شبكة المعلومات الجامعية

بسم اللّه الرحمن الرحيم

SALWA AKL

شبكة المعلومات الجامعية

شبكة المعلومات الجامعية

التوثيق الالكتروني والميكروفيلم

SALWA AKL

شبكة المعلومات الجامعية

جامعة عين شمس

التوثيق الإلكتروني والميكروفيلم

قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها

علي هذه الأقراص المدمجة قد أعدت دون أية تغيرات

يجب أن

تحفظ هذه الأقراص المدمجة بعيدا عن الغبار

SALWA AKL

بعض الوثائق الأصلية تالفة

SALWA AKL

بالرسالة صفحات

لم ترد بالأصل

SALWA AKL

Department of Mathematics
Faculty of Science
Cairo University

Storage and Image Retrieval from Multimedia Database systems

Presented by

Khaled Hammoud AL-Sultan

A thesis submitted in partial fulfillment of the requirements for the Degree of Master of Computer Science

Supervised by

Prof. Dr. Laila Fahmy Abdelal

Prof. Dr. Medhat Elmessiery

Dr. Hassan Desoky Hamed

April, 2001

Approval Sheet

Storage and Image Retrieval from Multimedia Database systems

By

Khaled Hammoud AL-Sultan

This thesis for the M.Sc. degree in Computer Science, Department of Scientific Computation, Faculty of Science, Cairo University, has been approved by:

NAME	SIGNATURE
Prof. Dr. Laila Fahmy Abdelal	L. F. Abdelal
Prof. Dr. Medhat Elmessiery	M. A. Elmessiery
Dr. Hassan Desoky Hamed	H. D. Hamed

Acknowledgements

I would like to acknowledge all the people who have assisted me throughout my studies at Cairo University. I am extremely grateful to my supervisors, Professor Laila Fahmy Abdelal, and Professor Medhat Elmessiery for their continuous guidance and encouragement, and the valuable time that they spent on this project with me. I really feel indebted to them, and their friendship is deeply valued.

I am extremely grateful to Dr. Hassan Desoky Hamed for his guidance and support throughout the year of my postgraduate study. His comments and suggestions have contributed in many ways to the successful completion of this thesis.

I wish to thank my supervisor Professor Mahmoud Sumuk in my country.

I feel deeply indebted to Government of Syria Arab Republic, that encouraged me to take further education with financial and moral support so that this work can be accomplished.

I would also like to thank my fellow postgraduate candidates and friends for their discussion, suggestion and assistance in this research.

Finally, I would like to dedicate this thesis to my parent, brothers, sisters, my wife and children. Without their love, patience, understanding, and support, I would not have finished this thesis.

Abstract

Storage and image retrieval from multimedia database systems has become a requirement for many contemporary information systems. Most commercial image retrieval systems associate keywords or text with each image and require the user to enter a keyword or textual description of the desired image. This text-based approach has numerous drawbacks: associating keywords or text with each image is a tedious task; some image features may not be mentioned in the textual description; some features are "nearly impossible to describe with text"; and some features can be described in widely different ways. In an effort to overcome these problems and improve retrieval performance, we have focused more and more on content-based image retrieval in which retrieval is accomplished by comparing image features directly rather than textual descriptions of the image features. However, content-based image retrieval is a research area which is still in its infancy, dedicated to the image retrieval problem.

Features that are commonly used in content-based retrieval include color, shape, and texture. Color is the most important low-level feature, therefore, in this thesis we have focused our research on color-based image retrieval. Specifically color histogram has been widely used for content-based image retrieval systems and remains the most popular method for capturing low-level color information that because it is very simple and fast to compute, and similarity calculation can be performed very easily.

However, a color histogram has been shown to be ineffective for large image databases, and it provides only a very coarse characterization of an image; images with similar histogram can have dramatically different appearances. Furthermore, color histogram fail to incorporate spatial information, and therefore tend to give poor results. Therefore, three image retrieval methods have been described for combining color and spatial information: Color coherence vector (CCV), centering refinement (CR), and image grid technique (IG).

Unfortunately, these techniques have several limitations. For example, a Color coherence method concentrates on the idea of coherence pixels without taking into account spatial information, and Centering Refinement method concentrates only on distribution of color in an image. For this reason we propose a retrieval method called, Centering Coherence Method (CCM). It aims to overcome the above mentioned shortcomings and to improve the performance of image retrieval system.

The proposed method incorporates between Centering Refinement, and Color Coherence Vector method.

Finally, we present a prototype image retrieval system that allows a user to input an image and retrieves all images from a database similar to the user input image. Five retrieval methods have been implemented in this system, Color Histogram, CH), Centering Refinement, CR), Image Grid (IG), Color Coherence Vector (CCV), and Centering Coherence Method (CCM). The performance of the retrieval methods has been evaluated based on examining the two retrieval effectiveness measures *recall*, and *precision* .

In summary, the experimental results have shown that the retrieval results using the proposed scheme exhibit higher retrieval efficiency than other techniques. Specifically, the IG technique exhibits higher average precision and the proposed method provided the highest average precision over all others retrieval techniques.

Contents

Chapter 1

Introduction

1.1 Multimedia Databases

Multimedia databases systems are one of the most active research area in computer science. The media is an important aspect not only of the civilized societies, but also for the global interaction as a whole. The media may be defined so the meaning of communication among peoples (this communication can be either one person and the other persons; a person and TV, or a person and computer etc.), broadcasts, newspapers, and publishing books, and so on. Thus a **multimedia** is an amalgamation of three branches namely: the media world, the telecommunications, and the computer industry.

Multimedia database is a database that contains one or more types of information such as text, image, video clip, sound, diagram, and graphical animation. The types of information may be classified as three categories, firstly time-independent (sometimes-called static media data), secondly time-dependent (sometimes-called dynamic media), and thirdly dimension data like 2D and 3D. The data such as sound and video is categorized as time-dependent data because they have duration in time.
Multimedia database system is a system capable of storing, manipulating, and retrieving multimedia data effectively [Subrahmanian, 1998]. It is more complex than a conventional database. Moreover, the multimedia area is too broad, and very hard to cover all areas related to the multimedia systems. For this reason, we will focus in this thesis on the data models in the image database and the efficient query and retrieval processing algorithms.

1.1.1 Multimedia Data Model

The data types found in a typical multimedia database include

- Text
- Images: color, black and white, photographs, maps, and paintings

- Graphic objects: ordinary drawings, sketches, and illustrations, or 3D objects
- Animation sequences: images or graphic objects (usually) independently generated
- Video: also a sequence of images (called frames), but typically recording a real-life event and usually produced by a video recorder
- Audio: generated from a recording device
- Composite multimedia: formed from a combination of two or more of the above data types, such as an intermix of audio and video with a textual annotation.

Usually, individual objects in an image, or a video frame have some spatial relationship between them. Such relationships usually produce some constraints when searching for objects in a database. Multimedia information characterized by huge volumes of data. For instance, to store an uncompressed image of 1024 × 728 pixels at 24 bits per pixel requires a storage capacity of about 2 Mbytes. With a 20/1 compression ratio, the storage requirement could be reduced to about 0.1Mbyte. If we consider a video example, a ten-minute sequence of the same image at 30 frames/sec requires about 38,000 Mbytes of storage reducible to about 380 Mbytes with a compression ratio of 100:1.

Mathematical Model

The modeling of multimedia data is very necessary to organize and represent of multimedia features that to enable users to access, query, and retrieve efficiently. In this section we describe a mathematical model [Rui and Chang, 1999] for multimedia data. This model will take into account semantic levels or semantic features.

$$O = O(D, T, F, R) \qquad (1.1)$$

- D is the raw data of the object, e.g. a JPEG image, or an MPEG video, etc.
- T is the textual description of the multimedia object, this description include :
  - Fixed descriptors like title, author, year, etc. these descriptors are associated with the object.
  - Free-text description of the object.