IMAGE PROCESSING EDGE DETECTION IMPROVEMENTS AND ITS APPLICATIONS

Dr. S. Veni
Karpagam University, India
venikarthi04@gmail.com

Abstract: Image processing terminology is detection of edges and computer vision mainly focuses on the area of feature extraction that refers to the algorithms. This algorithm used for identifying points in a digital image and image edge detection is increasing. In this paper discussed about the applications of edge detection in three areas. There are diagnosis of lung cancer, fingerprint identification and moving sand dunes in mars.

Keywords: *Edge Detection, GIMP Sobel filter, Laplacian of Gaussian, Prewitt edge detection, Canny Edge Detector*

1. INTRODUCTION

Edge detection process is tracing the information of images such as shapes, texture and significant features. It is one of the basic initial processes for several image processing techniques in computer vision. Edge detection portrays the edges of the gray scale image so that the locations where a sudden change in the pixel value are identified and located as edges. This process is carried out in four main steps are Filtering, Detection, Enhancement and localization. Edge detection always comes out with representing the edges alone in white color and other locations in black and has a wide application in machine vision gauging, processing medical images, de-noising medical image, brain tumor detection, vehicle distance tracking, vehicle number plate tracking, remote sensing images, etc…..

1.1 Steps in edge detection

- Filtering – Filter image to improve performance of the Edge Detector with respect to noise
- Enhancement – Emphasize pixels having significant change in local intensity
- Detection – Identify edges using thresholding
- Localization – Locate the edge accurately, estimate edge orientation.

2. METHODS OF EDGE DETECTION

2.1 Sobel operator

Sobel edge detection is used in image processing method .The Sobel kernels are more suite for detect edges along the horizontal (180 degree) and vertical axis (90 degree). The Sobel operator is depends on convolving the image with a small, separable, and integer valued filter.

2.2 Canny Edge Detector

Canny edge detection is a multistage algorithm to detect a wide range of edges in images. It was presented in 1986 by Canny. The problem among this type of traditional edge detection method is that a low threshold produces false edges, but a high threshold misses important edges.

2.3 Prewitt edge detection

Prewitt operator edge detection mask is oldest method and best understood methods of detecting edges in images. The strength of the edge at particular location is then the square root of the sum of the squares of two derivatives.

2.4 Robert edge detection

In Robert edge detection, the vertical and horizontal edges bring out individually and then put mutually for edge detection result. The two separate images Gx and Gy will be combined to get result. The Robert cross kernels are relatively small. Therefore they are highly susceptible to noise.

2.5 Laplacian of Gaussian (LOG)

This method of edge detection was invented by Marr and Hildreth in1980.In this method, the Gaussian filtering is merged with Laplacian to break down the image where the intensity varies to detect the edges effectively. It locates the exact place of edges and testing wider area around the pixel .The LOG operator disadvantage is that it cannot find orientation of edge due to laplacian filter.

3. EDGE DETECTION OF MOVING SAND DUNES ON MARS

Here we discuss the application of an edge detection filter, the Sobel filter of GIMP, to the newly exposed motion of some sand dunes on Mars. The filter allows a good Comparison of an image HiRISE of 2007 and an image of 1999 recorded by the Mars Global Surveyor of the dunes in the Nili Patera caldera, calculating then the motion of the dunes on a longer period of time than that previously investigated.

The GIMP Sobel filter is applied as an example of the use of an edge detection method in enhancing the visibility of the motion of a dune on Mars. Only recently the dunes on Mars have been recognized as moving objects. This result has been accomplished by means of the images came from the satellites orbiting on Mars these images showed that the dunes in the Gale Crater for instance move at a rate of about 0.4m/yr. To investigate this motion researchers used images from the High Resolution Imaging Science Experiment (HiRISE), the camera onboard the Reconnaissance Orbiter. The researchers evidenced the sand motion in the Herschel Crater and in the Nili Patera caldera on Mars and it has been concluded that the rates of landscape on Earth and Mars are similar.

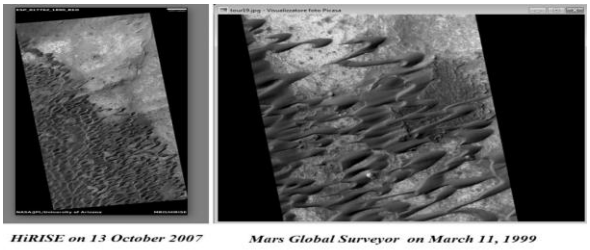

Figure 1: The images of the Nili Patera dune field that we can use for the study of moving dunes on Mars.

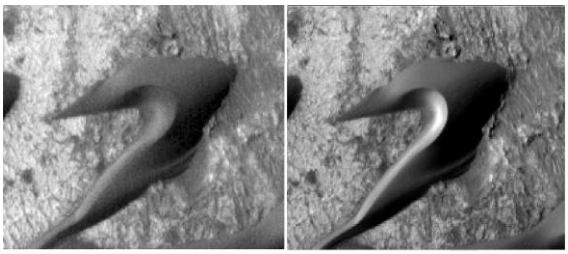

Figure 2: A barchan of the Nili Patera dune field in the Mars Orbiter Camera image

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(1999) on the left and inHiRISE on the right (2007). Note the displacement of the toe of the dune. Both images have been processed with GIMP to adjust brightness and contrast, to enhance the visibility of the ground on which the dune is moving and have then some reference points on it.

Figure 3: The images in the Figure 2 have been processed with the Sobel filter of GIMP, adjusting the threshold. Here the filtered images are shown in inverted colors. These two images can be used as layers and added to the original images.

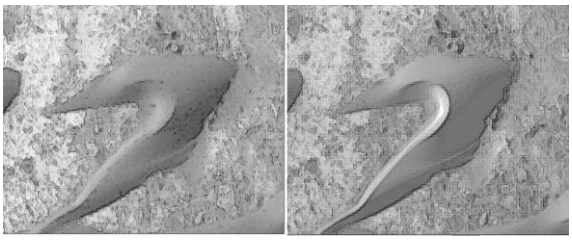

Figure 4: The images in Figures 2 and 3 are used as layers and merged together in a new image.

With respect to the images in Figure 2, we can see more clearly the relative displacement of the dune on the ground of the crater

Image processing method is using an edge detection filter to evaluate a HiRISE image and a Mars Global Surveyor image, and investigate the motion of abarchan in the Nili Patera caldera on Mars. The use of the GIMP processing is illustrating, an image processing and Sobel filtering permit better comparison of images coming from two collections, in this case those of the Mars Global Surveyor and HiRISE.

4. FINGERPRINT IDENTIFICATION USING EDGE DETECTION

Fingerprint technology has come a long way since its inception more than 100 years ago. The first primitive live scan fingerprint readers introduced in1988 had many problems compared to the sleek, inexpensive and relatively miniscule sensors available today. During the past few decades, research and active use of fingerprint

matching and indexing include also advanced our understanding of individuality, information in fingerprints and effective ways of processing this information. There are a more number of issues that remain to be rectifying in designing a completely automatic and reliable fingerprint individualization system especially when fingerprint images are of poor quality. One such aspect of identification of fingerprints can be overcome by using edge detection techniques.

Fingerprints the very basis for criminal history foundation at every police agency on earth has served governments worldwide for over 100 years to give perfect identification of criminals. Remains the most commonly used forensic evidence worldwide - in mainly jurisdictions fingerprint examination cases match or outnumber all other forensic examination casework combined. Worldwide, fingerprints harvested from crime "scenes lead to more suspects and produce extra evidence in court than all other forensic laboratory techniques combined. "Other visible human characteristics tend to change - fingerprints are much more persistent. surgery causing deep scarring or Barring injuries, or diseases like as leprosy damaging the formative layers of friction ridge skin (injuries, scarring and diseases tend to exhibit telltale indicators of unnatural change), finger and palm print features are not display to move about or change their unit relationship throughout the life of a person.

The digitization and processing of fingerprints involves a series of steps.

A large number of computer algorithms have been developed in the past three decades to automatically process digital fingerprint images. These algorithms have reduced the operational productivity of law enforcement agencies and have reduced the number of fingerprint technicians needed. Still five major problems have been identified in designing automated fingerprint processing systems namely digital fingerprint acquisition, image enhancement, feature extraction, matching and retrieval.

In the process of image acquisition various algorithms such as automatic finger detection algorithm, automatic fingerprint capture algorithm, vitality detection algorithm, image data-compression algorithm, image processing algorithm, fingerprint matching algorithm and cryptographic algorithms depending on the applications for which the stream of fingerprint images are being captured.

Next the fingerprint images obtained from different sources are being enhanced using algorithms based on the type of noise .The goal of such algorithms is to produce an image that does not contain any artificially generated ridge structures that might later result in the detection of false minutiae features. These algorithms use information which is already present in the fingerprint image and hence does not add any external information to the image. In the enhancement of latent prints for AFIS searching forensic experts are provided with live feedback about the enhancement through a graphical interface thus enabling them to use various algorithms to choose the region of interest in the fingerprint image such as cropping the image, inverting the color, adjusting intensity, flipping the image, magnifying the image, resizing the image window and applying compression and decompression algorithms. They may also include histogram equalization, image intensity rescaling, and image intensity adjustments with low and high thresholds, local otherwise global contrast enhancement, local or global background subtraction, sharpness adjustments, gamma adjustments, and brightness and contrast adjustments. Meanwhile in the automated enhancement of fingerprint images human assistance does not occur in the fingerprint individualization process. Enhancement algorithms are fully used in the automated mode to improve the fingerprint ridge structures in poor-quality images.

After a fingerprint image is pre-processed feature extraction is done. The pre-processed fingerprint image is converted into a binary image which is then thinned. There are various approaches through which binarization, thinning and minutiae detection can be done. The binarization algorithm is used to convert a gray-scale improved fingerprint image into binary (white and black) form where all black pixels matching to the ridges of the fingerprint and all white pixels correspond to valleys. Following the process of binarization a thinning algorithm is applied to convert the resulting binary fingerprint image into a single pixel width. The basic idea of the thinning process is to obtain a connected unit-width by performing iterative erosions of the outermost layers of a shape. The image obtained after applying the thinning algorithm is known as the thinned image.

In this thinned image it is defined that all pixels on a ridge have two neighboring pixels in the immediate neighborhood. If a pixel has only one neighboring pixel it is found to be a ridge ending and if a pixel has three neighboring pixels it is determined to be a ridge bifurcation. The estimation of local ridge orientation or direction within the fingerprint image serves to be one of the most important features. This is important to identify major core singularities which include features like as whorls, arches, deltas and loops. The identification of such structures within the image

enhances the efficiency of the recognition process of fingerprint images.

Following the feature extraction matching of fingerprint images is done. The process of fingerprint matching can be defined as the exercise of finding the similarity or dissimilarity in any two given fingerprint images. From the number of common minutiae found, their closeness of fit, the quality of the fingerprint images, and any contradictory minutiae matching information it is possible to assess the similarity of the two prints. Thus using edge detection techniques fingerprints can be identified more effectively.

5. CONCLUSION

Thus edge detection serves to be vital in the processing of a digital image. With various newly developed algorithms and techniques more efficiency can be obtained in the process. While the drawbacks of the methods are being rectified, edge detection is an area of interest with a wide range of applications. In this paper three such applications of edge detection in the fields of medical imaging, satellite imaging and fingerprint identification have been presented.

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