An Approach to Spatial Visualizing Method for Information Structure to Enhance Remember to Look

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Abstract. Individuals living in our information-driven society can feel overwhelmed by the amount of information as well as the myriad of technologies they can use to access it. Personal information management (PIM) is an activity in which an individual stores personal information items in order to retrieve them later. One ideal of PIM is that we always have the right information in the right place, in the right form, and of sufficient completeness and quality to meet our current needs. Personal information storage tends to become enormous over time. In addition, its structure can also become diversified and complex, resulting in information that is scattered in different forms across various devices and multiple versions. One way to solve the issue of information fragmentation is to emphasize the concept of remembering to look. Most information management system representations are using spatial metaphors, where virtual objects are displayed similar to physical objects in the actual world. The power of spatial metaphors lies in people's tendency to naturally use spatial metaphors.

Keywords: Spatial metaphor · Information structure · Personal information management

1 Introduction

Skills in the effective use of information are essential for individuals living in our information-driven society. Improvement to accessibility of information and communication technology (ICT) have placed new emphasis on both the quality of technology use as well as users' attitudes, thus going beyond the numbers of people who are able to access to use such technologies. Individuals living in our information-driven society can feel overwhelmed by the amount of information as well as the myriad of technologies they can use to access it. In addition to this, they often face much more information than can be consumed in current single session. Therefore, they must be able to identify information needs, to locate corresponding information sources, to extract and organize relevant information from each source, and to synthesize information from a variety of sources into cogent, productive uses [1]. Knowledge and attitudes, which are needed to carry out the above-mentioned activities, can be defined as 'information literacy' [2].

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There is no argument that technology, such as computers have potential to improve people's ability to manage information. Researchers in the human–computer interaction (HCI) field have consistently suggested that technology can improve performance; however, new technologies often result in individuals focusing on the technology itself rather than its purpose (i.e., information). There are limitations to focusing a specific technology or device on an entire collection of information that already has been fragmented. Therefore, improving performance in a specific field would not be enough. In recent years, there has been increased discussion of human–information interaction (HII), which investigates how people interact with information [3]. Interest in HII is due in part to a realization that these interactions are more central to our lives than are our interactions with computers [4]. Combining HCI and HII will provide new opportunities for increasing storage, retrieval, and effective use of information, and could result in the examination of technology from an integrated perspective, which takes into account human aspects as well as information and technology.

2 Literature Review

2.1 Personal Information Management

Personal information management (PIM) is an activity in which an individual stores personal information items in order to retrieve them later [5]. Moreover, it places special emphasis on the organization and maintenance of personal information collections those are stored for later use and repeated reuse [4]. Ease of retrieval is a key aim of PIM; however, its purpose is not solely focused on being able to find material again. One ideal of PIM is that we always have the right information in the right place, in the right form, and of sufficient completeness and quality to meet our current needs [4]. Jones claimed three core activities for PIM such as finding/re-finding, keeping, and meta-level (Table 1).

Finding activity is based on the people's needs to information. People seek, search, and browse information to satisfy their own goal. This activity might be a sequence of interactions rather than a single stage. They scan through results to determine information items that relate to a need. It the result wasn't enough to satisfy their need, additional finding activity would be required.

Activity that related with keeping is the way to create connection between new and old information items. It is not only about information itself rather also includes channels of information. Tasks related with information activity used to produce much more information that can't be consumed in the single session. It generally leads people's fear to forget, kind of prospective memory failure.

Table 1. Three personal information management core activities

Activities	Description
Finding/Refinding	Retrieve information from personal or public information storage
Keeping	Store information into personal information storage
Meta-Level	Focus on the personal information storage for management and organization

Meta-level activities operate broadly upon information within the personal information storage and on the mapping that connects need to information for such information. The prefix of "meta-" contains the meaning of "beyond," and "about" as well as "after." This activity attempts to enhance user's controllability to their personal information storage by stressing proactivity.

These three activities are interrelated, and help people to establish, use, and maintain a map between information and need. For example, "Keeping" activity is closely related to how the user may organize and manage the information in their personal information storage (i.e., "Meta-level"), and how they retrieve it later(i.e., "Finding/Refinding"). Keeping information into the right place in accordance with future need has never been easy [6]. It is a cognitively difficult and error-prone activity due to the inconsistency of human memory. The definition or purpose of a folder is often unclear and may change over time; for example, people often forget about folders they previously created for the same purposes. Therefore, as information is fragmented in diverse places—often too many to keep track of— it becomes increasingly harder to find in the future.

2.2 Information Fragmentation

Personal information storage tends to become enormous over time. In addition, its structure can also become diversified and complex, resulting in information that is scattered in different forms across various devices and multiple versions. Moreover, the convergence of social and cloud computing, along with the growing presence of networked devices, are creating new opportunities for people to move personal files to online places [7]. This means that individuals have more places to store and to find their information, across technologies, devices, and services. It can be defined as "Information fragmentation", and it creates problems for keeping, finding, and meta-level activities such as maintenance and organization [4].

2.3 Remember Where to Look

PIM includes the management of information going into our own memories as well as the management of external information, or information going into our storages. One way to solve the issue of information fragmentation is to emphasize the concept of remembering to look. Jones [4] selected remembering to look as a starting point of finding activity (i.e., the sense that the information is "in there somewhere"). Greater sense of control and context over the search process lessens the cognitive burden associated with query articulation.

3 Research Proposition

3.1 Information Presentation with Spatial Metaphor

A useful information system will target people's natural understanding of information use. Most information management system representations are using spatial metaphors,

where virtual objects are displayed similar to physical objects in the actual world. The power of spatial metaphors lies in people's tendency to naturally use spatial metaphors. The key to designing effective information navigation tools lies in discovering how people naturally conceive of information spaces, including the extent to which such spaces are thought of in terms of physical space [8]. It is easy to find virtual objects that following spatial metaphor such as a scroll bar and icons on desktop screen because their locations are intuitive. Most information spaces follow a two-dimensional (2D) desktop paradigm that uses a flat surface of display; however, the amount of information that has to be handled is increasing, and its structures are becoming increasingly complex, so this paradigm is approaching the limits of its own capacity.

Three-dimensional (3D) information space that replicates the way we live has also been suggested as a way to represent large amounts of information and to enhance the presence of that information. Application of spatial metaphors in 3D space can significantly improve individuals' recognition capabilities as well as the success of retrieval tasks. This is supported by empirical research studies for example, "data mountain" [9, 10]. Strengths and weaknesses of 3D space, however, both arise from the structure itself. A follow-up study that included a data mountain structure in actual physical space revealed that performance was lower in the 3D space than in a 2D space [11]. While 3D representations can convey more information, they consume much more human navigational capacity. These costs may take the form of additional cognitive load associated with the cognitive representation of three dimensions [12] or additional load associated with more complex procedures for generation of navigational commands. This means that 3D space requires people to make an extra effort.

Weaknesses of using 3D informational spaces are also associated with people's greater familiarity with 2D virtual interfaces [13]. For example, there is no word that represents exact direction to alert to someone who was in danger from being hit by a flying baseball immediately. In this aspect, free 3D space might require more effort to locate information, resulting in lowered performance. Formulaic information spaces that are in some way constrained might be better than a less structured 3D information space.

3.2 Visualizing Information Structure

Creating a structure for personal information storage through classification and organization is a fundamental part of PIM, because large environments cannot be viewed all at once. Indratmo and Vassileva [14] summarize organizational structure in information systems by dividing it into five types: hierarchical, flat, linear, spatial, and network (Table 2).

Table 2. Five structures of information organization

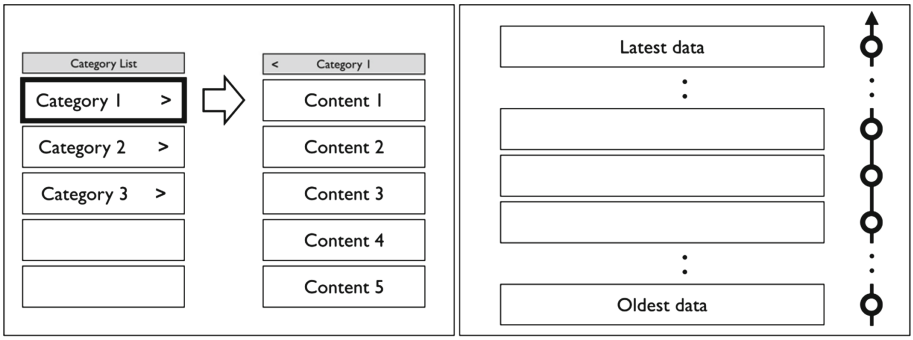
Structure	Example
Hierarchical	Folder and files
Flat	Tag
Linear	Alphabetically, chronologically ordered list
Spatial	Icons on the desktop
Network	Hypertext, link between items

These conceptual structures can be applied to the classification and organization of meta-data, and their representation can be visualized as an information space. Such a collection or visual inventory would allow these materials to be browsed through, giving users a sense of what they have [7] (Fig. 1).

Hierarchical structure is familiar to most people as folders and files. It visualizes hierarchical relationship between concepts and to help users to see such relationship. However, building a hierarchical structure in information can be a heavyweight cognitive activity due to our inconsistent memory. Concepts in information system are loosely related therefore information may be stored in multiple places in the system.

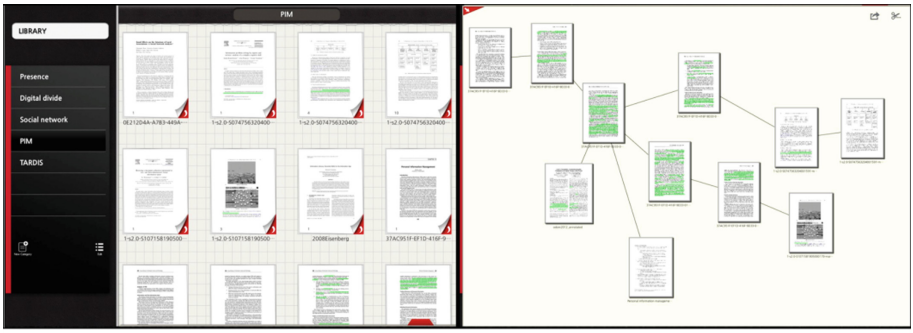
A flat structure can be represented as tags to label items. Several tags can be applied to a single item, so it may be more flexible than a hierarchical system. However, it is not surprising that these tags are often assigned inconstantly. It could be hard to search all relevant information with flat structure.

Linear structure arranges information items in an ordered list based on single attribute for example, time. It can be useful to maintain contextual aspect of information because people often arrange events in chronological ordering in their mind. Considering complexity in personal information system, property of linear structure that only single attribute can be applied at a time, can be a problem because relationship between items could not be captured. It is noteworthy that a linear structure such as time can be visualized in an information space. The domains of space and time are similar in their conceptual structure. People usually think about time using space as a metaphor. The spatial time metaphor is a one-dimensional, rather than a multidimensional, plain or space. This metaphor provides the relational information needed to organize events in time [15]. In our minds, past, present, and future occupy different positions on the line. This can be an intuitive and effective solution for locating time in space. When time is mapped onto the spatial dimension, its distance represents temporal duration, which allows people to estimate temporal duration using spatial distance [16]. It is also possible to predict a specific moment of time using a specific point in the spatial dimension. This means that people do not need to see a visual timeline at all times in order to estimate events in time. Partial information, such as hidden timelines



a) Hierarchical visualization b) Linear visualization

Fig. 1. Hierarchical (a) and Linear (b) visualization



a) Spatial visualization b) Network visualization

Fig. 2. Spatial (a) and network (b) representation

and a mid-point, are sufficient to recognize an event in time. This notion provides a guideline for constructing a timeline in information space (Fig. 2).

Spatial structure uses positions in display and user's mind in order to organize items. It is well known as computer desktop paradigm in a digital context with locating different types of information into different places. Visible items in desktop can be easily accessible, but it would not be efficient for large group of information items. There were several suggestions to overcome this problem with combining linear structure [17], but it is not widely used to store information.

Network structure is represented as a hypertext system. Providing link between different types of information items allows flexibility to system, meaning possibility to avoid structural constraint. However, it could be hard to see overview of whole structure, or navigate through it successfully. Hypertext, such as Internet document that is connected to a document via a link, also can be visualized in an information space. Moreover, this visualization can reduce users' cognitive effort in information activities. For example, individuals can connect information currently being viewed to information that was viewed previously; thus, spatial location can help individuals avoid "feeling lost" in complex information spaces. Much current research in hypertext appears to use the term "space" in its everyday sense, or as a physical relationship between objects [13], creating the notion that hierarchical and networked structures of information such as links between folder-contents or content-content can be visualized in information spaces. Other structures also have potential for visualization. Every possibility should be examined thoroughly.

4 Concluding Remarks

The primary motivation for this research came from a desire to leverage natural human capabilities to better understand information management. Based on prior research, new information management systems can be developed. Although a particular system will be developed and studied in this research, its concept can be applied to various types of information systems. The ultimate goal of this research is to make better use of

people's valuable resources such as time, effort, and attention. In addition, might improve personal productivity and teamwork. In conclusion, improvements in information literacy programs are also expected. We live in a very complex and often overwhelming information world, and I personally believe that researchers who focus on information and information systems have a responsibility to help people make its retrieval, use, and application easier and more natural.

References

1. Moore, P.: Information problem solving: a wider view of library skills. Contemp. Educ. Psychol. **20**, 1–31 (1995)
2. Eisenberg, M.B.: Information Literacy: Essential Skills for the Information Age. DESIDOC J. Libr. Inf. Technol. **28**(2), 39–47 (2008)
3. Fidel, R.: What Is Human Information Interaction? Human Information Interaction: An Ecological Approach to Information Behavior, pp. 17–43
4. Jones, W.: Personal Information Management. Annu. Rev. Inf. Sci. Technol. **41**, 453–504 (2007)
5. Bergman, O.: Variables for personal information management research. Aslib Proc. **65**, 464–483 (2013)
6. Bruce, H.: Personal, anticipated information need. Inf. Res. 10(3) (2005). http://www.informationr.net/ir/10-3/paper232.html
7. Odom, W., Sellen, A., Harper, R., Thereska, E.: Lost in translation: understanding the possession of digital things in the cloud. In: Presented at the CHI 2012: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, New York, USA, May 2012
8. Maglio, P.P., Matlock, T.: The conceptual structure of information space. In: Höök, K., Benyon, D., Munro, A.J. (eds.) Designing Information Spaces: The Social Navigation Approach, 385–403. Springer, London (2003)
9. Jones, W.P., Dumais, S.T.: The spatial metaphor for user interfaces: experimental tests of reference by location versus name. ACM Trans. Inf. Syst. (TOIS). **4**, 42–63 (1986)
10. Robertson, G., Czerwinski, M., Larson, K.: Data mountain: using spatial memory for document management. In: Presented at the Proceedings of the 11th annual ACM symposium on User interface software and technology, New York, USA (1998)
11. Cockburn, A., McKenzie, B.: Evaluating spatial memory in two and three dimensions. Int. J. Hum. Comput. Stud. **61**, 359–373 (2004)
12. Barshi, I., Healy, A.F.: The effects of mental representation on performance in a navigation task. Mem. Cogn. **30**(8), 1189–1203 (2002)
13. Boechler, P.M.: How spatial is hyperspace? interacting with hypertext documents: cognitive processes and concepts. Cyber Psychol. Behav. **4**, 23–46 (2001)
14. Indratmo, J., Vassileva, J.: A review of organizational structures of personal information management. J. Digit. Inform. **9**, 1–19 (2008)
15. Boroditsky, L.: Metaphoric structuring: Understanding time through spatial metaphors. Cognition **75**, 1–28 (2000)
16. Casasanto, D., Boroditsky, L.: Time in the mind: using space to think about time. Cognition **106**, 579–593 (2008)
17. Lee, J.-G., Lee, K.C., Shin, D.-H.: A New Approach to Exploring Spatiotemporal Space in the Context of Social Network Services. In: Meiselwitz, G. (ed.) Social Computing and Social Media, pp. 221–228. Springer International Publishing, Cham (2014)