

0.6 ABSTRACT

The main topic of this research is the implementation of a mathematical approach for visual information retrieval (VIR) systems. The purpose of this research is the creation of a model design to predict behaviors in VIR systems to establish relations between elements that deal with VIR systems. A direct method is tested with a subspace arrangement approach. A radial basis function (RBF) is tested as similarity metric and the General Principal Component Analysis (GPCA) is modified inside its segmentation process.

The implementation of this mathematical model is to built of a corpus image selection, an appropriate descriptor method, a segmentation approach and a similarity metric process. These are called *VIR elements*. The goal of this research is to found a mathematical formalism to explain how all the previously mentioned items can be relation between and then to make predictions about behavior inside a VIR system.

Initially, four corpus of data are tested, the descriptor of RGB colors is implemented to obtain a three dimensional description of image data. Then a selection of radial basis function is used to implement a similarity metric. A visual image retrieval system is sketched obtaining a model of predictions that can be detected improving design of future VIR systems.

Several versions of GPCA were tested to select the best algorithm which achieve the highest segmentation of image set. A variation of Robust general principal component analysis with multivariate timming (RGPCA-MVT) were carried out to improve the percentage of successful segmentation. A radial basis function is implemented in the retrieval process of the VIR system.

Experimentations with COIL collections successfully retrieve an 88 % of queries. An improvement is obtained in the RGPCA-MVT with RBF (radial basis function) basis. The detection of ambiguity items to implement a VIR system can be achieved tested another kind of feature extraction methods. The Gutmann algorithm can be used in further works

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to improve the RGPCA-MVT segmentation.

The novelty of contribution in this research is to taken an approach that has been applied at ordinary differential equations that is applied in VIR field applied as similarity metric for a retrieval process with a radial basis function that allows encouraging results in image querying.

A variety of 24 publications have been written along the develop of this research, (see Appendix B for abbreviations) the conferences are: CISSE, PRIP, WSEAS, DCBIyT, NAN-OTRON, CORE, CARS & FOF, CEA, CERMA, SOMI, SIGMAP, PHAROS, CEUR, MCPR, AIAR, AND LANMR workshop. The most important publications are (Flores-Pulido et al., 2009(a)) in LANMR, (Flores-Pulido, 2009(b)) in PHAROS and (Flores-Pulido et al., 2010) in CERMA forums that helped to detail the research that is in your hands. One of each work published allow the maturity process of this work.

This document is structured as follows: Chapter 1 shows relevant details about our research work starting from an introduction to visual information retrieval area, the main challenges and systems developed and the general overview of our research. The methodology, objectives, hypothesis, and a briefly mention at our contribution are explained. Chapter 2 gives generalities of related works that are divided in GPCA and RBF related applications that provide relevant ideas at DSM develop. Chapter 3 provides theoretical fundamentals of our research which were required for the undestanding of our work. The chapter 4 shows the develop of our VIR elements with abstract approches as well as mathematical treatments for image retrieval elements, and it is shown a serie of tests with RBF and GPCA approaches for retrieval and classification phases. Finally, the analysis of alternative experiments and the main contribution are detailed in chapter 5 and 6 respectively.

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