# Setting of Document Importance Based on Analysis of User's Usual Working

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## Abstract
We studied a system that allows users to browse multiple documents on a tabletop display. However, in such situations, important documents may be buried, just as they do in the real world. To solve this problem, we investigated which documents were the most important for users by observing and analyzing their usual working patterns. As a result of this, we found that writing and the position, frequency of use, and the date of documents are related to importance. In particular, we focused on writing and position. Then, based on these two parameters, we developed a system that sets an importance level to each document.

## Author Keywords
Tabletop; Document; Support; and Importance.

## ACM Classification Keywords
H.5.2. User Interfaces---Interaction, styles, Theory and methods,

## General Terms
Design, Human Factors

## Introduction
Tabletop displays and electronic documents are increasingly common; it is anticipated that tabletop displays will come to be used as a personal working space since users read more electronic documents.

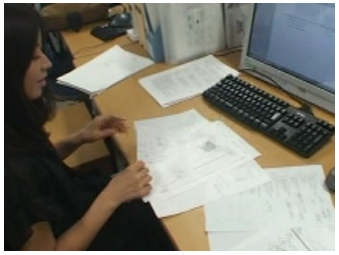

**Figure 1**. An actual desktop with scattered and stacked documents

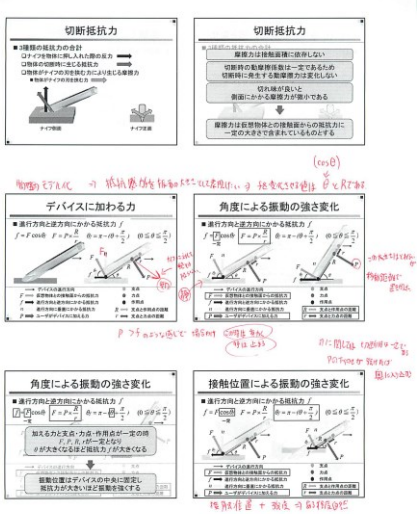


**Figure 2.** Example of document that was classed as "very important" with comments on content and some marks

Girgensohn et al. [2] developed a specialty document browser for managing and reading electronic documents. They described how users quickly verified their desired document by displaying the thumbnail of the first page of the document, rather than by using icons. Features of tabletop displays include a large working space, free movement and placing of data, and touching data directly like real world. Therefore, we think that the features of desktop displays are appropriate for browsing multiple documents that are shown in readable size. There are some studies [3], [4] concerning reading a document that consists of multiple pages. Users can manage multiple files and folders on a tabletop display; thus, they can manipulate several documents simultaneously. However, in such situations, important documents may be buried, just as they do in the real world. Deller et al. [1] developed a system for managing and reading multiple documents, whereby users can place documents in a 3D space and organize important documents at the front. However, they need to set in advance which documents are more important to them.

Therefore, based on the user's usual working pattern, we aim to develop a system that can automatically suggest important documents.

## Analysis

We conducted a study (A) to investigate which documents the system should suggest as important to users. We observed six subjects' usual working patterns (Figure 1) and asked them what types of documents were important to them. As a result, we found that parameters such as the amount of writing and the position of the document, its frequency of use, and dates, such as dates of use and deadline date, all contributed to the importance of the document.

We aimed to develop a system that could extract the users' preference and intention from their normal working patterns and suggest the most important documents for each of them. In this study, we decided to start with using the amount of writing on the document and its position, because this was easy to quantify.

*Analysis of writing on documents*

In study (B), we asked 10 subjects to (1) provide documents that they used within a month and (2) answer questions about writing on these documents with (i) why, (ii) where, and (iii) what they wrote. The answers were (i) to easily find, add, and arrange information; (ii) important parts and parts with queries; (iii) using parenthesis, underlines, marks such as circles and stars, and notes.

We conducted study (C) to investigate the relationship between the writing and importance of the document. We asked the same 10 subjects to (1) provide around 10 documents that they used recently; (2) classify them into three grades based on importance (1: not important, 2: important, 3: very important); and (3) answer a questionnaire about the relationship between writing and the importance of the documents in question. All subjects reported a relationship between the amount of writing and the importance, and we observed this phenomenon from their documents (Figure 2). In addition, some of the subjects used different marks depending on the importance. For example, a star was more important than a circle. Where colors were used, these could indicate

**Figure 3**. Experimental setup in study (D)

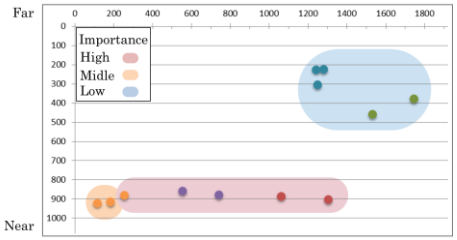


**Figure 4**. Result of study (D)


**Figure 5**. Result of importance setting based on the amount of writing

importance. However, in the cases in which a deadline was mentioned in the document, all subjects enclosed it in a circle for emphasis. Others answered that there was no relationship, and that they used multiple colors depending on the writing date and speaker.

From the above results, we found that the amount of writing was related to the importance of the document, whereas the use of marks and colors was different for each subject.

*Analysis of placing*

When the user worked with multiple documents as references, they placed the frequently used documents close for ease of use. We conducted study (D) to investigate the relationship between the position and importance of the documents. We asked five subjects to provide around 10 documents that they had used recently and to imagine making a new document using these documents as references. Furthermore, in this experiment, the document consisted of some pages that were divided and used as a single-page document. We measured some parameters that we thought were related to the importance of the document: the position and stacking order (every five seconds) and number of touches recorded. After the task, we asked them to rate the importance of each stack. We used a touch display that resembled a tabletop display (Figure 3). Subjects repeated this trial two times. The results of one of the subject are shown in Figure 4. Dots show the position of the document, with each document given its own color. Ellipses show a group of documents with the same importance level. As a result of the experiment, most subjects answered that the documents closest to them were more important. However, some documents were put close to the subject but were not read frequently, because they were at the bottom of the stack. When we focused on the stacking order, the documents that were placed further away and at the bottom of the stack were no longer used for the task and were not important. There was no relationship between the touch count and the importance of the document.

From the above results, we found there is a relationship between the position of documents and their importance, such as the distance between the user and the documents and the stacking order.

## Proposed method

*Importance setting by writing*

Figure 5 shows the result of setting importance based on the amount of writing. This system arranged the documents in the order of importance, starting from the front left.

Regarding marks and colors, usage was different with each subject. Therefore, in our system, the user could choose the marks and colors and sort the documents according to choice. Documents that had the same marks as the user's selection were placed from the front left, depending on the number of marks, and the others were placed from the rear left and sorted by the amount of writing. Sorting by color was the same as sorting by mark. In addition, by enclosing dates, importance could be set on the basis of date (i.e., the closer the deadline, the higher the importance). Documents in which the user enclosed the date in a circle were placed from the front left, similar to the case of marks and colors.

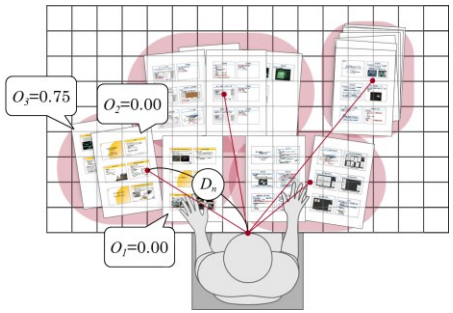


**Figure 6**. $O_n$ and $D_n$

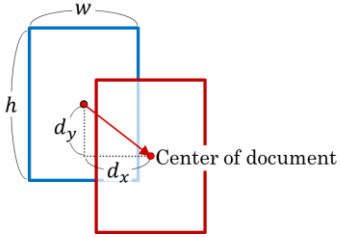


**Figure 7**. Calculation of $O_n$

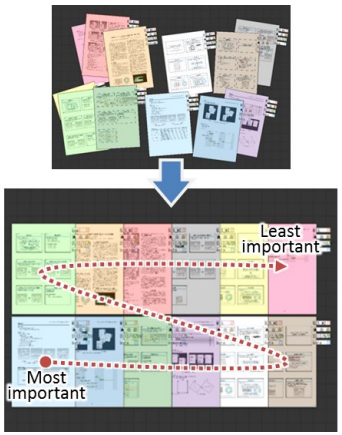


**Figure 8**. Result of importance setting based on position

*Importance setting by placing*

As a result of our analysis, we found that the importance of the document based on writing was related only to the amount of writing. However, in the case of importance based on the position of the document, we found both the distance and stacking order were related to the importance.

We made a model using these two parameters to calculate the importance of document $I_n$ using the following equation:

$$I_n = \frac{k}{D_n} + l \times (1 - O_n)$$

where $O_n$ is the parameter of the size of overlapped areas, $D_n$ is the parameter of the distance between the user and the center of the document group (Figure 6). We used this measurement instead of the distance to each document, because most of the subjects manipulated documents as a group. In this system, we classify all documents in the work space by Ward's method [5]. $O_n$ is given by the distance between documents using the following equation, where non-overlapped documents $O_n$ = 0 and perfectly overlapped documents $O_n$ = 1,

$$O_n = \frac{(w - d_x) \times (h - d_y)}{w \times h}$$

where the width and height of the document are $w$ and $h$, respectively, the x and y direction of distance between the central points of two overlapped documents are $d_x$ and $d_y$, respectively (Figure 7). Furthermore, as a result of study (D), we made the weight of $O_n$ greater than that of $D_n$. Therefore, $k > l$.

Figure 8 shows the result of the system that was implemented in this model. More important documents based on $I_n$ are placed at the front left.

## Conclusion and future work

In this paper, we observed and analyzed a user's usual working pattern to investigate which documents were most important for them. As a result of our analysis, we focus on the writing and position as the parameter which are related to importance. We realized to set the importance of the documents based on each parameter. A full explanation cannot be given because of limited space; however, users can use also the tag functions which are used in typical desktop system, and the tags are generated automatically based on the writing.

For future study, we will consider the importance setting based on the other parameters, and using the combination of the parameters. In addition, we will evaluate the usefulness of our system through an experiment. We anticipate the implementation of a learning function to our system for adapting each user's preferences based on their natural behavior.

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