A User Interface Using a Spiral Representation for Image Retrieval on a Mobile Terminal

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ABSTRACT
To efficiently visualize a set of images for a similar image search system on a mobile terminal which is equipped with a touch screen, we propose a method that ranked images are represented in a spiral manner and they can be dragged along the spiral for finding a target image. We also propose efficient search operations for the system. As a result of comparison experiments between our system and a traditional one, evaluations of our system in terms of 'intuitive', 'beauty', 'fun', and 'novelty' were higher than those of traditional one.

Author Keywords
Image retrieval; mobile terminal interface; image visualization.

ACM Classification Keywords
H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

General Terms
Human Factors.

INTRODUCTION

In recent years, small size mobile terminals such as smartphones have been rapidly and widely used. These devices equipped with a camera have been used for content based image retrieval such that similar images are retrieved from the internet based on a shot image with the camera as a search query and the similar images are displayed on the screen by the order of their similarities. Figure 1 (a) shows an example of an image retrieval system on a mobile terminal [2]. However, these systems have the following disadvantages: (1) Since these images are located in a reticular pattern, it is not easy to understand the similarity ranking of each image intuitively. (2) Since all the images are displayed with the same size, the number of displayed images on a screen is limited. (3) The page change operation is needed when a user wants to browse the other set of retrieved similar images. In this situation, the discontinuity is occurred in images between the pages.

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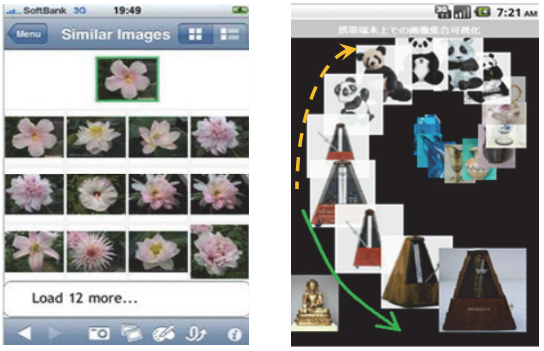
In order to solve the problems, we propose a method that locates a set of retrieved images in a spiral manner. We also propose suitable operations for our system.



(a) Traditional system [2] (b) Our system

Figure 1. Visualization of a retrieved image set

IMAGE DISPLAY IN A SPIRAL MANNER

In our system, since a set of images are displayed in a spiral manner as shown in Figure 1 (b), the problems (1) and (2) mentioned above can be solved as follows:

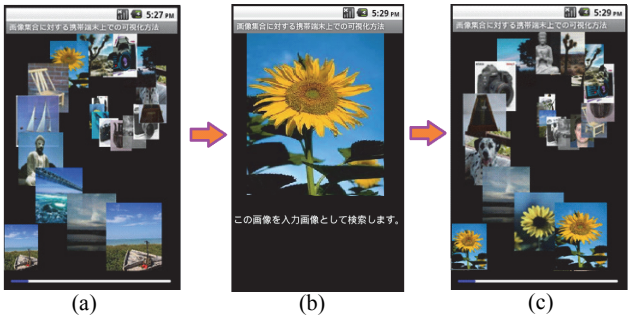
- A highly ranked image is located in front of a low ranked one and it is also displayed with larger size. Therefore, a user could intuitively understand the similarity ranking among the displayed images.
- Since two adjacent images are partially superposed each other and an image size is determined by its similarity ranking, our system can display a lot more images than the traditional one (See Figure 1 (a)). In our system, 20 images are displayed on a screen.

OPERATIONS FOR IMAGE RETRIEVAL

In our system, when a user drags the circumference of the images in a counterclockwise fashion such as the green arrow shown in Figure 1 (b), the images are rotated counterclockwise along the spiral and their image sizes are gradually increased. In this situation, if the size of the top ranked image is larger than a certain threshold value, it is disappeared and instead a low ranked image is appeared from the center of the spiral. On the contrary, when he/she drags the panel in a clockwise fashion illustrated by the yellow dashed arrow, it yields opposite effects. In addition, flick operation instead of drag yields more rapid rotational

transfer of the images. It is considered that since displaying of the sequence of ranked images is maintained all the time, it can solve the problem (3) mentioned in the introduction.

In an image retrieval system, it is necessary to search again with a new image query which is selected from the images displayed on a screen. Figure 2 shows this process. In this figure, the image of sunflower is selected as a new query. The selection of an image is done to touch around the upper left corner of the image for a certain time. The selected image is displayed on the other page and the confirmation text message is displayed under the image shown in Figure 2 (b). When a user taps the message part, the new retrieved images are displayed shown in Figure 2 (c). In the screen, the current query is located at bottom left.



(a) (b) (c)

Figure 2. Selection of an image and re-search

In addition, the following operations are also implemented:

- In order to understand the current position of the displayed image set among the ranked image sequence, the horizontal scroll bar is placed at the bottom of the screen. This bar is also used to jump to an arbitrary position.
- It is possible to enlarge an image by double-tap operation.
- When the query image at bottom left of the screen is touched for a certain time, a search history (in other words, the sequence of used query images) is displayed.

EXPERIMENTAL RESULTS

To construct an image retrieval system, we implemented the above-mentioned functions on an Android mobile terminal (Sony Ericsson Xperia acro). To compare our system with a traditional one, we also constructed a system which displays the retrieved images in a reticular pattern such as shown in Figure 1 (a). This system was also constructed on the same terminal. The target image database consists of 150 images extracted from Caltech 101 [1] and they were stored on an SD card which the terminal is equipped with. The degree of similarity between images was calculated based on a well-known color histogram method.

12 test users operated both systems (our system and the traditional one) and responded a questionnaire which consists of 7 evaluation items on a 5-point scale (5 is high and 1 is low). Figure 3 shows the result. As a result, the evaluations of our system in terms of 'intuitive', 'beauty', 'fun', and 'novelty' were higher than those of traditional one. It is considered that the spiral representation of the images and the drag operation for rotational transfer of them leaded to the high evaluation. On the other hand, the evaluations in terms of 'usability', 'viewability', and 'operability' were lower. The reason is that it was difficult to manipulate low ranked images and not easy to view them because their size are too small. In particular, for the novice users, a double-tap operation on the low ranked images tended to lead a false operation.

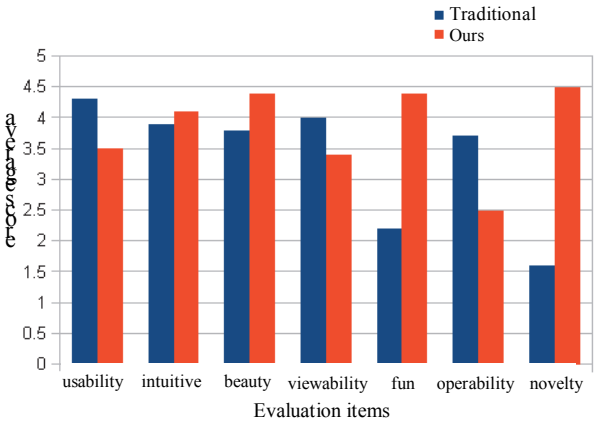


Figure 3. Questionnaire result for 7 evaluation items

CONCLUSION

In order to efficiently visualize a set of images for a similar image search system on a mobile terminal which is equipped with a touch screen, we proposed the method that the ranked images are represented in a spiral manner and they can be dragged along the spiral for finding a target image. To realize efficient search operations for the system, we also proposed the methods about the following functions: selection of an image and re-search, representation of the current position of an image set with a scroll bar, magnification of an image, and representation of search history. We implemented the above functions in a mobile terminal and 12 users tested the system. As a result, the evaluations of our system in terms of 'intuitive', 'beauty', 'fun', and 'novelty' were higher than those of traditional one. However, it was difficult to manipulate low ranked images and not easy to view them because their size are too small. In future work, we plan to improve the system by solving the problems.

REFERENCES

1. Caltech 101 image datasets. http://www.vision.caltech.edu/Image_Datasets/Caltech101/.
2. GazoPa similar image search. http://www.gazopa.com/.