. Then, depending on the rigor of guideline application, the designer might document a rule for implementation and possibly for later formal evaluation of conformance. The SAM windows are all based on NaviText windows software, which provide generic windowing operations like scrolling, paging, searching, file interface, sorting, resizing, line deletion, and so on.

The different windows provide different views of the same information, allowing the same guideline title with importance and conformance ratings to appear in many windows at the same time, and allowing the results of operations on a guideline in one window to be instantly and automatically displayed in all others. Supporting multiple views is a core feature of hypertext capabilities.

The windows used in SAM are listed below, with details following. Virtually all of them can be used with any online hypertext standard, because the different views are useful in many contexts, and the gathering-annotating-evaluating operations are common to all uses of standards.

- The Table of Contents Window
- The References Window
- The Expanded Text Window
- The Gathered Guidelines Window
- The Text Reader Window
- The Copy Text Window
- The Help Window
- The Options Window

3.1. The Table of Contents Window

This window displays the table of contents of the Report using varying levels of detail. As little as just the title of the Report can be shown, or the section titles, functional area titles (subordinate to the sections), or guideline titles can be added using the EXPAND command. When a guideline is expanded, or the introductory text for a structural unit is requested with the INTRO command, the text is shown in the Text Reader window.

3.2. The References Window

This window displays the outside references used in the Guidelines Report. Each line shows the names of the authors and dates of the reference, and expansion to show the complete reference is possible with the EXPAND command.

3.3. The Expanded Text Window

This window keeps track of all the structural units (sections, functional areas, guidelines) for which the text was expanded. This allows a user to go back to some text that was read earlier.

3.4. The Gathered Guidelines Window

This window holds all the guidelines marked using the MARK command. The MARK command can be applied to guideline titles, references (which marks all the guidelines referring to that reference), functional areas (which marks all the guidelines in that area), or sections (which marks all the guidelines in that section). Once in the Gathered Guidelines window, the guidelines can be ordered, expanded, rated, and deleted as appropriate.

3.5. The Text Reader Window

This window is used as the destination for all large pieces of text expanded by the EXPAND or INTRO command. For example, the introductory text for the whole Guidelines Report is several hundred lines. To allow comparison of large pieces of text, the Copy window is provided.

3.6. The Copy Text Window

This window is used for comparing text from two windows, or for comparing distant text in one large window. At any time, from any window, the contents and context of a window can be copied to the Copy window for later study.

3.7. The Help Window

This window contains the online help for the system. It begins as a series of lines containing the names for commands, the keys to which they are bound, and short descriptions. The EXPAND command can show more detail.

3.8. The Options Window

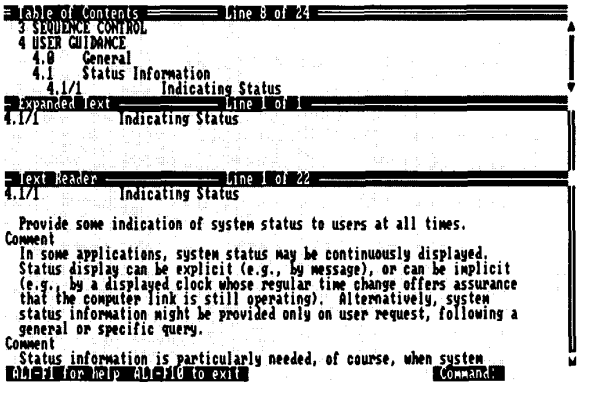
This window contains the options that control the format of expanded guidelines, both online and in reports. Options are set with the ASSIGN command, and more information about any option can be obtained with the EXPAND command.

4. Some Examples of Using SAM

Paper is a poor medium for describing any screen-oriented interactive system. That is one reason why SAM was built to be able to record its own use and replay demonstrations. Still, the following examples will make the workings of SAM more concrete.

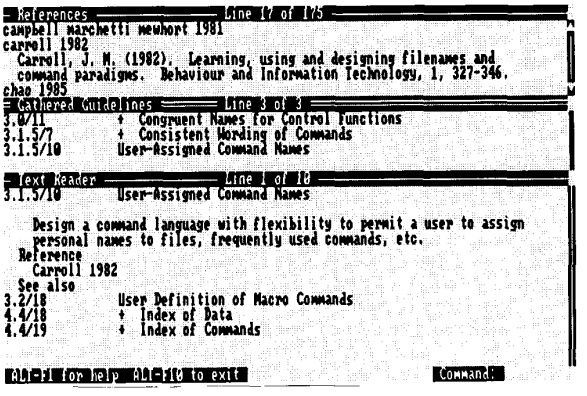
4.1. Example: Hierarchical Browsing and Expansion

The user is in the Table of Contents window and has expanded section 4 (USER GUIDANCE), functional area 4.1 (Status Information), and guideline 4.1/1 (Indicating Status). When the guideline is expanded, its text is expanded in the Text Reader, and its title is placed in the Expanded Text window.



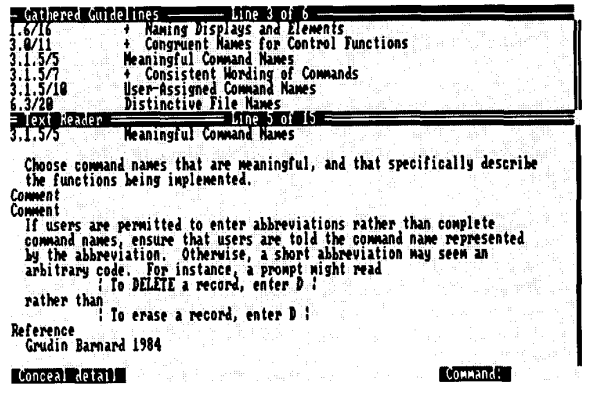
4.2. Example: Inverting References

The user activated the Reference window, searched for the author name (Carroll), and expanded the reference found. Then the user marked the reference, placing the three guidelines referring to the found reference into the Gathered Guidelines window. Finally, the user activated the Gathered Guidelines window and expanded the third guideline into the Text Reader, where the reference to Carroll (1982) can be found.



4.3. Example: Reviewing Guidelines

The user has changed window sizes so that the Gathered Guidelines and Text Reader take up the whole screen. The user can then expand guidelines to learn more about them, and delete ones that are not relevant to the current topic. Once a set has stabilized, a customized report can be generated.



5. Experiences With SAM

SAM was used in its own design and evaluation during an iterative-design prototyping development. When a part of SAM was being designed, such as the contents and format of window titles, we used SAM to find guidelines relevant to that part. Usually we would look at the general functional areas relevant to the part. For example, for window titles, the general guidelines on feedback and status information were relevant, as were guidelines in the phrasing of text instructions. These guidelines were supplemented by guidelines found with keyword search and by following cross-references from relevant guidelines. Although the process takes a long time, careful user interface design protects against user problems later. In many areas for which standards are created, such effort is worthwhile. Now, SAM is being used by other user interface designers and we are getting positive feedback on its effectiveness, both as a formal and informal design and evaluation support tool.

We wonder if we spend more, not less, time with the Guidelines in hypertext form than with the paper form. It may seem that we should spend less, if SAM is effective. For equivalent tasks with similar outputs, SAM is much faster than working with paper. However, we think that with SAM, we make better use of more of the information in the Guidelines report. We are not bound by a contract to use the Guidelines, and we might avoid the extra work of using the Guidelines were they not in a form convenient for use. Consider the tedious task of looking up a topic in the index, finding several guidelines, inserting markers for later reference, and then reading them, possibly finding several cross-references for each, and all the while, taking notes of guideline and page numbers. Now multiply this task by dozens of design issues. Probably, we would not do all this without cutting a few corners. With a bulky document, no matter how well human engineered for paper use, some operations are simply intractable with print. We believe that a good basis for judging standards is the question, "Would I use this if I did not have to?"

Based on positive experiences with the SAM interface to the Guidelines report, we are now working on hypertext interfaces to other standards documents. First, we will work on supporting following links from one document to another. For example, we will allow readers to follow references from the Guidelines report to sections in the often cited MIL-STD-1472C. Then, we will work to support specialized hypertext interfaces to other whole documents. While we hope to build on what has been done so far, we acknowledge that each standards document has its own structure and its own routine operations requiring support. Some operations will be universal, like showing more or less detail and following cross-references. Others, like displaying lists of a certain type of structure and attaching ratings to them, will be too difficult for most users to specify in a generic hypertext system. The structuring of information in a document to make a useful hypertext, and the creation of complex operations that are unique to a document, will have to be done by hypertext designers who are expert in the area addressed by standards. We hope to establish working relationships with the authors of standards documents to help them make their documents more useful.

To work on other standards documents, we acknowledge the need to deal with the many forms of media used in those documents. Graphics and interactive video make the mass storage devices like CD-ROM attractive for future hypertext standards documents, and especially for sets of related documents.

In conclusion, we think that hypertext methods enhance the accessibility of information in highly structured technical reference documents like standards. Computer standards are a class of standards that we think should be leading others into better uses of computers to make standards more useful. It is ironic that for many computer standards, online forms are unavailable, and for those that are available online, we think that it is imperative that they utilize the data structuring capabilities of hypertext information systems.

6. References

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7. Acknowledgements

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