

# Using a Fuzzy Object-Relational Database for Colour Image Retrieval

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**Abstract.** The paper presents a fuzzy database management system, and a fuzzy method for dominant colour description of images, on which an image retrieval system is built. The paper shows the suitability of the fuzzy database management system for this kind of applications when the images are characterized by fuzzy data. The synergy of these two introduced components, improves traditional image retrieval systems in three aspects: natural and automatic image description, a natural and easy query language, and high performance in query resolution.

## 1 Introduction

Nowadays, large image collections offered to non expert users in near to real time environments (i.e. through web sites) are becoming more common. This kind of systems manage a huge amount of data, are concurrently accessed by many users, and require fast query resolution. In our opinion, three key issues are decisive in this kind of systems, natural and automatic image descriptors, a natural and easy query definition mechanism and high performance in query resolution. This paper proposes the usage of a combination of an automatic image description method and a Fuzzy Object-Relational Database Management System (FORDBMS) to solve these issues.

The initial approaches to image retrieval systems were based in textual descriptions of the images. Although it is an useful mechanism, the descriptions must be made by humans. Currently, image retrieval systems are based in automatic extracted image features, such as colour, texture and shape. Usually, these systems uses sample images or sketches to define queries, which can be inappropriate for non expert users.

In this paper we use a novel method for describing images based on its dominant colours [1]. This method takes advantage of fuzzy set theory for dealing with vagueness in colour descriptions. It describes the dominant colours of an image as fuzzy colours, and assign to each one a dominance degree. This fuzzy

approach lets define query conditions on the basis of linguistic terms, which seems to be more natural for non expert users.

The large amount of data requires a database management system (DBMS) to manage efficiently its storage and retrieval. The DBMS has to deal with the other two key issues: easy query definition and query processing performance.

To ensure high query processing performance, the employed DBMS must implement advanced query processing techniques, such as indexing and query optimization, and high availability, scalability and distribution degrees. Actual market leader DBMSs offer seamlessly all the previously required features. Despite of that, most actual DBMSs implements the relational data model, and some of them including object-relational features, which is not suitable to seamlessly manage fuzzy data required by the kind of image description algorithm considered in this paper.

On the other hand, a great research effort has been spend in making possible to store and manage fuzzy data in databases [2, 3, 4, 5, 6, 7]. Nevertheless, the existing fuzzy DBMSs (FDBMS) are research prototypes. These FDBMS, due to their early stage, are not able to ensure the previously required features for applications for the storage and retrieval of such large image databases.

In order to solve the drawbacks of both, actual DBMSs and the prototypical FDBMSs, we propose a Fuzzy Object-Relational model [8]. This model defines a group of types and operators to store, manage and query fuzzy data, which can be used to extend an Object-Relational DBMS (ORDBMS) to implement a FORDBMS. This extension consist in adding a group of user-defined types and operators to the ORDBMS taking advantage of its extension mechanisms. This approach combines the desired features of actual DBMSs and the ability of fuzzy data storage and handling of prototypical FDBMS. The resulting FORDBMS is very suitable for supporting flexible content based retrieval of images for the discussed type of systems.

This usage of extended datatypes and operators for including fuzzy data management in classical databases, matches with the SQL:1999 standard. This standard compliance lets express a fuzzy query in a fully SQL compliant sentence, which lets implement a SQL compatible fuzzy query definition language.

The rest of the paper is organized as follows. Section 2 introduces the mechanism for describing images based on its dominant colours. Section 3 describes the proposed FDBMS and depicts how it can be used to model the image descriptors. Section 4 describes the proposed operators for defining conditions used in image queries. Section 5 shows some query examples and their results. Finally, Section 6 highlight the concluding remarks and future works.

## 2 Dominant Fuzzy Colour Descriptor

To achieve a good performance in the retrieval process, efficient methods for describing images are needed. The current retrieval systems face this issue by means of features, such as colour, texture or shape [9]. In this context, dominant colours arise as a powerful tool for describing the representative colours in an image.