Synopsis
on

A Salient Region Extraction Based on Color and Texture Features

Submitted by

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Abstract:

Image classification is one disposal procedure for high level semantic analysis, example, image data mining, knowledge discovery and intelligent data analysis. As one image generally contains multiple semantic objects, it's not appropriate to conduct image classification according to the global features. So, image segmentation is a must before image classification. However, accurate semantic segmentation is still out of implicit semantic object regions in one image, as one semantic object with distinct regions would be segmented into several irrelevant regions by current most image segmentation algorithms based on low level color or texture features, i.e. the hierarchical clustering based approach (HCBA), the eigen regions based strategy (EBS) and the novel regions based methods (NRBM). This leads to the effectivity lose for these region based image classification schemes, as a larger number of implicit regions will be achieved. Mean while, these individual regions are generally meaningful and unexpected result would be caused by these classification strategies, although some salient regions are extracted to reduce the complexity of region-based image classifications. Furthermore, these schemes are the arbitrary classification schemes, and could not indicate the information about other implicit objects. In this project, we propose salient regions based fuzzy classification (SRFC) methods. Firstly we give a salient region extraction algorithm based dominant colors and Gabor texture features. Then, according to the proposed classification scheme the salient regions from all the candidate images are clustered into disjoint categories. These categories are further used as for those candidate images, and for each candidate image its number of salient regions belonging to the same category would be used to evaluate the degree of the images belonging to the category. With comparison to the HCBA scheme for individual salient regions, the classification accuracy is improved by about 16% by the proposed SRFC scheme.

Salient regions are usually defined as those regions that could present the main meaningful or semantic contents. However, there are no uniform saliency metrics that could describe the saliency of implicit image regions. Most common metrics take those regions as salient regions, which have many abrupt changes or some unpredictable characteristics. But, this metric will fail to detect those salient useful regions with flat textures. In fact, according to human semantic perception, color and texture distinctions are the main characteristics that could distinct different regions. Thus we present a novel saliency metric coupled with color and texture features, and its corresponding salient region extraction method. In order to evaluate the corresponding saliency values of implicit regions in one image, three main colors and multi-resolution Gabor features are respectively used for color and texture features. For each region, its saliency value is actually to evaluate the total sum of its Euclidean distances for other regions in the color and texture spaces.

Introduction:

The research work of content-based image retrieval (CBIR) over the last few years has shown that retrieving images through matching images solely on that basis of global similarities is often too crude to produce satisfactory results. On the other hand, semantic object-based image retrieval is still far too rudimentary and fragile to produce reliable results. Intermediate-level processing between high and low-level processing for content-based image retrieval is required. Therefore, it is necessary to identify the perceptually salient and semantically meaningful regions in images. However, it is difficult to isolate the meaningful region of interest from the scene without a prior knowledge. In a common case, the regions with many abrupt changes or some unpredictable characteristics often attract the human's attention, are considered as the salient regions of images in this paper. Thus, salient regions of one image are those regions that could present the main contents of the image, which were detected according to local features as such as colors, textures and shapes. Moreover, we believe that these salient regions are potentially more effective for image indexing, retrieval and classification. According to the above definition of salient regions, Kadir and Brady proposed a salient region detection method “Scale Saliency”, and its improved versions are given in literature by Ling Shao and Michael Brady. Although this method could detect those regions with rich information in terms of information entropy, this method must be evaluated for every pixel with different size vicinities. As an alternative approaches, salient points-based approaches are presented in and, where the salient regions were detected according to the density of salient points in each local segmented region. However, there exists fatal drawback for both the “Scale Saliency” method and these salient points-based approaches, i.e., as they could not detect those meaningful regions with flat textures and few salient points. In the reference, an important index was used as the metric of region saliency, and the sizes of implicit image regions could also be reflected in its definition. Actually, as the complexity of practical image analysis, ones could not deal with every region for different sizes, and it’s very important to exclude those implicit regions smaller than the specified size. As the regions to present the main content of one image, the salient regions should be larger than the given region sizes and with rich semantic information to human being. Consequently, we propose a novel salient region detection method, which could take account of the implicit region sizes and their saliency relative to other regions. Firstly, all the regions smaller than the given sizes are excluded from the candidate regions, then the most salient will be picked out after their saliency relative to other candidate regions were evaluated. The saliency could be achieved according to their feature vectors, and these feature vectors consist of main colors and texture features, where the texture features are presented by the means and variances of Gabor coefficients at several different frequencies and orientations as given in and three main colors in every region are extracted by the mean-shift cluster method. Thus, the proposed scheme could pick out the most salient regions in terms of people perception and region size requirements than the approaches given in. This paper is organized as follows. We detail the “Scale Saliency” and salient points-based detection methods together with the important index given in, and this paragraph also discloses the drawbacks of these methods. Subsequently, the proposed scheme is described in detail and the saliency is given as the combined Euclidean distance among these candidate regions in terms of colors and texture features. Furthermore, the tunable Gabor filter bank is also involved to show the concrete implicit scheme.

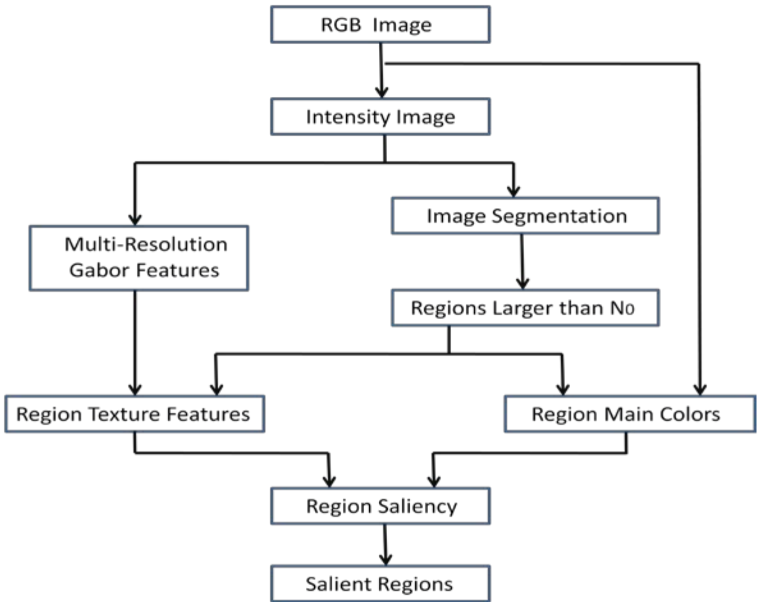
Problem Statement:

Image classification is necessary for high level operations such as image data mining, face recognition etc. for accurate image classification it is necessary to first segment the image into proper salient regions. Most traditional ways such as intensity or color segmentation divides the image into many irrelevant regions. In order to avoid this we should segment image and texture and color features should be calculated for each of this region so that saliency can be calculated. Other algorithms are mostly dependent on the low level global texture and color features.
Also some regions which may differ in texture and color may be very insignificant in the size. Hence we apply a constraint on our algorithm that after segmentation choose only those regions that are greater than a threshold region say N_0. This region is dependent on the type of application for which we are developing the extraction algorithm. The regions extracted after this technique will reflect the main content in the image which are persistent to the human perception of vision. Hence we can say that our technique is based on the biological model of perception of images.
Although people can distinct any acute differences in color spectrum, the human visual system cannot simultaneously perceive a large number of colors. Also we have taken into consideration the human visual system for interpreting the textures.

Objectives of project:

Natural images have several semantic objects. Our objective is to divide these natural images into salient regions according to the human visual perception of images. One salient region should be compact, complete and significant enough, and neither a small region nor a fragmentary region can be one meaningful region. Furthermore, in terms of colors and textures, the salient regions should also have distinguishing features from their neighbor regions or other regions. Provided that each region is characterized by its feature vectors, they are the syntheses of color and texture features.
In order to achieve this we firstly convert the RGB image into intensity image. This image is segmented according to any simple algorithm. The multi resolution Gabor texture features of the segmented regions are calculated which are similar to human visual multichannel perception of texture. Also we use RGB image to calculate the dominant color of the selected regions. Now these parameters are used in the novel saliency metric that we propose. All the regions having the saliency values greater than that of a particular threshold are selected. This way salient region is extracted from a natural image.

Modules in the project:



1. ***RGB Image:***

   The first step of segmenting the image is the RGB image. In RGB model the primary colors are red, green and blue. It is an additive model in which colors are produced by adding all the components. In RGB model white imply that all the colors are present while black implies the absence of color. RGB model is represented by the unit cube. With one corner located at the origin of 3 dimensional spaces. The axes are named as RGB with values ranging from 0 to 1. Origin (0,0,0) is considered as the black and opposite corner (1,1,1) is white.

2. ***Intensity Image:***

   The next step includes the calculation of the intensity of each dominant region from the image. The intensity can be calculated using the HSI model. In this model the luminance, or also known as intensity is decoupled from the color information already gathered, which is described using hue channel and saturation channel. Hue and Saturation of color responds closely to the way human perceive color. This model is suitable for interactive manipulation of color images where changes occur for each variable shift that corresponds to that operator inputs.

3. ***Multi-Resolution Texture Feature:***

Texture is an important property of surfaces which characterizes the nature of the surfaces. An important task in image processing and machine vision is the task of segmenting regions of different texture in an image. Texture segmentation is the process of partitioning an image into regions based on their texture. The texture segmentation is being inspired by multi-channel operation of the human visual system for interpreting texture. A typical definition of texture is, "a spatial arrangement of local (grey-level) intensity attributes which are correlated within areas of the visual scene corresponding to surface regions."

This lead to the conclusion that people are sensitive to three texture properties: repetition, directionality and complexity. So, we have focused on the multi-channel Gabor filtering approach for identifying different texture regions. The multi-channel filtering approach is actually a multi-resolution decomposition process comprising of series of filters of different range of frequency and orientation. The filters with smaller bandwidth are desirable because they allow making finer distinction among different textures.

4. ***Image Segmentation:***

As the name suggests, image segmentation is the process of partitioning digital image into different segments based on its salient regions present in the image and the dominant colors of the image. The image segmentation has three methods: manual, automatic and semi-automatic. The goal of image segmentation is clustering of pixels into salient image regions or simplifying the representation of the image into something that is more meaningful and easier to analyze. More precisely, image segmentation is the process of assigning a label to every pixel in an image such that pixels with the same label share certain visual characteristics.

The result of image segmentation is a set of segments that collectively cover the entire image, or set of contours extracted from the image. Each of the pixels in a region is similar with respect to some characteristics or computed property, such as color, intensity, or texture. Adjacent regions are significantly different with respect to some characteristics.

5. ***Dominant Color Feature:***

Although people can distinct any acute differences in color spectrum, the human visual system cannot simultaneously perceive a large number of colors. Therefore, dominant colors can account for the spatially varying image characteristics in different implicit meaningful regions, and are invariant to region scales. For every salient region achieved its color values in terms of red, green and blue color components which are then classified into k groups via the adaptive clustering algorithms (ACA). The adaptive clustering algorithm (ACA) is an iterative algorithm that segments the image into k classes, where each class is characterized by a spatially varying characteristic function. The key of adapting to the local image values is that the ACA estimates the characteristic function by averaging the image values corresponding to each class over a sliding window whose size decreases as the algorithm converges. Then the average values of each group are considered as dominant colors, and their corresponding percentage of occurrence in current regions are also further figured out according to region size and the color dominant pixel.

6. ***Salient Region Extraction:***

One salient region should be compact, complete and significant enough, and neither a small region nor a fragmentary region can be one meaningful region. Furthermore, in terms of color and texture, the salient region should also have distinguishing features from their neighbor regions or other regions. Provided that each region is characterized by its feature vectors, their synthesis of color and texture features. According to the feature vectors of all the regions, the saliency of one region is given as the sum of its Euclidean distance from all the other regions. More than one salient region should be found to meet for the requirements of image analysis, so the set of salient regions are selected as the first several regions according to their saliency values or those regions whose saliency values are greater than one given special threshold. Meanwhile, in order to reduce the competition complexity of the saliency values, some smaller fragmentary regions must be excluded from the candidate regions, as these regions are not considered as meaningful regions for incoming image processing, i.e., regions smaller than N_0.

Applications of project:

1. ***Medical imaging:***
   Medical imaging is creating the image of human organs for clinical purposes or medical science. Proper image segmentation is most important part for the classification of various internal organs or tumors. For identifying the abnormality we must be able to classify the images. For that we must extract the salient regions from the image. Other applications of this are:
   - Locate tumors and other pathologies
   - Measure tissue volumes
   - Computer-guided surgery
   - Diagnosis
   - Treatment planning
   - Study of anatomical structure

2. ***Locating objects in satellite images:***
   The images from satellite may be used for mapping or forestry. Whatever may be the purpose but we must be able to identify what the image contains. In order to classify an image into road or forest or agricultural land we must be able to extract the portions of different object from the images.

3. ***Face recognition systems:***
   A facial recognition system is a computer application for automatically identifying or verifying a person from a digital image or a video frame from a video source. One of the ways to do this is by comparing selected facial features from the image and a facial database. It is typically used in security systems and can be compared to other biometrics such as fingerprint or eye iris recognition systems.

4. ***Iris recognition system:***
   Iris recognition is an automated method of biometric identification that uses mathematical pattern-recognition techniques on video images of the iris of an individual's eyes, whose complex random patterns are unique and can be seen from some distance. Not to be confused with another, less prevalent, ocular-based technology, retina scanning, iris recognition uses camera technology with subtle infrared illumination to acquire images of the detail-rich, intricate structures of the iris. Digital templates encoded from these patterns by mathematical and statistical algorithms allow unambiguous positive identification of an individual.

5. ***Machine vision:***
   Machine vision (MV) is the process of applying a range of technologies to provide imaging-based automatic inspection, process control and robot guidance in industrial applications. While the scope of MV is broad and a comprehensive definition is difficult to distill a "generally accepted definition of machine vision is '... the analysis of images to extract data for controlling a process or activity.'

6. ***Agricultural imaging-crop disease detection:***
   In agricultural imaging the aerial images of fields are taken and are classified as the affected or unaffected crops so that they can be cured.

7. ***Mobile web browsing:***
   The role of Web images is an important issue for Web browsing using a mobile device. For example, many commercial products and research studies focus on how to reconstruct Web pages to fit the size of screens on mobile devices as a way to improve

their browsing capabilities. In doing so, some Web images should be discarded or downsized to fit in the page layout of the small screen.

8. ***Remote sensing:***

   Many image processing and analysis techniques have been developed to aid the interpretation of remote sensing images and to extract as much information as possible from the images. The choice of specific techniques or algorithms to use depends on the goals of each individual project. In this section, we will examine some procedures commonly used in analyzing/interpreting remote sensing images.