USER INTERFACE DESIGN FOR NEWS-RETRIEVAL SYSTEM REFLECTING INFORMATION STRUCTURE

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ABSTRACT

This paper presents a process of user interface design for information systems that helps to achieve optimal usability reflecting the information structure in a systematical manner. The design problem is recognized to be formed by design constraints from three major sources, which are task, interface, and system functions. In systems with intensive information retrieval tasks, the three sets of design constraints interact with each other through the information structure. This viewpoint leads to a new design process that has three stages. Firstly, information requirements are gathered through task analysis and system function analysis. Secondly, analysis of the information requirements along different levels of abstraction reveals the information structure, which is built of hierarchical or network relations. The relations include part-whole relations, goal-means relations, similarity or counterpart relations, and temporal relations. Thirdly, the informational interface is designed on the basis of the task procedures and the information structure. The information components required on the user interface are identified according to the task procedures and their spatial and temporal locations are determined to reflect the information structure. This design approach can deliver information-heavy interfaces with robust usability since the interfaces are based on the inherent information structure, not only on the task needs. As a result, the designed interfaces can support or reinforce users' mental models. In this paper, the method was applied to the design of a web-based news-retrieval and monitoring system to illustrate the detailed process and the outcome of the suggested method. **KEY WORDS** User interface design; Informational Interface; Information structure; News retrieval system

1. Introduction

UI design process is typically based on a top-down approach which starts from the analysis of users' tasks to derive the interface requirements. Alternatively, some researchers (Guindon 1992; Yoon, 2001; Yoon, 2003) suggest that a bi-directional approach based on both task knowledge and interface knowledge may be more practical. It is based on that the design constraints usually come from both socially formed conventions at the task-level and technical availability or presentation standards at the interface level.

In addition to the above two sources of constraints, this paper contents that the set of given system functions should also be considered another important source of design constraints since the physical function elements are usually conceived or technically determined before the UI design. These constraints do not necessarily hinder the usability of resulting interfaces. Properly observed constraints may actually play the role of the ground of communication between the designer and the users by fulfilling the common expectation of the users based on their common knowledge.

This paper presents a new UI design method that helps to achieve optimal usability in a systematical manner reflecting design constraints from the three major sources, which are task, interface, and system functions. The proposed method identifies the required information structure integrating the task constraints and system function constraints and put it in the center of UI design. This approach is reasonable since, in the information system, information is in the center of tasks and functions. The proposed method was applied to the UI design for a web-based news retrieval system.

2. Overview of the Design Process

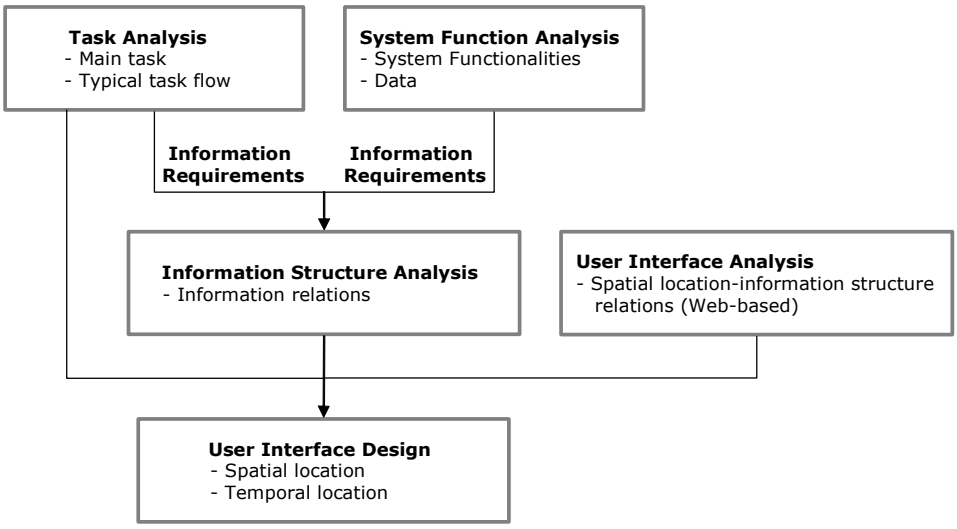

Figure 1. UI Design Process

Information requirements are first obtained through task analysis and, in more detail, system function analysis. Information requirements obtained through task analysis are general and system-independent. The requirements include both the contents of information and the required processes. System function analysis determines the availability of these contents and processes on the basis of the functions and data provided by the system. Also in this stage, more detailed identification and definition of the information requirements become possible. Some marginally required information and processes may or may not be included in the design depending on whether they are easily made available in the target system.

A comparative analysis of the information requirements reveals the relations within the required information and leads to the information structure which consists of multiple levels of abstraction. The spatial and temporal organization of the information elements being represented on the interface is determined based on the identified information structure. This match between the commonly

understood and expected information structure and the presented interface enables users utilize their mental models and also strengthen the models through the use.

Each stage of the overviewed design procedure is explained in the rest of this paper using the examples that appeared during a practical design of the news-retrieval system.

3. Information Requirements Gathering Through Task Analysis and System Function Analysis

Through task analysis, typical tasks of news-retrieval behavior were identified and the task flow was analyzed as shown in Figure 2. Information requirements of each task step are shown in the second column in Table 1. Because information requirements obtained from the task analysis were general and system-independent, more detailed information was obtained from system function analysis as shown in the last column in Table 1.

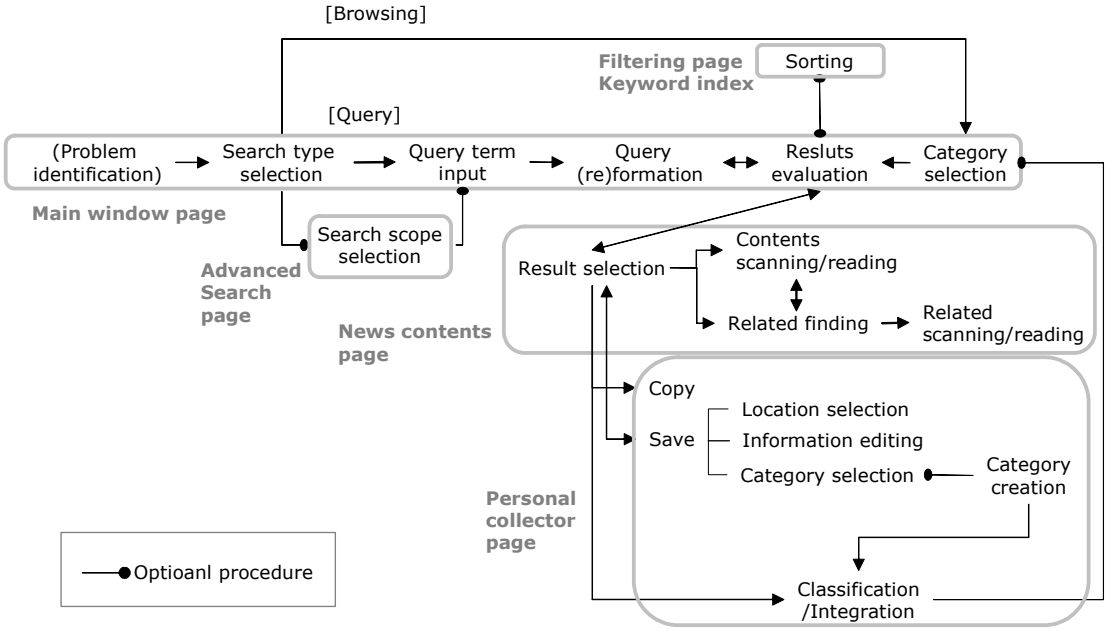

Figure 2. Typical Task Flow of News-Retrieval Behavior

Table 1. Information Requirements Analysis through Task Analysis and System Function Analysis

Task	Information requirements through task analysis	Information requirements through system function analysis
Search scope selection	Search scope	News type (event/news), Date, Category (topic section, event category)
Query term input	Query term	Keyword, Thesaurus
Category selection	Classification Category	Event category (event list), Topic section category
Results evaluation	News	Headline, Contents, Keyword, Date
Sorting	Sorting item	Date, Degree of match with query keyword
Result selection	News	News
Contents scanning/reading	News contents	Headline, Contents, Keyword, Date
Related finding	News	Event, News

In the system function analysis, information provided by the system functionality and the specified data types of *NewsML*, which is an XML-based standard format to represent and manage news, was

analyzed. The major functions of the system were *text partition*, n*ews indexing*, *topic detection*, and *topic tracking*. The text partition and news indexing technologies were used to index keywords, news terminology, and a thesaurus. The topic detection and tracking functions analyzed the temporal and geographical information in the news content and automatically associated the related news with each other as time passed. By these functions, a news item, when first occurred, is marked *new event*. The chief news editor selected 'main events' among them and the subsequent news which were related to the main events were classified accordingly. Similarly, each reporter or viewer could establish *personal events* and accumulate the news items related to the events. News documents are classified into not only the event classes but also *topic section* categories. Topic section categories were determined by the company and defined in *TopicSets* class in NewsML format. The topic section included 10 main sections (i.e. politics, economy, industry, national, international, culture, science, accident, speech/publication, sports) and 62 sub-sections. News headline, sub-headline, contents and metadata such as keyword, date, and copyright were stored in *NewsLines* class.

4. Information Structure Analysis

The gathered information requirements were analyzed to reveal the information structure, which consisted of the relations among information elements and classes. The relations included both vertical relations that associated higher and lower level information constructs and horizontal relations that connected the information elements at a same abstraction level. The vertical relations were either part-whole relations or goal-means relations. The horizontal relations were temporal relations and similarity/counterpart relations. The relations defined and used in the system were shown in Table 2.

Table 2. Information Relations in Information Structure

Information-Information	Information relations
Query keyword-events/news	① Cross-levels: goal-means relation
Main topic section-sub topic section	② Cross-levels: part-whole relation
Topic section-event list	③ Within-level: equivalent, independent (own lower level news jointly)
Topic section-news	④ Cross-levels: part-whole relation
Main event-new event	⑤ Within-level: equivalent, independent (do not own lower level news jointly)
Main event-personalized event	⑥ Within-level: equivalent, independent (own lower level news jointly)
New event-personalized event	⑦ Within-level: equivalent, independent (own lower level news jointly)
Topic section/event-news	⑧ Cross-levels: part-whole relation
News-keyword	⑨ Cross-levels: part-whole relation
Event-event, News-news	⑩ Within-level: equivalent
News-news (related news)	⑪ Within-level: equivalent, similar and counterpart relation
News-metadata/contents	⑫ Cross-levels: part-whole relation, whole-component

5. Interface Design

The allocation of functions and information on each web page were performed based on the task flow shown in Figure 2. On the main page, users could search news by querying or browsing through topic section or event lists and evaluate retrieved news results. On the news-contents page, users accessed the contents and related information for specific news item which was selected in the main

page.

Users tended to expect particular information to be presented in a specific location according to their mental models and previous experiences. The relative locations on the web pages - top, bottom, right, left and center - were associated with representative information characteristics. The association used in this research was summarized in Table 3.

Table 3. Information Characteristics on Spatial Location of Web Page

Location on web page	Information characteristics and relations
Top	ⓐ Information of the highest level of abstraction
	ⓑ Higher level of information for contents
bottom	ⓒ Metadata ⓓ Additional information
Left	ⓔ Higher level of information for contents
Right	ⓕ Higher level of information for contents ⓖ Metadata
center	ⓗ Main information, contents
Top-bottom	ⓘ Equivalent, dependent
Left-right	ⓙ Equivalent, independent
Top-center(left-center)	ⓚ Cross-levels, dependent, part-whole relation, goal-means relation
Right-center	ⓛ Cross-levels, dependent, part-whole relation, goal-means relation
	ⓜ Related information
Center-bottom	ⓝ Main information-additional information ⓞ Contents-metadata

The information elements to be provided on each page were selected from Table 1 and their spatial locations were determined by comparing the information relations and characteristics that appeared in Table 2 and Table 3. The mapping and locating results are shown in Table 4 and the prototype web pages are shown in Figure 3.

Table 4. Spatial Location of Information on Web Page

Main page			News-contents page		
Information	Information Characteristics mapping	Spatial location	Information	Information characteristics mapping	Spatial location
Query field -event/news	①+ⓚ	Top-bottom	Query field	①+ⓚ+ⓐ	Top
Query field	①+ⓚ+ⓐ	Top	Topic section	③+ⓙ+④+ⓚ+ⓔ	Left
Topic section -event list	③+ⓙ	Left-right	News-classification (section/event)	⑧+ⓘ	Center-right
Topic section -news list	④+ⓚ	Left-center	News-keyword	⑨+ⓘ	Center-right
Topic section	③+ⓙ+④+ⓚ+ⓔ	Left	News-related news	⑪+ⓜ	Center-right
Event list-news	⑧+ⓘ	Right-center	News (contents)	ⓗ	Center
Event list	⑧+ⓘ+ⓕ	Right	Classification (section/event)	⑧+ⓘ+ⓕ	right
Event/news	ⓗ	Center	Keyword	⑨+ⓘ+ⓖ	Right
News -current input news	⑩+ⓝ	Center-bottom	Related news	⑪+ⓜ+ⓖ	Right
Current input news	⑩+ⓝ+ⓓ	bottom	Current input news	⑩+ⓝ+ⓓ	bottom

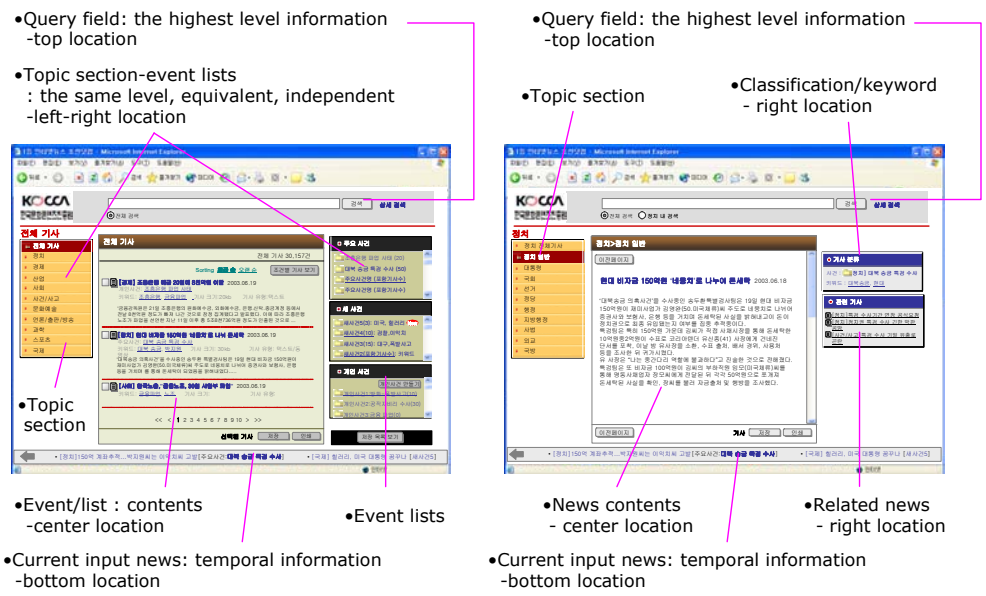

Figure 3. Prototype Screen Shots; (a) Main Page (b) News-Contents Page

6. Conclusions

In this paper, a design process for informational UI which enables integrating and reflecting the constraints from tasks, interface means, and system functions is suggested. Using the suggested method, designers can systematically determine the optimal spatial and temporal locations of the information items on the UI according to the information structure which corresponds to users' mental models. In such an information system, information to be retrieved is in the center of the tasks so that it should be explicitly used for the integration of design decisions. The proposed information design process aims to provide a comprehensive and generalized design process, although the strongest emphasis was put on practical usefulness.

Acknowledgement

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