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A REVIEW ON NOICE REMOVAL IN DIGITAL IMAGE PROCESSING

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ABSTRACT

Now, in this beginning of the twenty-first century, image processing has become a well-established engineering discipline. Digital image processing is a field of study which is rapidly growing during the past few decadeswith the increased utilization in manyengineering applications. Image processing has found a significant role in scientific, industrial, space, and government applications. Image processing is carried out withvarious improvements in the size, speed, and cost effectiveness of digital computers andrelated signal processing technologies. Algorithms used for digital image processing provides different results on different types of image sources, for example, an edge segmentation algorithm which provides better result for medical image may give worst result for satellite images. Advances in the theoretical basis of image processingcontinue still even after decades of research.This paper provides reviews on recent research techniques developed for image processing on recent years. This paper is prepared to help the researchers those started their research in digital image processing.

Keywords: Image processing, Segmentation, Noise Removal, Image Enhancement

INTRODUCTION

Digital image processing is an algorithmic process which may be executed by a computer with little or no human intervention, on any specific images like satellite image, medical image or typical photo. Many interfaces like Programmer's Imaging Kernel System (PIKS) application program interface (API) and simulation tools like Matlab helps the researchers for increased interest on image processing.

For processing such an image, thereare many major technical image processing task are needed such as noise removal, image reduction, extraction, segmentation, and image enhancement. In the design and analysis of image processing systems, it is convenient and often necessary mathematically to characterize the image to be processed.

The task of image segmentation is a first step in many computer vision methods and serves to simplify the problem by grouping the pixels in the image in logical ways. Image segmentation is hard to clearly define because there are many levels of detail in an image and therefore many possible ways of meaningfully grouping pixels. Additionally, after choosing a definition for an optimal segmentation, there are many computational difficulties in finding such segmentation.Fast image segmentation method can be more useful and valuable in the field of Medical imaging, Satellite imaging, underwater imaging, etc. Several general-purpose algorithms and techniques have been developed for image segmentation.

When the input data to an algorithm is too large to be processed and it is suspected to be particularly redundant then the input data will be transformed into a reduced representation set of features. Transforming the input data into the set of features is called feature extraction.

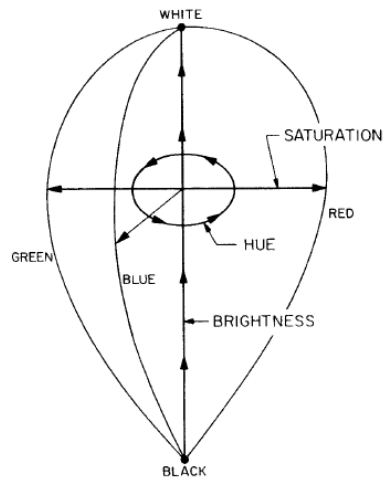

Figure 1 Vision of Image (Grosso and Tistarelli, 1995)

PROCESS OF DIGITAL IMAGE PROCESSING

Digital image processing is based on the conversion of a continuous image field toequivalent digital form. The vision of image in the digital world is represented in figure 1. The fundamental process flow is shown in the figure 2.

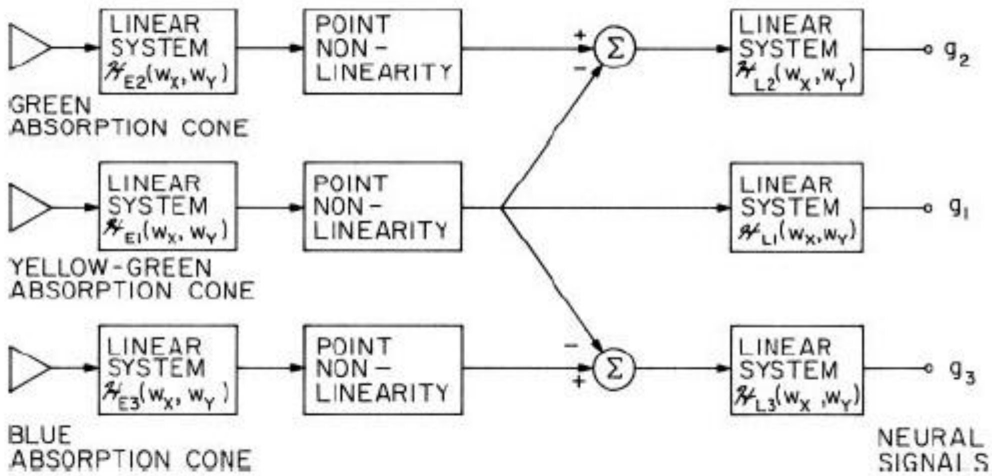

Figure 2Fundamentals of digital image processing system

The first phase of digital image processing is sampling. In a physical image sampling system, the sampling array will be of finite extent, thesampling pulses will be of finite width, and the image may be undersampled. In operation, a narrow light beam is scanned directly across a positivephotographic transparency of an ideal image. The light passing through thetransparency is collected by a condenser lens and is directed toward the surface of aphotodetector. The electrical output of the photodetector is integratedover the timeperiod during which the light beam strikes a resolution cell. In the analysis it will beassumed that the sampling is noise-free (Munoz-Salinas, 2008).

An image may be subject to noise and interference from several sources, includingelectrical sensor noise, photographic grain noise, and channel errors. These noiseeffects can be reduced by classical statistical filtering techniques. Image noise arising from a noisy sensor or channel transmission errors usuallyappears as discrete isolated pixel variations that are not spatially correlated. Pixelsthat are in error often appear visually to be markedly different from their neighbours.Noise added to an image generally has a higher-spatial-frequency spectrum than thenormal image components because of its spatial de-correlated-ness. Hence, simplelow-pass filtering can be effective for noise cleaning.

The rapid advancements in multimedia technology have increased the relevance that repositories of digital images are assuming in a wide range of information systems. Effective access to such archives requires that conventional searching techniques based on textual keywords be complemented by content-based queries addressing visual features of searched data. To this end, a number of models have been experimented which permit to represent and compare images in terms of quantitative indexes of visual features. In particular, different techniques have

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been identified and experimented to represent content of single images according to low-level features, such as color, texture, shape and structure, intermediate-level features of saliency and spatial relationships, or high-level traits modelling the semantics of image content (Sudha and Mohan, 2011).

IMAGE RETRIEVAL

In this section, image retrieval based on size, colour are implemented in MatLab using GUI tools are shown for the easy understandability. Most of the image retrieval are implemented using region based image representation. In addition to the region-based image representation, image chromatic content is globally represented by a histogram which enables image retrieval by global color similarity. In this latter case, the user can select an example image and search for images similar to the query on the base of color distribution. A simple image representation GUI is shown in figure 3.

Shape based retrieval is supported by letting the user sketch the contour of a shape he/she is looking for. A shape based retrieval GUI is shown in figure 4.The shape is represented by breaking its boundary into tokens according to points of minima of the curvature function computed on the shape boundary. A sample broken shape and its curvature function is shown in the figure 5. Shape tokens are then individually represented using their curvature and orientation.Shape comparison is supported by combining distances computed on individual tokens of two matching shapes.

In addition to this, shape tokens are combined with an indexing structure (metric tree) capable to speed up the search by reducing the number of distance computation between the query shape to the database shapes from a linear scan of the database shapes to a sub-linear scan (Weimin et al, 2010).

The figure 4 shows the retrieval results for a query shape. In this approach, the user can draw the query shape in the white panel on the left, while results are shown on the right in decreasing order of similarity. The shapes identified in each result image are delimited by their minimum embedding rectangles.

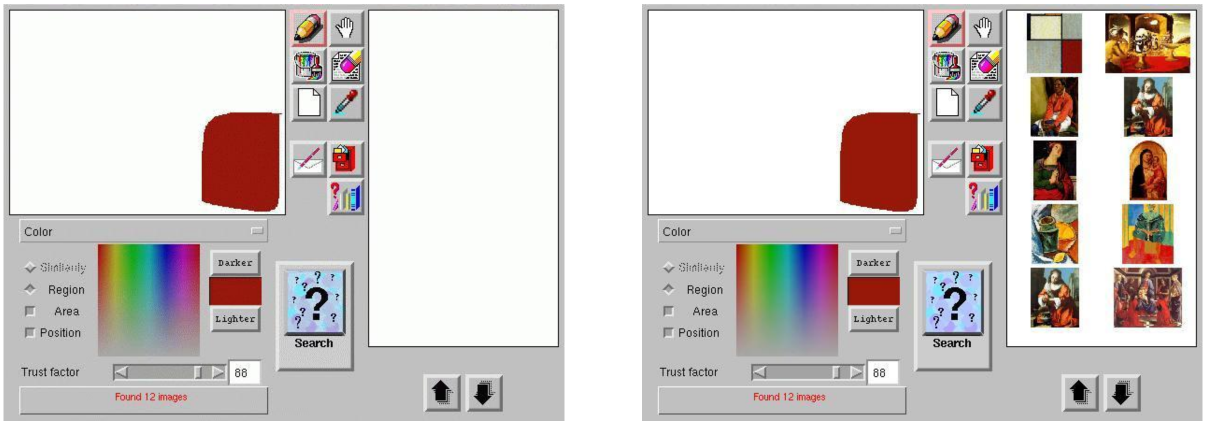

Figure 3.Sample image retrieval in GUI Based Matlab

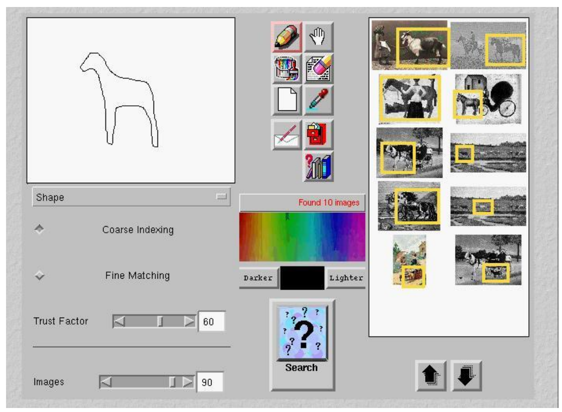

Figure 4.A shape retrieval example.

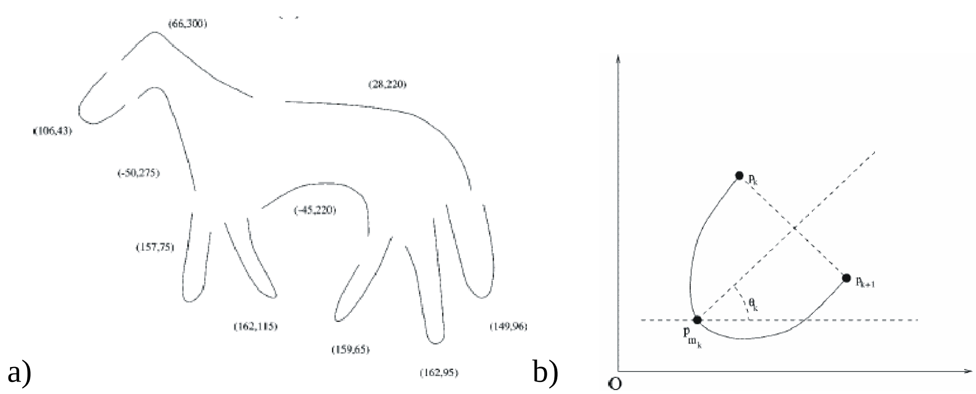

Figure 5.a) Broken shape and b)itsminima of the curvature function

IMAGE PROCESSING IN 3D MODELS

In recent years, the use of 3D models has been progressively spreading throughout many application domains: in manufacturing industries, 3D models are used in the design of many different objects and components, and are archived to enable reuse and rapid prototyping of new products; in medicine, many tests that are fundamental for disease study and diagnosis provide output data in the form of 3D models; in videogames design, reuse of available models may speed up the development of new games; in video production, where high quality 3D models are used for special effects, considerable resources, in terms of time and effort, can be saved by reusing or adapting existing models (Bradski and Kaehler, 2008); in cultural heritage, regular acquisition of the 3D structure of statues, bas-reliefs and art-pieces supports monitoring potential deformations of object structure due to inappropriate preservation conditions.

In addition to this, it should be noticed that the availability of 3D models is increasing thanks to a growing number of techniques enabling their generation. These solutions differ in terms of costs, resolution and type of acquired information (the un-textured external surface of the object, the textured external surface or even the interior composition of the object) and include CAD, tomography, magnetic resonance, 3D laser scanners, structured light systems and photogrammetry.

Holding these assumptions, retrieval by content of 3D models will emerge as a key issue in the next future and some solutions have already been proposed to address this problem. Many solutions proposed so far, rely on the extraction of content descriptors capturing global properties of 3D object surface: moments, distributions of vertex distances, surface curvature or angles between faces. Alternatively, surface properties can be described in transformed domains, like the wavelets and the spherical harmonics.

A new solution combining the advantages of view-based and structure-based approaches to description and matching of 3D objects(Begum and Karray, 2011). The new solution relies on Spin Image signatures and clustering to achieve an effective, yet efficient representation of 3D object content.For each mesh vertex V, a spin image is built mapping any other mesh vertex x onto a two-dimensional space, which is shown in the figure 6. In figure 6, a spin image computed on the vertex of a 3D model is shown on the left, and on the right, the spin images for the same object computed along the four normals A, B, C, D to the object surface are shown.The grey-level spin images are derived by considering the density of mesh vertices that map on the same point of the spin image, and evaluating the influence of each vertex over the neighboring pixels of its projection, according to a bilinear interpolation scheme.

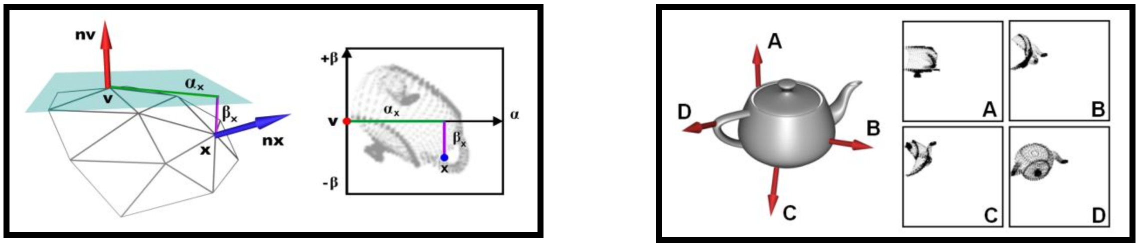

Figure 6.Vertex of a 3D model and Four normal object surface

Recent days, fuzzy and swarm intelligence based clustering are become more popular and provides optimal results (Chandramohan and Baskaran, 2010, 2011a and 2011b). Description vectors have been clustered using fuzzy clustering so as to take the centers of the clusters as signatures of the spin image representation. The optimal number of clusters is derived considering two functions that express a measure of under- and over-partitioning, respectively. The optimal number of clusters is the number that minimizes the sum of the two functions representing the trade-off between under- and over-partitioning. Finally, similarity between spin image signatures of 3D objects is obtained considering the permutation that minimizes the sum of distances between the corresponding cluster centers. A sample circular crowns and sectors used to derive a vector representation of the spin image are shown in figure 7.

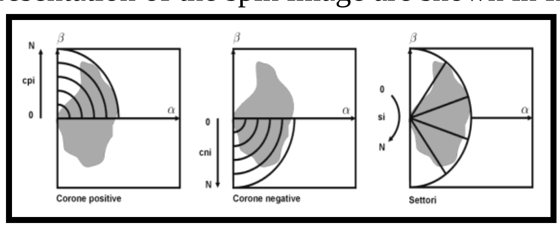

Figure 7.Vector representation of the spin image

In order to validate the retrieval performance of the proposed approach, a compound 3D repository of VRML models has been constructed by gathering 3D models featuring different characteristics mainly in terms of resolution and complexity. In particular, the 3D repository includes 3D models collected from the Web, from the 3D Princeton Shape Benchmark Archive and from the De Espona Encyclopedia.

All models of the compound 3D repository have been processed in order to extract the Spin Image signature and signatures of four other approaches for 3D objects representation and retrieval that we used for comparison purposes. A variety of dissimilarity measures to compare content descriptors have been also considered. In addition, models of the compound 3D repository have been manually annotated so as to represent semantic information about their content. Annotations are used to automatically extract precision and recall curves. These have been used to provide a representative comparison of the performance of prototype retrieval engines.

Retrieval performance based on Spin Image signatures has been compared against the performance of four other prototype retrieval engines, using Light Field (LI), Curvature Histogram (CH), Shape Functions (SF) and Curvature Moments (CM). Comparison has been carried out in terms of figures of precision and recall. Although comparison is still in progress, preliminary results suggest that retrieval based on Spin Image signatures outperforms the other prototype retrieval engines for medium- and high-resolution 3D models. In Figure 8, the average precision/recall curves are reported for the five methods under investigation are shown. This has been obtained by using objects from every model category of the Princeton shape benchmark database as query model. In the figure 8, retrieval results are reported for three query models, average precision/recall curves are reported, comparing Spin Images (SI) against four other approaches for 3D object retrieval, namely, Light Field (LI), Curvature Histogram (CH), Shape Functions (SF) and Curvature Moments (CM) are shown.

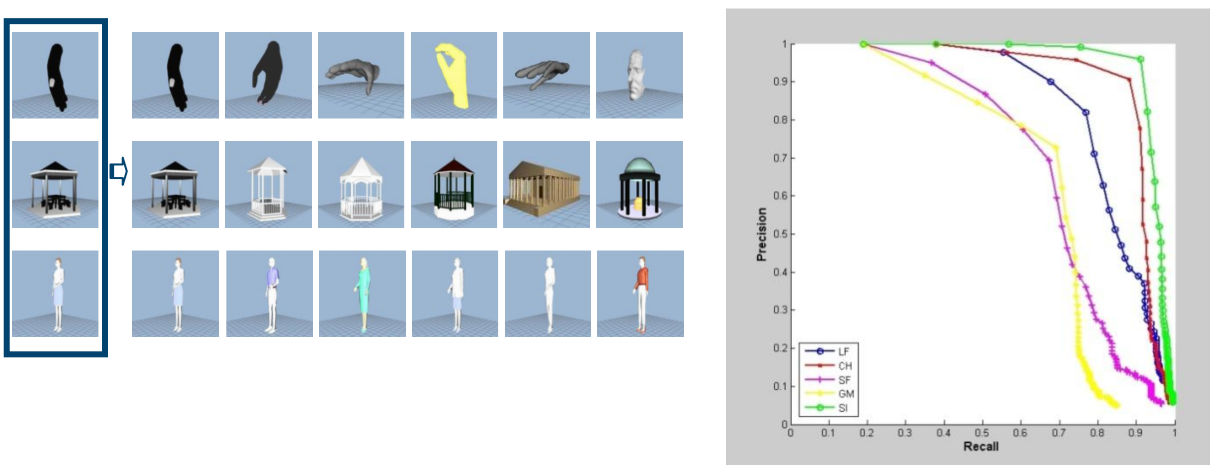

Figure 8.Retrieval results based on three query models and its Average precision/recall curves

Image Retrieval (IR) is one of the most exciting and fastest growing research areas in the field of multimedia technology. Some of the major problems recognized in image retrieval are:

- Lack of a good measurement of visual similarity
- Little importance accorded to user interaction and feedback
- Neglect of spatial information.

Large and distributed collections of scientific, artistic, and commercial data comprising images, text, audio and video abound in our information-based society. To increase human productivity, however, there must be an effective and precise method for users to search, browse, and interact with these collections and do so in a timely manner.The fundamental operation in image retrieval is similarity assessment. This reflects the preference in image retrieval of general users, who want to retrieve a number of similar images and then use them to iteratively refine their queries. Therefore IR systems should be designed to be an effective and efficient tool for browsing and navigating in image databases.

CONCLUSION

Image retrieval is a very fast growing research area in the last few years. Famous early examples include the QBIC system from IBM which allows users to retrieve images based on color, texture, layout and by a sketch; the Photobook system by MIT Media Lab which is very powerful for retrieving images from homogeneous collections; the Virage system by Virage company which can be tailored to many applications; the Chabot system from UC Berkeley. These systems provide interactive human-machine interfaces for image searching and browsing. The above are only a few of the best-known approaches, much work is being carried out on specific areas used by these systems, in particular by the computer-vision and pattern recognition specialists, for developing better segmentation, classification and interpretation algorithms of the image content.

Most systems use the query by example approach, where the user selects one or several images, and the system returns the ones judged similar. An alternative way of querying the image database based on content, is by allowing the user to sketch the desired image's color/texture layout, thus abstracting the objects searched for. Other more targeted systems allow the user to specify spatial constraints on the dominant objects. All of these methods suffer somewhat from the drawback that the system relies on the usersabilities and does not adapt to his/her needs.

Another active research direction is to speed-up the retrieval process. As discussed above, since image searching is only based on primitive-features, the results might not meet the user's expectation at the first result. Therefore IR systems must support interactive querying, i.e. letting users view the results quickly, refine their queries and try again. This requires the retrieval process to be fast, even with a large database (typically over 10000 images). In this approach the user must be able to specify in a natural way what he/she wants, and do this using the entire range of available features, either in conjunction or separately.

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