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A Review of Literature on Edge Detection Techniques

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Abstract

Edge detection is a fundamental tool used in most image processing applications to obtain information from the frames as a precursor step to feature extraction and object segmentation. This process detects outlines of an object and boundaries between objects and the background in the image. Edge is a boundary between two homogeneous regions. Edge detection refers to the process of identifying and locating sharp discontinuities in an image. Edge detection is an important pre-processing step for any image processing application, object recognition and object detection. This paper reviews the literature on edge detection. Literature Review indicates that several works has been done in the field of edge detection. The work carried out by different researchers includes comparison of various edge detection techniques, various image segmentation techniques, improved versions of edge detectors etc.

Introduction

Edge detection is the name for a set of mathematical methods which aim at identifying points in a digital image at which the image brightness changes sharply or, more formally, has discontinuities. The points at which image brightness changes sharply are typically organized into a set of curved line segments termed *edges*. The same problem of finding discontinuities in 1D signals is known as step detection and the problem of finding signal discontinuities over time is known as change detection. Edge detection is a fundamental tool in image processing, machine vision and computer vision, particularly in the areas of feature detection and feature extraction. The first step in image analysis is segment the image. Segmentation subdivides an image into its constituent parts or objects. The level to which this subdivision is carried depends on the problem being viewed. Sometime need to segment the object from the background to read the image correctly and identify the content of the image for this reason there are two techniques of segmentation, discontinuity detection technique and Similarity detection technique. In the first technique, one approach is to

partition an image based on abrupt changes in gray-level image. The second technique is based on the threshold and region growing. Edge detection is a very important area in the field of image processing. Edge detection detects outlines of an object and boundaries between objects and the background in the image. Edge is a boundary between two homogeneous regions. Edge detection refers to the process of identifying and locating sharp discontinuities in an image. Different edge detectors work better under different conditions. In order to choose the better technique, we must first know which edge detectors perform better under which conditions.

Review of Literature on Edge Detection Techniques

In this section, work done in the area of edge detection is reviewed and focus has been made on detecting the edges of the digital images. Edge detection is a problem of fundamental importance in image analysis. In typical images, edges characterize object boundaries and are therefore useful for segmentation, registration, and identification of objects in a scene. Edge detection of an image reduces significantly the amount of data and filters out information that may be regarded as less relevant, preserving the important structural properties of an image.

Shizu Zhu [5] proposed the new method of edge detection based on multi-structure elements morphology and image fusion. Edges are detected using four different orientations SE (structure element) where direction angles of all the structure elements are 0□, 45□, 90□, 135□ and final edge result is got by image fusion using entropy weighted method. The proposed method not only can effectively eliminate the image noise, but also effectively maintain good edge information. In 1997,NgGeok See and Chan KhueHiang proposed a technique for edge detection based on neural network. Neural network has many processing elements joined together and usually organized into groups called layers. Training is provided to the neural network in supervised or unsupervised learning mode, to force the network to yield particular result to a specific input [6]. M Rama BaiandVenkata Krishna[7] described the new morphological approach for noise removal cum edge detection for both binary and gray scale images. WenshuoGao [8] proposed a method which combines Sobel edge detection operator and soft-threshold wavelet de-noising for edge detection. This method used on images which include White Gaussian noises. The widely used operators such as Sobel, Prewitt, Roberts and Laplacain are sensitive to noises and their anti-noise performances are poor. This paper proposes an edge detection method which combines soft-threshold wavelet de-noising and Sobel Operator, its anti-noise performance is very strong. Firstly soft-threshold wavelet used to remove noise, then Sobel edge detection used for edge detection on the image. The effect by using this method to do edge detection is very good and can remove the noise effectively. Zhengquan He, M.Y.Siyal [9] proposed a new technique based on neural network. Most of the existing techniques like Sobel {reference} are effective in certain senses and require more computation time. In the proposed edge detection technique a three layer BP neural network is employed to classify the edge elements in binary images into one of the predefined categories. To detect edges first binarize the image by choosing threshold by some optimal criteria and classify the edge patterns of binary images in different categories. Train the neural network on these patterns and on their

noisy patterns. After the network is trained, it can recognize the input pattern as a most like pattern in our edge pattern bank. This technique is more flexible to the edge structures in the image. It can not only extract straight lines but also can extract corners and arcs edges. Tzu-Heng Henry Lee and Taipei [10] described the various edge detection algorithms and detector design methods.

MitraBasu[11] presented a survey of Gaussian-based edge detection techniques. This described in a gray level image of an edge. Edge detection is the process which detects the presence and locations of these intensity transitions.

Sabina Priyadarshini [12] proposed a new technique of edge detection that employs simple additions and divisions and finds out fine edges. It makes use of a threshold that is computed automatically during the edge detection process and it's simple to compute the threshold value. It is based upon simple arithmetic and logic operations, consisting of three procedures: image binarization, image contraction and image subtraction. The proposed method is a computationally simpler and performs better than Sobel's method and requires much lesser computation than Sobel's method. Zhang, Zhao and Li Su [13] proposed a technique based on the integer logarithm ratio of gray levels. In order to remove the ability of noise rejection they proposed a ratio of gray levels between the two successive image points rather than the difference of gray levels to denote the variation in the gray levels. In this, division operation becomes the subtraction operation of the logarithmic ratio of gray levels. This is more convenient for calculations. StamatiaGiannarou, Tania Stathaki [14] proposed a technique that allows combining the methods of different edge detection operators in order to yield improved results for edge detection in an image. This is called Receiver Operating Characteristics (ROC) analysis. This technique uses the statistical approach to automatically form an optimum edge map, by combining edge images from different detectors. The characteristics of this method are to produce accurate and noise free results. One possible concern regarding these techniques is the selection of the edge detectors to be combined. Mohamed A. El-Sayed[15] described the hybrid entropic edge detector and proposed a method to decrease the computation time and generate high quality of edge detection.Peter Wilkins et al.[16] described the approach to reduce the search space for image retrieval. A fair degree of overlap can be achieved in a reduced subset that can be retrieved in a timely manner .C.NagaRaju [17] proposed an edge detection algorithm based on multi- structure elements morphology. The eight different edge detection results are obtained by using morphology gradient algorithm and final edge results are obtained by using synthetic weighted method. The proposed algorithm results are compared with the conventional mathematical morphological edge detection and differential edge detection operators such as Watershed method, Sobel operator and canny operator and obtained the better edges over traditional methods. M. Hanmandlu et al. [18] proposed a technique based on Univalue Segment Assimilating Nucleus (USAN) area i.e. fuzzy technique. The USAN characterizes the structure of the edge present in the neighbour hood of a pixel and can thus be considered as a unique feature of the pixel and is fuzzified. This technique is best in yielding the large number of longest edge segments. This is used for the applications like face recognition and fingerprint identification, as it does not distort the shape of the image and is able to retain all the important edges. Appropriate

fuzzification function and threshold election are important for the success of the proposed edge detection algorithm.Later on Fast fuzzy edge detection technique was proposed. Heuristic membership functions, simple fuzzy rules, and fuzzy complements were used to develop new edge detectors [20].Then Fuzzy edge detector using entropy optimization was proposed. The proposed fuzzy edge detector involves two phases:–global contrast intensification and local fuzzy edge detection. In the first phase, a modified Gaussian membership function is chosen to represent each pixel in the fuzzy plane [21].To realize the fast and accurate detection of the edges from the blurry images, the Fast Multilevel Fuzzy Edge Detection (FMFED) algorithm was proposed [22]. The FMFED algorithm first enhances the image contrast by means using a simple transformation function based on two image thresholds. Second, the edges are extracted from the enhanced image by the two-stage edge detection operator that identifies the edge candidates based on the local characteristics of the image and then determines the true edge pixels using the edge detection operator based on the extreme of the gradient values.

Softwares for Edge Detection

MATLAB, a software package for high-performance numerical computation and visualization, is one of the most widely used tools in the engineering field today. Its broad appeal lies in its interactive environment, which features hundreds of built-in functions for technical computation, graphics, and animation. In addition, MATLAB provides easy extensibility with its own high-level programming language.
Main features are given below:

- Discusses new features and applications, including the new engine of symbolic computation in MATLAB
- Provides two sets of self-guided tutorials for learning essential features of MATLAB
- Includes updated commands, examples, figure, and graphs
- Familiarizes users with MATLAB in just a few hours though self-guided lessons
- Covers elementary, advanced, and special functions
- Supplements any course that uses MATLAB
- Works as a stand-alone tutorial and reference

Conclusion

Literature review indicates that several works has been done in the field of Edge detection. These works includes comparison of various edge detection techniques, various image segmentation techniques, improved versions of edge detectors etc. Edge is a boundary between two homogeneous regions. Edge detection refers to the process of identifying and locating sharp discontinuities in an image. Edge detection is an important pre-processing step for any image processing application, object recognition and object detection. Edge detection is very helpful in case of noise free images. But in case of noisy images it is a challenging task. Noisy images are corrupted images. Their parameters are difficult to analyse and detect.

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