A REVIEW OF EDGE DETECTION METHODS

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Abstract

In this paper, the overview of the Edge Dection Methods are surveyed. Feature selection and extraction is the pre-processing step of Edge and Object Detection. Obviously this is a critical step in the entire scenario of Image Mining. Our approach to mine from Images –is to extract patterns and derive knowledge from large collection of images, deals mainly with identification and extraction of unique features for a particular domain. Though there are various features available, the aim is to identify the best features and thereby extract relevant information from the images using different image retrieval methods. Various methods for extraction are used in this paper. Content Based Image Retrieval is the popular image retrieval method by which the target image is to be retrieved based on the useful features of the given image. In this paper, the concepts of Content Based Image Retrieval and Image mining have been combined and a new clustering technique has been introduced in order to increase the speed of the Edge Detection method. This paper presents a survey on various edge detection methods that were proposed earlier in literature.

Index Terms: Image Retrieval Methods, Image Features, Edge Detection, CBIR.

1. INTRODUCTION

The World Wide Web is regarded as the largest global image repository. An extremely large number of image data such as satellite images, medical images, and digital photographs are generated every day. These images, if analyzed, can reveal useful information to the human users. Unfortunately, there is a lack of effective tools for searching and finding useful patterns from these images. Image mining systems that can automatically extract semantically meaningful information (knowledge) from image data are increasingly in demand. The fundamental challenge in image mining is to determine how low-level, pixel representation contained in a raw image or image sequence can be efficiently and effectively processed to identify high level spatial objects and relationships. The popular amongst them are Features based on color, Features based on texture and Features based on shape. Content-based means that the search analyzes the actual contents of the image. The term content in this context might refer to colors, shapes, textures, or any other information that can be derived from the image itself.

1.1 Preprocessing

Image pre-processing is the name for an operation on images at the lowest level of abstraction whose aim is an improvement of the image data that suppress undesired distortions or enhances some image features important for further processing. It does not increase image information content. Its methods use the considerable redundancy in images. Image pre-processing tool, created in Mat Lab, realizes many brightness transformations and local pre-processing methods.

1.2 Feature Extraction

Feature Extraction involves reducing the amount of resources required to describe a large

set of data. When performing analysis of a complex data one of the major problems stems from the number of variables involved. Analysis with a large number of variables generally requires a large amount of memory and computation power or a classification algorithm which over fits the training sample and generalizes poorly to new samples. Feature extraction is a general term for methods of constructing combinations of the variables to get around these problems while still describing the data with sufficient accuracy. Feature transformation is a group of methods that create new features (predictor variables). The methods are useful for dimension reduction when the transformed features have a descriptive power that is more easily ordered than the original features. In this case, less descriptive features can be dropped when building models.

1.3 Mining

Image Mining is focused on extracting patterns, implicit knowledge and image data relationship or patterns which are explicitly found in the images from databases or collections of images. Some of the methods used to gather knowledge are: image retrieval, data mining, image processing and artificial intelligence. These methods allow Image mining to have two different approaches. First, is to extract only from databases or collections of images, and second, dig or mine a combination of associated alphanumeric data and collection of images.

1.4 Interpretation and Evaluation and Knowledge discovery

After mining, patterns are obtained and these patterns finally evaluate and interpret the knowledge that is required. The knowledge retrieved can be used by individual or organization for various purposes to make predictions and profitable output further.

2. EDGE DETECTION

Segmentation refers to the process in which an image is subdivided into constituent regions or objects. These objects can be further processed or analyzed for the extraction of quantitative information. Shape of an image describes more or less each and every object presented in an image.Edge extracted from an image tells us about the full content of an image. The Prewitt filter and the Sobel filter belong to a class of filters called 'first-derivative' filters, which essentially calculate the slope of grayscale intensities in an image in a given direction. They give a maximum value (or minimum value) at regions with discontinuities in grayscale values and are frequently used in edge detection. There are various techniques of edge detection available i.e. Prewitt method (Fig a), Sobel method (Fig b) and Robert method (Fig c).One way to find boundaries of objects is to detect discontinuities in intensity values at the edge of a region. These discontinuities can be found by calculating the first and/or second order derivatives of an image.

The first derivative of choice in image processing is the gradient, defined as the vector:

$$gradf = [G_x\ G_y]$$

Where $G_x = df/dx$ and $G_y = df/dy$ are the partial derivatives in the horizontal and vertical directions of the image. The magnitude of this vector is

$$|grad\ f| = (G_x^2 + G_y^2)^{1/2}$$

The gradient vector points in the direction of steepest ascent. The angle of steepest ascent is given by:

$$a(x, y) = tan^{-1}(G_y/G_x)$$

Roberts $Gx=X_8-X_6$

2.1 Prewitt Method

The **Prewitt operator** is used in image processing, particularly within edge detection algorithms. Technically, it is a discrete differentiation operator, computing an approximation of the gradient of the image intensity function. At each point in the image, the result of the Prewitt operator is either the corresponding gradient vector or the norm of this vector. The Prewitt operator is based on convolving the image with a small, separable, and integer valued filter in horizontal and vertical directions and is therefore relatively inexpensive in terms of computations like Sobel and Kayyali operators. On the other hand, the gradient approximation which it produces is relatively crude,in particular for high frequency variations in the image. The Prewitt operator was developed by Judith M. S. Prewitt.The following **Fig. a** represented the Prewitt method.

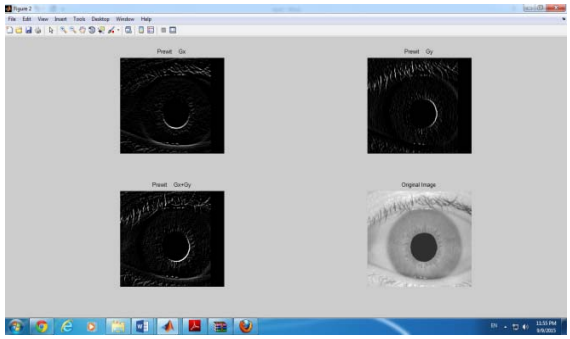

Fig. a) Prewitt Method

2.2 Sobel Method

The Sobel operator,sometimes called the Sobel–Feldman operator or Sobel filter, is used in image processing and computer vision, particularly within edge detection algorithms where it creates an image emphasising edges. It is named after Irwin Sobel and Gary Feldman, colleagues at the Stanford Artificial Intelligence Laboratory (SAIL). It was co-developed with Gary Feldman atS AIL. Sobel and Feldman presented the idea of an "Isotropic 3x3 Image Gradient Operator" at a talk at SAIL in 1968.Technically, it is a discrete differentiation operator, computing an approximation of the gradient of the image intensity function. At each point in the image, the result of the Sobel–Feldman operator is either the corresponding gradient vector or the norm of this vector. The Sobel–Feldman operator is based on convolving the image with a small, separable, and integer-valued filter in the horizontal and vertical directions and is therefore relatively inexpensive in terms of computations. On the other hand, the gradient approximation that it produces is relatively crude, in particular for high-frequency variations in the image. The following Fig. b represented the Sobel method.

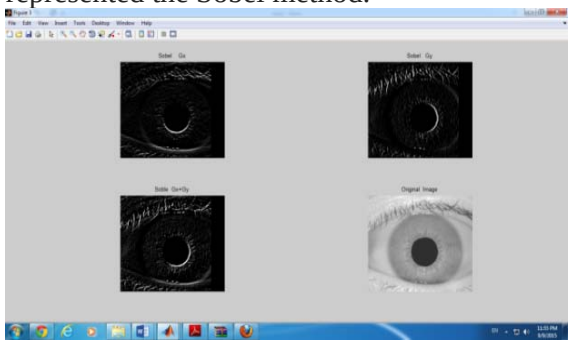

Fig. b) Sobel Method

2.3 Robert Method

The Roberts cross operator is used in image processing and computer vision for edge detection. It was one of the first edge detectors and was initially proposed by Lawrence Roberts in 1963. As a differential operator, the idea behind the Roberts cross operator is to approximate the gradient of an image through discrete differentiation m which is achieved by computing the sum of the squares of the differences between diagonally adjacent pixels. The following Fig. c represented the Robert method.

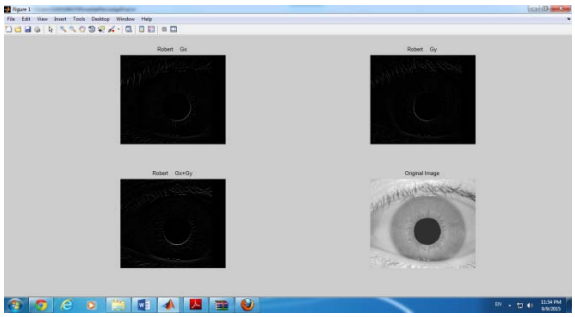

Fig. c) Robert Method

Conclusion

This paper presents a survey on various edge detection methods that was proposed earlier by researcher. This overview of edge detection methods focuses on image retrieval implementations, usability and challenges. It also delivers conceptual overview of methodology. Image retrieval is an expansion of Image mining in the field of image processing.

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