PIBE: Manage Your Images the Way *You* Want!*

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Abstract

A customizable system for image browsing, named PIBE*, is proposed. In details,* PIBE *provides the user with a set of browsing and personalization facilities that enable an effective and efficient exploration of the image collection. The approach is novel and appealing because: 1) the personalization actions over the hierarchical organization of images are local, 2) the storage of the browsing structure is persistent, and 3) the provided GUI makes browsing and personalization facilities extremely intuitive and "easy-to-use".*

1 Introduction

The wide access to Internet together with the advent of digital photography make more and more pressing the need of efficiently and effectively managing growing amounts of digital data, such as pictures and images. Many systems have been proposed in the last few years (e.g., Picasa[1] by Google and flickr[2] by Yahoo), offering the user tools to create and manage their photo albums and providing image descriptions that facilitate access to them. However, the search capabilities of such systems are limited to *manually* associated metadata tags with the main consequence that the effectiveness of the result depends on the accuracy of user annotations. The usual way for overcoming the problems due to manual annotations of images is to describe image content by means of automatically extracted low-level features (such as color, texture, and shape) [3].

In this work we present PIBE,[3] a novel *adaptive* browsing image system that allows the user to create and manage personal image collections in a semi-automatic way. In PIBE images are characterized using color descriptors, which are used to automatically build a hierarchical browsing structure that groups together similar images. By means of a set of novel browsing and personalization facilities, appropriately supported by intuitive visualization graphical tools, the user is able to *explore* and *adapt* the provided structure depending on her current preferences. In this way, the semantic gap existing between the user subjective notion of similarity and the one according to which the system organizes the images is alleviated, if not completely overcome.

2 The PIBE System

We originally described PIBE in [1], where only a limited number of personalization functionalities were provided with respect to the extended version described in [2]. We present here the "de oro" version of PIBE, which now includes a brand new Graphical User Interface (GUI).

The core component of the PIBE system is the hierarchical browsing structure, called Browsing Tree (BT). In details, the BT is automatically derived from visual image descriptors whose only requirement is to be points (feature vectors) in a N-dimensional space. By recursively applying a (k-means) clustering algorithm on such visual image descriptors, images sharing low level characteristics are grouped together deriving the nodes of the BT. The image comparison criterion is based on a (dis)similarity function between the corresponding feature vectors. A key point to highlight with regard to the dissimilarity function is that each node of the BT uses an adaptive *local* criterion (weighted Euclidean distance) to compare images. In this way, user preferences are contextualized to the relevant portion of the dataset and the hierarchical organization of the BT avoids costly global reorganizations. At the first step of the clustering process, the k-means algorithm is applied to the whole dataset by using default weights; then, it is recursively applied down to the desired granularity level to each of the derived k clusters using an updated dissimilarity function whose weight components correspond to the inverse of the variance along each component of feature vectors within the cluster. Finally, for each node a *representative* image (i.e., the image that is closest to the cluster *centroid*) is selected for visualization purposes.

PIBE provides the user with two main functionalities,

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[1] Picasa: http://picasa.google.it/.
[2] flickr: http://www.flickr.com/.
[3] PIBE: http://www-db.deis.unibo.it/PIBE/.

Browsing and Personalization, that are available through an intuitive and user-friendly GUI.

Browsing: The user can explore the BT by means of a spatial visualization approach (named *Space View*), where feature vectors are mapped on the 2-D screen to highlight image similarity (the more images are close to each other, the more they are similar). In particular, within the Space View PIBE provides two browsing modalities to visit the image dataset: A traditional top-down modality (named *Vertical Browsing*), where the user selects an image on the display and zooms in the corresponding BT node; in the second modality (named *Horizontal Browsing*) the user expresses her interest in something that is similar to two or more images in the display, without having to visit all the relevant branches one at a time. In both cases, the visualization concerns the *local* content of one node (for the vertical browsing) or of two or more nodes (for the horizontal browsing).

On the other hand, to offer a *global* visualization modality of the BT, PIBE's GUI provides the user with a sequential visualization tool, named *Tree View*, which offers usual navigational facilities (expanding/collapsing nodes, visiting nodes, etc.). When the user clicks on (the representative image of) a BT node in the Tree View, the content of the Space View is replaced with images included in the selected node.

Finally, to help the user in remembering the history of its browsing session, the GUI provides a third visualization tool, named *Context View*, which takes memory of each vertical/horizontal exploration action by highlighting the sequence of clicked images, for the vertical exploration, and using a grey box to represent a horizontal browsing action. In particular, by clicking on each element of the Context View the user can return back to a previous visualization in the Space View.

Personalization: The initial structure of the BT may not always perfectly satisfy current user preferences. For example, some images may be included in the wrong subtree or a node may have too many/too few children. To overcome such problems, PIBE provides a set of personalization actions to help the user adapting the automatically built BT to her preferences.

The most frequent situation is when a node is included in the wrong parent node. The user may want to move the whole sub-tree (represented by the representative image of the node) or just a single image to another part of the BT. PIBE enables this behavior by mean of the *Fusion* action.

Another common problem is when a BT node is too specialized, i.e., it has too many children. In this case, by means of the *Merge&Divide* action, PIBE allows the user to reduce the number of children nodes.

Finally, it could be the case that a node is not considered by the user as an appropriate generalization of its children, e.g., because they are not deemed similar. In this case, by means of the *Split* action, the user can drop the parent node and substitute it with two or more selected children.

Fusion, Merge&Divide, and Split actions implicitly contain a local reorganization of the involved BT nodes (with the updating of their dissimilarity functions) and, consequently, of their sub-trees. However, the user may be interested in just moving some images around the BT, without affecting local similarity criteria, and in performing the more costly tree reorganization in the future. For example, this is the case when the user wants to reorganize the BT at a finer-than-cluster granularity level by moving single images between clusters. To this end, PIBE provides the *Graft* and *ReCluster* actions, respectively.

Personalization actions can take place in both the Space View and the Tree View by means of *drag&drop* or *menu item selection* modalities. The Context View does not support personalization actions, since it only represents the history of the current browsing task.

3 Demonstration

We designed PIBE for non-expert users that are interested in managing their own photos. Let us illustrate a possible usage scenario.

First of all, the user selects the file representing a specific pre-computed BT by means of the File menu option "Open a Browsing Tree". The selected BT is then loaded by PIBE and representative images of the first level of the BT (i.e., the content of the root node) are initially displayed into both the Space View and the Tree View. At this point, the user can execute either browsing or personalization actions as described in the previous section. For example, she can start exploring the collection content through the Tree View by recursively opening many BT nodes. When the user has a better idea on the organization of the provided browsing structure, she may desire to better explore a specific portion of the dataset by exploiting the functionalities offered by the Space View.

At the end of the session, the user can save the customized BT for future uses by selecting "Save the Browsing Tree" or "Save the Browsing Tree as..." from the File menu. In this way, the user can also have different personalizations of the same dataset for different purposes, thus allowing multiple browsing tasks.

References

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