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Comparative Study of Edge Detection Techniques in Shoeprint Recognition System

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Abstract- In Digital image processing,edge detection plays a major role.Edges form the outline of an object and also it is the boundary between an object and the background. A study on image edge detection methods is presented in this paper. Edge information can be extracted by applying detectors with different methodology. Detecting accurate edges are very important for analyzing the basic properties associated with an image such as area, perimeter, and shape. This research paper presents a brief study of the fundamental concepts of the edge detection operation, theories behind different edge detectors, calculating mean and standard deviationof an image and their result analysis.

Index Terms: Edge detection,digital image processing,shoeprint

1. INTRODUCTION

The goal of segmentation is to simplify and change the representation of an image into something that is more meaningful and easier to analyze.Segmentation subdivides an image into its constituent regions or objects.Image segmentation algorithms generally based on one of two basic properties of intensity values,i.e. discontinuity and similarity.The main purpose of edge detection is to simplify the image data in order to minimizethe amount of data to be processed .The detector has to decide whether each ofthe examined pixels is an edge or not. This paper gives an overview of edge detection methods and edge detector performance evaluation. The result of the simulations were analyzed and compared by writing simple edge detection algorithm andMatlabfunctions, one can have a better understanding of the various edge detectionalgorithms developed in the past.

Several edge detector methods are there for detecting edges like canny, sobel, prewitt, laplacian and laplacian of Gaussian (LoG). These edge detectors work better under different conditions [13,15]. Comparative analysis between canny,sobel and prewitt operators has been presented in this paper. Performances of such operators are carried out for a shoeprint image by using MATLAB 7.0 software

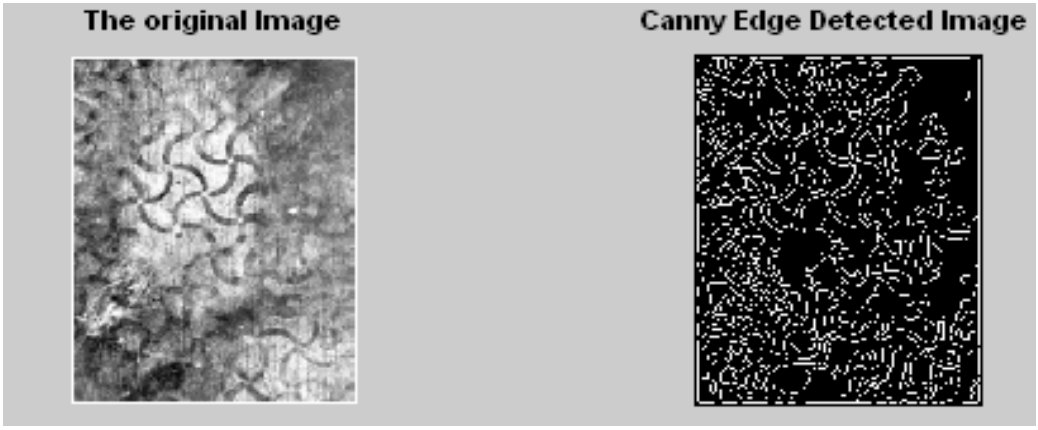
1.1 EDGE DETECTORS

1.1.1 Canny

Among various edge detectors the Canny edge detector has been shown to have many useful properties. It is considered to be the most powerful edge detector since it uses a multi-stage algorithm consisting of noise reduction, gradient calculation, non-maximal suppression and edge linking. The detected edges preserve the most important geometric features on shoe outsoles, such as straight lines, circles, ellipses.

$$K_{GX} = \begin{bmatrix} -1 & 0 & 1 \\ -2 & 0 & 2 \\ -1 & 0 & 1 \end{bmatrix}$$

$$K_{GY} = \begin{bmatrix} 1 & 2 & 1 \\ 0 & 0 & 0 \\ -1 & -2 & -1 \end{bmatrix}$$



(a) (b)

Figure (1) Canny Edge Detector (a) Original image (b) Canny Edge Detected Image

1.1.2 Sobel

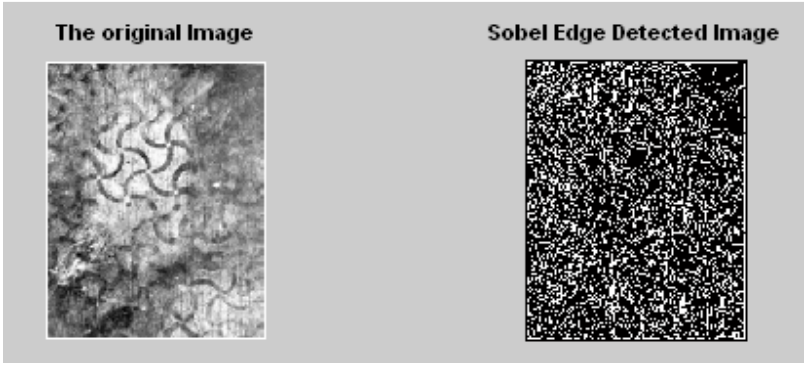
The sobel edge detector computes the gradient by using the discrete differences between rows and columns of a 3X3 neighborhood. The sobel operator is based on convolving the image with a small, separable, and integer valued filter. In below a sobel edge detection mask is given which is used to compute the gradient in the x (vertical) and y (horizontal) directions.

-1	-2	-1
0	0	0
1	2	1

G_x

-1	0	1
-2	0	2
-1	0	1

G_y



(a) (b)

Figure (3) Sobel Edge Detector (a) Original image (b) Sobel Edge Detected Image

1.1.3 Prewitt

Prewitt operator edge detection masks are the one of the oldest and best understood methods of detecting edges in images The Prewitt edge detector uses the following mask to approximate digitally the first derivatives Gx and Gy. The following is a prewitt mask used to compute the gradient in the x (vertical) and y (horizontal) directions.

-1	-1	-1	-1	0	1
0	0	0	-1	0	1
1	1	1	-1	0	1

G_x G_y

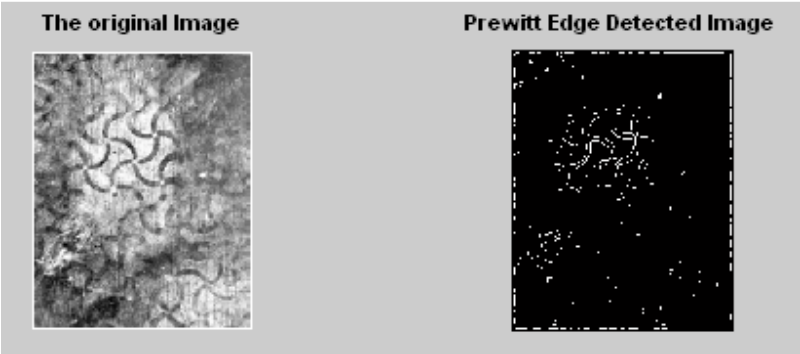


Figure (3) Prewitt Edge Detector (a) Original image (b) Prewitt Edge Detected Image

2. METHODOLOGY

In this section we make detection of edges in shoeprint image.We have proposed the following algorithm to detect the edges from it.

Step 1. First take an intensity image of shoeprint

Step2. Apply edge detectionmethod

Step3. Apply different threshold values

Step4. Calculate mean and standard deviation

Step 5 Results are analyzed

2.1 Mean and Standard deviation

In some situations ,the mean describes what is being measured ,while the standard deviation represents noise and other interference.In these cases,the standard deviation is not important in itself,but only in comparison to the mean.This gives rise to the term :Signal- to -noise ratio(SNR),which is equal to the mean divided by the standard deviation.

$$\mu = \frac{1}{N}\sum_{i=0}^{N-1} x_i$$

Mean

$$\sigma^2 = \frac{1}{N-1}\sum_{i=0}^{N-1}(x_i - \mu)^2$$

Standard deviation

3.EXPERIMENTAL ANALYSIS AND DISCUSSION

For the experimental work,we have taken an image of shoeprint as an input.we have allpied the above mentioned edge detectors on this image. This experimental work is carried out in MATLAB .figure shows original image which is taken for experimental analysis.

Fiq 2 shows the images which are obtained by applying edge detection methods.The mean and standard deviatuion is evaluated for resultant image as shown in table 1 to table 3.for canny edge detection method the threshold values must be less than 1

Threshold	Mean	Standard Deviation
0.01	0.2080	0.4059
0.02	0.2080	0.4059
0.03	0.2077	0.4057
0.04	0.2072	0.4053
0.05	0.2064	0.4048

Table I: Mean and Standard deviation calculation with different thresholds in Canny edge detector

Threshold	Mean	Standard Deviation
0.01	0.3460	0.4757
0.02	0.3416	0.4742
0.03	0.3261	0.4688
0.04	0.2985	0.4576
0.05	0.2634	0.4405

Table II: Mean and Standard deviation calculation with different thresholds in Prewitt edge detector

Threshold	Mean	Standard Deviation
0.01	0.3405	0.4739
0.02	0.3364	0.4725
0.03	0.3232	0.4677
0.04	0.2994	0.4580
0.05	0.2664	0.4421

Table III: Mean and Standard deviation calculation with different thresholds in Sobel edge detector

4. CONCLUSION

In this work,a shoeprint image has been studied for detecting edges using various types of edge detection methods: Canny, Sobel and Prewitt have been tested to detect the edges. We have also applied different threshold values in all the above methods. The results are analyzed , compared and also evaluated through the quality metrics like mean and standard deviation. Through this work, it is observed that the choice of edge detection method on the shoeprint image depends upon the type of image. Through this work it is found that for the shoeprint images, prewitt and sobelalgorithms performs better under almost all scenarios

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