Multiple Object Retrieval in Image Databases Using Hierarchical Segmentation Tree

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ABSTRACT
With the rapid growth of information, efficient and robust information retrieval techniques have become increasingly more important. Multiple object retrieval remains challenging due to the complex nature of this problem. The proposed research, unlike most existing works that are designed for single object retrieval or adopt heuristic multiple object matching scheme, aims at contributing to this field through the development of an image retrieval system that adopts a hierarchical region-tree representation of image, and enables effective and efficient multiple object retrieval and automatic discovery of the objects of interest through users' relevance feedback. We believe this is the first systematic attempt to formulate a comprehensive, intelligent, and interactive framework for multiple object retrieval in image databases that makes use of a hierarchical region-tree representation.

Categories and Subject Descriptors
H.3.3 [**Information Storage and Retrieval**]: Information Search and Retrieval – *relevance feedback, retrieval models, search process.*

General Terms
Algorithms, Performance, Design, Experimentation.

Keywords
Content-based image retrieval, multi-object retrieval, hierarchical region-tree, multi-resolution image segmentation

1. INTRODUCTION
With the rapid growth of information, efficient and robust information retrieval techniques have become increasingly more important. One of the challenges in this context is the ability to process, extract and discover semantically relevant information that may be embedded in visual data. The purpose of the proposed research is to develop a new visual information analysis, representation, and retrieval framework for automatic discovery of salient objects that are likely to be the user's query interest in image databases. This abstract will describe a content-based image retrieval framework which supports multiple object retrieval.

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We believe the key to achieving the above goal is a new systematic and hierarchical representation of visual information, and a related analysis and retrieval framework that make it possible for a machine to interpret an image in terms of its containing regions and their relationships. In the proposed research, an efficient and accurate hierarchical image segmentation algorithm based on multi-resolution analysis will be developed to alleviate the over- and/or under-segmentation problems through the preservation of associative relationships between image regions as a hierarchical region-tree. This algorithm will be designed in a way to simultaneously produce image segmentation results and hierarchical region-tree representations, which are typically obtained through two separate processes in existing approaches, so as to reduce the time complexity. The proposed framework uses the query-by-example approach which allows users to search image database given a query image. With hierarchical region-tree representations, the relevance of an image to the query image is thus measured according to the proper sub-tree comparison. As a full comparison of all sub-trees is unlikely to be feasible, we will design and develop an efficient strategy for selecting and comparing proper sub-trees. One possible selection strategy is based on the assumption that nodes at a higher level usually reflect the dominant objects which are often users' interest, while nodes at a lower level often provide local details for the objects at higher levels and are more likely to be over-segmented regions. Based on these heuristics, the proposed approach will perform proper sub-tree comparison in a top-down manner and stop searching further down the tree when a certain matching criteria is met. Another key contribution of the proposed research is the integration of relevance feedback into the proposed multiple object retrieval system, which allows automatic discovery of the objects of users' interest and is expected to improve the retrieval accuracy through feedback-retrieval loops. While there is a clear indication of needs for such interactive learning capabilities, we believe this is the first systematic attempt to formulate a comprehensive, intelligent, and interactive framework for multiple object retrieval in image databases that makes use of a hierarchical region-tree representation.