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Getting more Information and useful data from Fusion of images and Image Retrieval method based on Singular Value Decomposition

Pulla Pravalika
Student,
Harshith Group of Institutions.

Jogu Praveen Kumar
Assistant Professor,
Harshith Group of Institutions.

Abstract:

In computer vision, Multisensor Image fusion is the process of combining relevant information from two or more images into a single image. The resulting image will be more informative than any of the input images. An image retrieval system is a computer system for browsing, searching and retrieving images from a large database of digital images. Most traditional and common methods of image retrieval utilize some method of adding metadata such as captioning', keywords, or descriptions to the images so that retrieval can be performed over the annotation words. Manual image annotation is time-consuming, laborious and expensive; to address this, there has been a large amount of research done on automatic image annotation. Additionally, the increase in social web applications and the semantic web have inspired the development of several web-based image annotation tools. In linear algebra, the singular value decomposition (SVD) is a factorization of a real or complex matrix. It has many useful applications in signal processing and statistics. In this paper we work on an Image retrieval technique based on SVD and how it compares with other methods.

Keywords:

Image Fusion, Image Retrieval, SVD.

Introduction:

Image fusion techniques allow the integration of different information sources. The fused image can have complementary spatial and spectral resolution characteristics. However, the standard image fusion techniques can distort the spectral information of the multispectral data while merging.

In satellite imaging, two types of images are available. The panchromatic image acquired by satellites is transmitted with the maximum resolution available and the multispectral data are transmitted with coarser resolution. This will usually be two or four times lower. At the receiver station, the panchromatic image is merged with the multispectral data to convey more information. Many methods exist to perform image fusion. The very basic one is the high pass filtering technique. Later techniques are based on Discrete Wavelet Transform, uniform rational filter bank, and Laplacian pyramid.

Multisensor data fusion has become a discipline which demands more general formal solutions to a number of application cases. Several situations in image processing require both high spatial and high spectral information in a single image. This is important in remote sensing. However, the instruments are not capable of providing such information either by design or because of observational constraints. One possible solution for this is data fusion.Image fusion methods can be broadly classified into two groups - spatial domain fusion and transform domain fusion.

The fusion methods such as averaging, Brovey method, principal component analysis (PCA) and IHS based methods fall under spatial domain approaches. Another important spatial domain fusion method is the high pass filtering based technique. Here the high frequency details are injected into upsampled version of MS images. The disadvantage of spatial domain approaches is that they produce spatial distortion in the fused image. Spectral distortion becomes a negative factor while we go for further processing, such as classification problem. Spatial distortion can be very well handled by frequency domain approaches on image fusion. The multiresolution analysis has become a very useful tool for analysing remote sensing images. The discrete wavelet transform has become a very useful tool for fusion.

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Some other fusion methods are also there, such as Laplacian pyramid based, curvelet transform based etc. These methods show a better performance in spatial and spectral quality of the fused image compared to other spatial methods of fusion.The images used in image fusion should already be registered. Misregistration is a major source of error in image fusion. Some well-known image fusion methods are:

- High pass filtering technique
- IHS transform based image fusion
- PCA based image fusion
- Wavelet transform image fusion
- Pair-wise spatial frequency matching

Image search is a specialized data search used to find images. To search for images, a user may provide query terms such as keyword, image file/link, or click on some image, and the system will return images "similar" to the query. The similarity used for search criteria could be meta tags, color distribution in images, region/ shape attributes, etc.

- Image meta search - search of images based on associated metadata such as keywords, text, etc.
- Content-based image retrieval (CBIR) – the application of computer vision to the image retrieval. CBIR aims at avoiding the use of textual descriptions and instead retrieves images based on similarities in their contents (textures, colors, shapes etc.) to a user-supplied query image or user-specified image features.
- List of CBIR Engines - list of engines which search for images based image visual content such as color, texture, shape/object, etc.
- Image collection exploration - search of images based on the use of novel exploration paradigms.

It is crucial to understand the scope and nature of image data in order to determine the complexity of image search system design. The design is also largely influenced by factors such as the diversity of user-base and expected user traffic for a search system. Along this dimension, search data can be classified into the following categories:

- Archives - usually contain large volumes of structured or semi-structured homogeneous data pertaining to specific topics.
- Domain-Specific Collection - this is a homogeneous collection providing access to controlled users with very specific objectives. Examples of such a collection are biomedical and satellite image databases.
- Enterprise Collection - a heterogeneous collection of images that is accessible to users within an organization's intranet. Pictures may be stored in many different locations.
- Personal Collection - usually consists of a largely homogeneous collection and is generally small in size, accessible primarily to its owner, and usually stored on a local storage media.
- Web - World Wide Web images are accessible to everyone with an Internet connection. These image collections are semi-structured, non-homogeneous and massive in volume, and are usually stored in large disk arrays.

Singular value decomposition:

In linear algebra, the singular value decomposition (SVD) is a factorization of a real or complex matrix. It has many useful applications in signal processing and statistics.Formally, the singular value decomposition of an m × n real or complex matrix M is a factorization of the form M = UΣV, where U is an m × m real or complex unitary matrix, Σ is an m × n rectangular diagonal matrix with non-negative real numbers on the diagonal, and V (the conjugate transpose of V, or simply the transpose of V if V is real) is an n × n real or complexunitary matrix. The diagonal entries Σi,i of Σ are known as the singular values of M. The m columns of U and the n columns ofV are called the left-singular vectors and right-singular vectors of M, respectively.The singular value decomposition and the eigendecomposition are closely related. Namely:

- The left-singular vectors of M are eigenvectors of MM.
- The right-singular vectors of M are eigenvectors of MM.
- The non-zero singular values of M (found on the diagonal entries of Σ) are the square roots of the non-zero eigenvaluesof both MM and MM

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Applications that employ the SVD include computing the pseudoinverse, least squares fitting of data, multivariable control, matrix approximation, and determining the rank, range and null space of a matrix.The below architecture explains the architecture of an image retrieval system.

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The user uses the query interface to submit the query which is processed and browses the image collection to extract the visual features or the texts. This is based on the type of the image retrieval system being used.

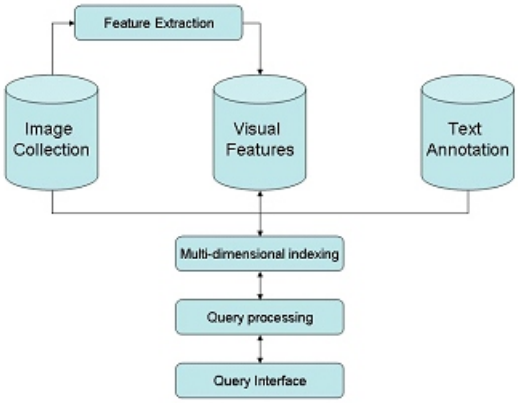


Figure 1: Architecture of an Image Retrieval System

a. Need for image retrieval systems:

The need for a desired image is by groups such as artists, designers, teachers, historians, advertising agencies, photographers, engineers and journalists. The requirement for images and corresponding use varies considerably among the groups mentioned above.

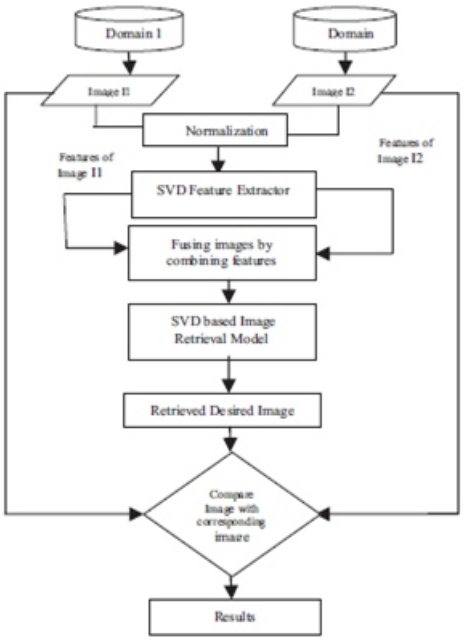
Before the advent of digitized images, librarians and archivists were providing access to images through text descriptors and classification codes manually.

b. Challenges faced by Image Retrieval technologies:

The basic features that users look for in images include color, shape or texture. With the huge amount of information present over the internet, it needs to be organized efficiently for effective browsing search and retrieval.

The knowledge on how the systems interact with the visual information is required to further develop an understanding of Image Retrieval systems.

Work Flow of Proposed SVD based IR Model :



Conclusion:

In this paper, we have implemented SVD method for image retrival. Real-time face identification is necessary in most practical applications. The proposed method can process face images in high speed and obtain good results. Its effectiveness and good performance has been proven by experiments.

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