Thesis Abstract

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Title of Thesis:

A Multicontext-adaptive Query Creation and Search System for Large-scale Image and Video Data

Summary of Thesis:

This thesis addresses the dynamic adaptability of a multimedia search system to the contexts of its users and proposes a new query creation and search system for large-scale image and video data. The contexts of a user in this system are defined as three types of preferences: content, intention, and response time. A content preference refers to the low-level or semantic representations of the data that a user is interested in. An intention preference refers to how the content should be regarded as relevant. And a response time preference refers to the ability to control a reasonable wait time.

The important feature of the proposed system is the integration of context-based query creation functions with high-performance search algorithms into a unified search system. This system adapts the inverted list data structure to construct a disk-resident database model for large-scale data in high-dimensional feature space. The database model has an intrinsic property, the orthogonality of indexes, which facilitates the functionality of the query creation and search system. The query creation process consists of two main operations: (1) context-based subspace selection and (2) subspace manipulation that includes several unary and binary functions to alter and combine subspaces in order to reflect content preferences of users. The pruning search mechanism consists of three search algorithms that are designed to adapt to different types of intention preferences of users. Three search algorithms have a same processing logic: (1) prioritizing feature indices for searching based on the input content preferences, (2) initializing starting points of searching based on the input intention preferences, (3) iteratively finding relevant candidates, and (4) ranking candidates by actual relevance scores and returning top results to users.

This thesis contributes to the multimedia retrieval research field a solution to the tradeoff between functionality and usability of a search system. With the query creation method, the proposed system provides users with a flexible means to express their varying contextual preferences. Moreover, with the pruning search mechanism, the system maintains a comparative high search performance to other conventional search techniques without disrupting the feature space by dimension reduction or weakening retrieval capabilities by static indexing.

Two application systems has been implemented to demonstrate the effectiveness and applicability of the proposed system: a context-dependent image search system with dynamic query creation and a frame-wise video navigation system. Many quantitative experiments were intensively studied using these systems. The experimental results have shown a high usability of query creation functions to reflect imaginations of users into queries and the advantages of the search algorithms to obtain high performances comparative to other conventional search techniques.

Keywords: Multimedia Retrieval, Subspace Selection, Query Creation, Large-scale Data, Video Navigation.