A Review on Various Edge Detection Techniques in Distorted Images

Geetanjali Jain, Supreet Kaur
Punjabi University Regional Centre for Information Technology and Management, Punjab, India

DOI: 10.23956/ijarcsse/V7I4/0234

Abstract—Edge identification is one of the key issues of computerized picture, in this paper, we might examine different systems for edge location and should expand and think about every one of them. There will be some scientific morphology technique and a few traditional edge recognition administrators are checked on. This paper gives strategies, for example, Canny administrator and scientific morphology, which outlines generally great picture edge location techniques, and gives a reference to some discovery events where requires litter edge width in reasonable application.

Keywords—Canny edge detection, Morphology, Operators

I. INTRODUCTION

Since from the last few decades, application of computer vision is enormously increasing in almost all fields of life. From sorting products in the industry, to surveillance in the security zones, car parking systems to medical image processing etc. Therefore, automatic visual inspection of images is necessary [1-4] which is used in industry for detecting defects in textile design, glass industry and steel rerolling mills, due to the fact that comparing of numbers is more easy than comparing images [5]. Thus image analysis is very important and necessary. One main image analysis technique is the edge detection process, in which abrupt variation of the image intensity is detected [6]. Different techniques are used for detecting the edges in which the most common and computationally light technique is the Linear Time Invariant filters. In case of the first order filters, the goal is to find first order derivative where its magnitude is high [7]. There are other well known techniques for edge detection which can be grouped mainly in two categories i.e. search based techniques and zero crossing algorithms [8]. In zero crossing detectors second order derivative is computed for edge detection while in case of search based methods first order derivatives are computed. The most well known conventional methods like Sobel, Canny, Prewitt, and Laplacian belong to one of the above classes. The main aim of edge detection is to identifying points in a digital image at which the image brightness changes sharply or, more formally. Image edge detection deals with extracting edges in an image by identifying pixels where the intensity variation is high. It 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. The edge is the set of the pixel, whose surrounding gray is rapidly changing. The internal characteristics of the edge-dividing area are the same, while different areas have different characteristics. The edge is the basic characteristics of the image. There is a lot of information of the image in the edge. Edge detection is to extract the characteristics of discrete parts by the difference in the image characteristics of the object, and then to determine the image area according to the closed edge.

II. RELATED STUDY

You-yi Zheng et. All [1] provides two methods: Canny operator and mathematical morphology, which summaries relatively good image edge detection methods, and provides a reference for some detection occasions where requires smaller edge width in practical application.

Mendoza, O. et. All [2] combination of some of these techniques with fuzzy inference system (FIS) has been applied. In this work a new FIS type-2 method is implemented for the detection of edges and the results of three different techniques for the same goal are compared.

Moon, H. et all [3] propose an approach to accurately detecting two-dimensional (2-D) shapes. The cross section of the shape boundary is modeled as a step function. We first derive a one-dimensional (1-D) optimal step edge operator, which minimizes both the noise power and the mean squared error between the input and the filter output. This operator is found to be the derivative of the double exponential (DODE) function, originally derived by Ben-Arie and Rao (1994).

We define an operator for shape detection by extending the DODE filter along the shape's boundary contour. The responses are accumulated at the centroid of the operator to estimate the likelihood of the presence of the given shape. This method of detecting a shape is in fact a natural extension of the task of edge detection at the pixel level to the problem of global contour detection. This simple filtering scheme also provides a tool for a systematic analysis of edge-
based shape detection. We investigate how the error is propagated by the shape geometry. We have found that, under general assumptions, the operator is locally linear at the peak of the response. We compute the expected shape of the response and derive some of its statistical properties.

Patel, D.K. et. al [4] This means that if the edges in an image can be identified accurately, all of the objects can be located and basic properties such as area, perimeter, and shape can be measured. Here fuzzy logic based image processing is used for accurate and noise free edge detection and Cellular Learning Automata (CLA) is used for enhancing the previously-detected edges with the help of the repeatable and neighbour hood-considering nature of CLA.

Om Prakash Verma et all [5] proposes a new edge detection technique is proposed to deal with the noisy image using fuzzy derivative and bacterial foraging algorithm. The bacteria detect edge pixels as well as noisy pixels in its path during the foraging. The new fuzzy inference rules are devised and the direction of movement of each bacterium is found using these rules. During the foraging if a bacterium encounters a noisy pixel, it first removes the noisy pixel using an adaptive fuzzy switching median filter in Toh and Isa.

Cristian Brognara et. all [6] propose a simple method to extract edges from Polynomial Texture Maps (PTM) or other kinds of Reflection Transformation Image (RTI) files. It is based on the idea of following 2D lines where the variation of corresponding 3D normals computed from the PTM coefficients is maximal. Normals are estimated using a photometric stereo approach, derivatives along image axes directions are computed in a multiscale framework providing normal discontinuity and orientation maps and lines are finally extracted using non-maxima suppression and hysteresis thresholds as in Canny’s algorithm.

Wilhelm Burger et all [7] Color images contain richer information than grayscale images and it appears natural to assume that edge detection methods based on color should outperform their monochromatic counterparts. For example, locating an edge between two image regions of different hue but similar brightness is difficult with an edge detector that only looks for changes in image intensity.

Xiaochun Zhang et. all [8] introduces a scale-invariant and contrast-invariant multi-scale differential edge detector. The method is a direct consequence of two key discoveries: (1) a precise scale normalization method and (2) a formula to verify scale-invariant detectors. The new scale normalization method provides differential operators with respect to scale, among them the scale-invariant edge detectors. To investigate these differential detectors quantitatively, mathematical functions were used to represent the edges and to solve for the parameters, including position, width, contrast, offset, and orientation, in closed form. Noise is filtered as a low-contrast feature.

M. Kawecki et al [9] defines a novel, simple and fast morphological edge detector is presented. It is based on the definition of a non-flat, dynamic structuring element and on the new definition of a simple morphology operation, useful as a generalisation of many image processing operations. The several results of the algorithm’s application are presented, as along with the results of its implementation in a real-time IR and TV image fusion hardware system.

Arup Kumar Pal et al [10] In this paper, the authors have proposed an image steganography method for improving the embedding capacity of the grayscale cover image. In general, the embedding of the secret message into the sharp areas i.e. edge region rather than in the smooth areas i.e. non edge region of the cover image attains relatively better quality stego-image. So in the proposed work, we have also exploited the presence of edges in the cover image to embed a large amount of secret message into the cover image. The proposed method carried out into two phases: in the first phase the cover image is classified into edge region and non-edge region. Subsequently in the second phase, the binary secret message bits are embedded by replacing some least significant bits (LSBs) of each pixel. In the proposed work, x LSBs replacement are preferred for the pixels belongs to edge region and y LSBs replacement are considered for non-edge region pixels where x>y. The proposed method increases the embedding capacity of the cover image compare to some existing standard steganographic methods.

III. EDGE DETECTION METHODS

**Sobel**: Sobel is the well known simple conventional edge detection technique in which 3x3 convolution masks are used for detection of the edges in x and y directions. These masks are shown in Figure 1. Both masks can be applied to the images independently and the output magnitudes are combined to find the absolute magnitude of the whole image.

\[
\begin{array}{ccc}
-1 & 0 & +1 \\
-2 & 0 & +2 \\
-1 & 0 & +1 \\
\end{array}
\]

\[
\begin{array}{ccc}
+1 & +2 & +1 \\
0 & 0 & 0 \\
-1 & -2 & -1 \\
\end{array}
\]

G_x

G_y

**Canny**

Canny is another well known conventional edge detection algorithm which is popular due to its optimum performance. It is basically an optimization problem with constraints. Three different criteria are addressed in this detector i.e. low error rate, localization and single response to a single edge. These parameters were implemented by canny.
Prewitt

Prewitt edge detection method is almost similar to Sobel operator. In this case 3x3 masks are used to find the gradients in x and y directions. This method is computationally efficient and suitable for images with high resolution. Masks of Prewitt detector are shown in Figure 2.

\[
\begin{array}{ccc}
-1 & 0 & +1 \\
-2 & 0 & +2 \\
-1 & 0 & +1 \\
\end{array}
\]

\(G_x\)

\[
\begin{array}{ccc}
-1 & 0 & +1 \\
-2 & 0 & +2 \\
-1 & 0 & +1 \\
\end{array}
\]

\(G_y\)

Fig2. Prewitt Masks

Laplacian

Laplacian operator is from the zero crossing category of the edge detection techniques. The detector detects the zero crossing in the second derivative to find edges.

Roberts Operator: It performs 2-D spatial gradient measurement on an image. It highlights regions of high spatial frequency which often correspond to edges. The cross convolution mask is shown in figure3. [20]

\[
\begin{array}{cc}
-1 & 0 \\
0 & 1 \\
\end{array}
\]

\[
\begin{array}{cc}
0 & 1 \\
-1 & 0 \\
\end{array}
\]

Fig3. Roberts Mask

IV. IMAGE SEGMENTATION USING GENETIC ALGORITHM

Genetic Algorithms (GAs) can be seen as a software tool that tries to find structure in data that might seem random, or to make a seemingly unsolvable problem more or less ‘solvable’. GAs can be applied to domains about which there is insufficient knowledge or the size and/or complexity is too high for analytic solution. Basically, a genetic algorithm consists of three major operations: selection, crossover, and mutation. The selection evaluates each individual and keeps only the fittest ones in the population. In addition to those fittest individuals, some less fit ones could be selected according to a small probability. The others are removed from the current population. The crossover recombines two individuals to have new ones which might be better. The mutation operator induces changes in a small number of chromosomes units. Its purpose is to maintain the population diversified enough during the optimization process. The existing GA’s are founded upon the following main principles:

1. Reproduction
2. Fitness
3. Crossover
4. Mutation

Image segmentation using OTSU

Threshold selection is used in OTSU algorithm. The OTSU method is one of the applied methods of image segmentation in selecting threshold automatically for its simple calculation and good adaptation. In image processing, OTSU’s thresholding method is used for automatic binarization level decision, based on the shape of the histogram. The algorithm assumes that the image is composed of two basic classes: Foreground and Background. It then computes an optimal threshold value that minimizes the weighted within class variances of these two classes. It is mathematically proven that minimizing the within class variance is same as maximizing the between class variance.

The different thresholding techniques are

1. Histogram shape-based methods.
2. Clustering-based methods.
3. Entropy-based methods.
5. Spatial methods.
6. Local methods.

V. CONCLUSION

This paper conclude that these edge detection operators can have better edge effect under the circumstances of obvious edge and low noise. But the actual collected image has lots of noises. So many noises may be considered as edge to be detected. In order to solve the problem, wavelet transformation is used to denoising. Yet its effect will be better if those simulation images processed above are again processed through edge thinning and tracking.
REFERENCES


