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Semantic Image Analysis for Intelligent Image Retrieval

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Abstract

Image understanding and analysis is the most exciting and fastest-growing research areas in the computer vision. Recent computer vision technologies and algorithms are support efficient semantic image analysis and retrieval. Image analysis is deal with image representation, estimation formula, and sampling density. Image analysis at semantic level is result in automatic extraction of image descriptions as per human perception which ultimately bridge semantic gap between low-level visual features and the high-level concepts capturing the conveyed meaning. Vital semantic image information is basically retrieved from image content, mainly from meaningful image objects and their mutual relations. In this paper, we present Semantic analysis of image by knowledge driven approach , start with Image content analysis with respect to semantic concepts, design image database and knowledge base on the basis of semantic content and retrieval, presentation and modification of image reference database or knowledge base for knowledge delivery intention. Experimental result shows improvement in image retrieval performance and accuracy.

Keywords: computer vision; human perception; image reference database; knowledge base; semantic gap; semantic image analysis;

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1. Introduction

Image analysis is processing technique where images are processes and extract meaningful information from images. Image analysis is differs substantially from image processing [10]. Image analysis can be study as a direct measurement or parameter estimation problem in image transformation .it is study the relationship between measurement accuracy, the sampling frequency, and the formulas for parameter estimation. Digital Image Analysis is analysis technique which automatically obtains useful information from image. Semantic image analysis provides better and as per human perception access to image databases, and content filtering, summarization, enhanced human and computer interaction, etc. Image analysis play important role in several application fields such as space research applications, medical imaging and search engine applications.

1.1. Basic types of image Analysis

For sake of simplicity, we broadly classify image analysis in two categories, human visual cortex based image analysis and Computer Image Analysis.

● Human visual cortex based image analysis

Being a human, we are excellent image analyst for extracting higher-level image features. Human image analyst plays important role in many application such as medicine, security, and remote sensing application. As we know, the human visual cortex is an excellent image analysis apparatus, human visual perception models is basic inspiration of many image analysis tools such as edge detector, neural network.

● Computer Image Analysis

Today's fast and vast development of internet technology and computerization, we need very accurate and perfect image analysis and processing techniques to get perfect, useful and semantic information from images in order to use them in many science and industry applications. Computer Image Analysis covers the fields of computer or machine vision, and medical imaging, and makes heavy use of pattern recognition, digital geometry, and signal processing. Computer image analysis is further classified as digital image analysis and object based image analysis. It is a quantitative or qualitative characterization of two-dimensional or three-dimensional digital images [7].

1.2. Applications of image Analysis

Image processing applications are ranging from simple, bar coded tags reading to complex medical image diagnosis for bio medical applications. The applications of digital image analysis are continuously expanding through all areas of science and industry [10], including medicine, such as detecting cancer in an MRI scan, microscopy, such as counting the germs in a swab, remote sensing, such as detecting intruders in a house, and producing land cover/land use maps, astronomy, such as calculating the size of a planet, materials science, such as determining if a metal weld has cracks, machine vision, such as to automatically count items in a factory conveyor belt, security, such as detecting a person's eye color or hair color, robotics, such as to avoid steering into an obstacle, optical character recognition, such as automatic license plate detection, assay micro plate reading, such as detecting where a chemical was manufactured, metallography, such as determining the mineral content of a rock sample, defence and filtering etc.

2. Related work

In this section, we focus on recent related research in image analysis area such as multiscale mode in image analysis, automatic image analysis tool, and embryogenesis Image Analysis etc.

Multiscale Mode for Image Analysis of Brain Tumor is designed which combines methods from cancer simulation and medical imaging [21]. Proposed approach use a healthy brain atlas to MR images of tumor patients and then a healthy atlas and a pathologic patient image, with registration algorithms is implemented. A domain-specific automated image analysis framework is designed for the detection of pre-cancerous and cancerous lesions of the uterine cervix [17]. Medical image analysis techniques are employed for analysis and visualization of medical

image data in an appropriate way [18]. Proposed approach designs he image processing algorithms using the popular graphical data-flow builder MeVisLab. Embryogenesis Image Analysis is employed in 3D+t Morphological processing where 3D+t image sequences are process directly with mathematical morphology operators, using a new classification of the 3D+t structuring elements [19]. Several image analysis methods such as filtering, tracking, segmentation are dedicated to the analysis of 3D+t datasets. An image analysis algorithm is developed which facilitate noncontact measurements of sporadically shaped images taken with a sole smart phone or tablet camera [20]. Proposed image analysis approach includes computing depth using autofocus data, a custom sensor fusion of inertial sensors and feature tracking.

3. Advanced developments in Image analysis

There is a lot of recent and sophisticated developments in image analysis field such as automated kiwifruit counting system, cocci bacterial cells detection system, automatic cocci batecteria identification and classification tool, Brightfield microscopy videos processing system, for automatic beef steak grading, quick diagnosis system of crop growth and development etc.

From last decades, image analysis techniques are used widely in the automation of industrial processes for measuring of the intensity of light and the reconstruction of the phase maps. A digital camera is used to capture changes in interference colors, and RGB profiles which are evaluated by image analysis techniques [2]. Automated kiwifruit counting system [5] is developed by employing digital image analysis techniques, three simple counting methods and a minimum distance classifier based segmentation technique. An automatic identification and classification tool for the different types of cocci bacterial cells in digital microscopic cell images developed by using image analysis techniques along with K-NN and Neural Network classifiers [6]. Three dimensional measurements are enhanced using permanent staining and brightfield microscopy. Brightfield microscopy videos are processed using automated and efficient digital image processing algorithms [7]. Digital image analysis techniques are used for automatic beef steak grading [8]. Here, image analysis technique was used for object boundary detection, especially for identifying objects of very irregular shapes in noisy digital images. Image analysis is a promising method for quick diagnosis of crop growth and development. Digital image analysis techniques are used for agriculture application for Estimating Crop Canopy Parameters [12]. Image analysis techniques are used to estimate the biomass and leaf area index through identifying the cotton canopy and background pixels accurately.

4. Proposed image retrieval system with semantic image analysis

Semantic analysis of image is a soul of many real life applications like image search engine, biomedical diagnosis. Proposed image retrieval system has three main phases for semantic analysis and retrieval of images as shown in fig.1
- Semantic image content analysis
- semantic content representation in semantic feature image knowledge base
- Retrieval and indexing

- Semantic image content analysis
Image content analysis start with Segmentation, where image is decompose image into segments. After segmentation, Clustering is carried out, in which determinate clusters and gasps within each of segments and assign semantic term to each cluster or gasp. After assigning appropriate fragment or fragments to each semantic term, analysis of actual fragments is carried out to get appropriate quantitative value for each semantic term. Finally, appropriate semantic networks and partial semantic functions and values are developed. A final semantic function and its semantic value assign to the analyzed image. Clusters create segments and the image as a whole. Normally, Combinations of number of image processing techniques are used for semantic analysis of image content, and create and update of image databases. Semantic content analysis mined semantic pixel information, semantic feature information and semantic fact and figure about image.
- semantic content representation
The semantic networks present a verbal description of image or verbal facts about image, pixel and feature

information which is stored in a semantic feature image knowledge base. Basically, semantic networks are present an image description or completing image based on segments. We are used pixel and feature information about object in image segment. Vital semantic information necessary to infer image content is mainly in meaningful image objects and their mutual relations. These objects may be closely related to particular segments, which applied for multi-scale image analysis. Fractal Net Evolution merges insight in the fractal structure of the world and of semantics with object orientation. Each objected present three types of semantic information, semantic feature information, semantic fact and figures, and semantic pixel information. The procedure first extracts image objects and then classified by fuzzy-logic classifiers on the basic of semantic information. A hierarchical network of image objects developed for representing the image information in different resolutions. Each segment has own semantic information and divide into two types of structural units: clusters and gasps and their semantic content is quantified via partial semantic functions its final semantic function is used to calculate semantic information capability of the image Natural language is used describe an image content, its segments, clusters or gasps. A text about image in natural language is in form of text fragments or semantic networks of facts and information closely related to image structure units. Information and facts contained within image segments are put together in appropriate records or documents by maintain relationship among these records and fact about image information. A semantic feature image knowledge base is responsible for maintaining theses relationship between record and facts.
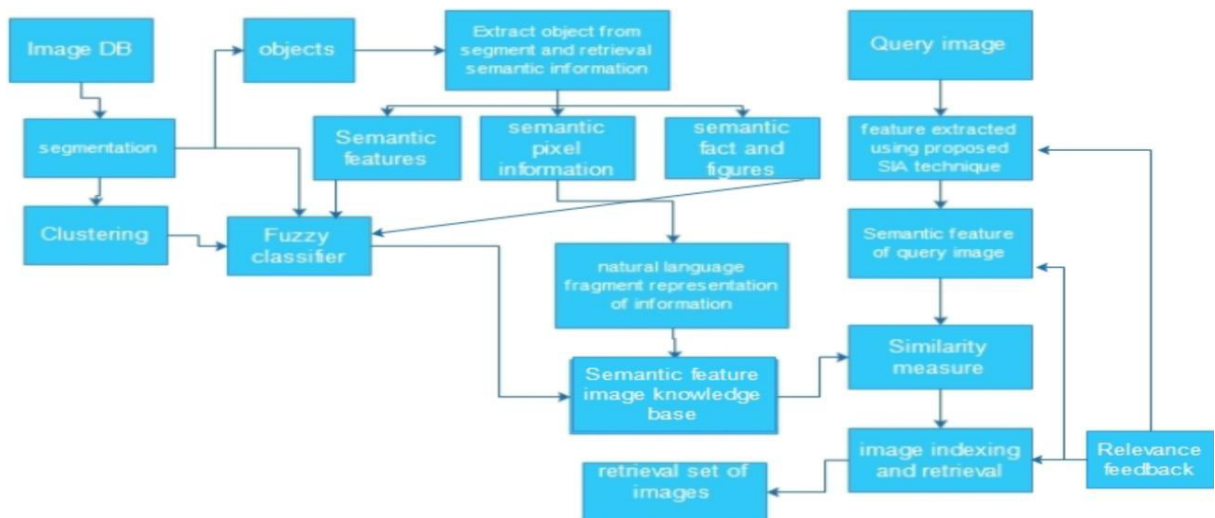

Fig.1. Proposed image retrieval system

- Retrieval and indexing

User fired query to proposed system in the form of query image, feature of query image are extracted using proposed semantic image analysis techniques which are compared with image features stored in semantic feature image knowledge base and retrieved set of relevant images which are further indexed on the basis of relevance feedback.

5. Result

We have implemented a semantic image analysis technique for image retrieval system based on image content. Experimental result shows improved in retrieval performance by utilizing large data set. Proposed system take input in the form of image query as shown in fig. 2(a) and output in the form of set of relevant images as shown in fig. 2 (b). For evaluation of performance, different parameters are used such as precision, recall, rank and f-measure. F-measure is used to calculate accuracy of image retrieval. Precision is the percentage of retrieved images that belong

to set of relevant images and recall is the percentage of relevant images covered by the retrieved images. Fig. 3 shows precision and recall curve and Table 1 shows image retrieval result evaluation of proposed system using precision, recall and f-measure. We need to modified feedback strategies in order to improve result and again need to exercise online large image datasets.
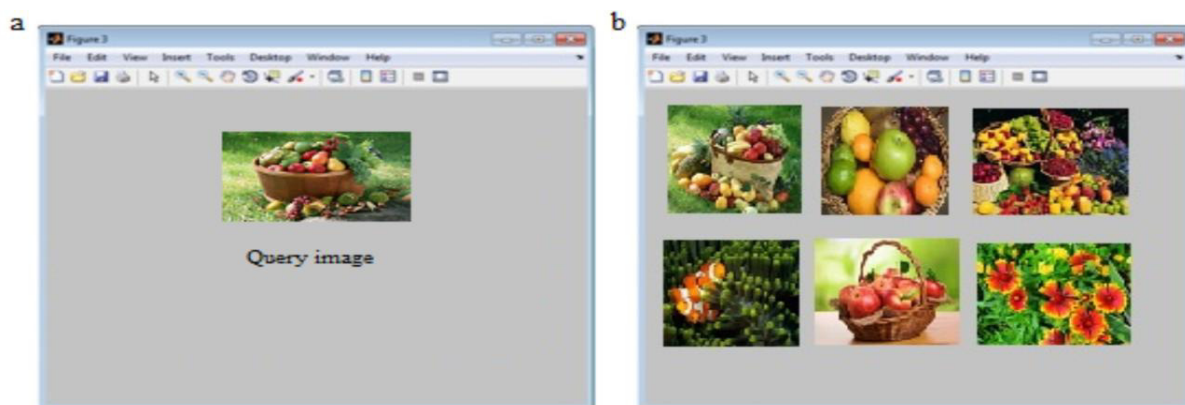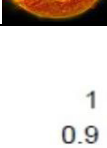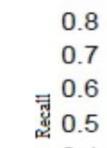

Fig.2. (a) Query image; (b) relevant set of images for query Image.

Table 1. Result evaluation of proposed system with precision, recall and f-measure.

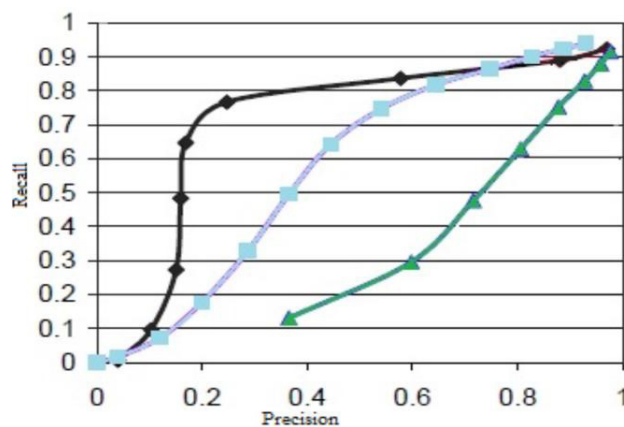| Query Image	Precision	recall	f-measure
	88.5	84.63	86.35%
	79.45	82.96	81.16%
	86.28	84.89	85.57%
	89.46	90.33	89.90%

Fig.3. Precision-recall curve

6. Conclusion

In this paper, we present framework for semantic analysis of image which enhanced performance of image retrieval system. There are three main steps for semantic analysis and retrieval of images, first, Image content analysis with semantic concepts, second, design image database or knowledge base on the basis of semantic content and finally, Design image database or knowledge base for information or knowledge delivery. Image analysis play important role in many application such as for search engine, medical diagnosis and agricultural applications. Experimental result shows that semantic image content analysis improves performance of image retrieval system in term of precision and recall.

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