6L-2

Concentric Shape Eraser and Detector for Traffic Signs Recognition

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1 Introduction

The process of detecting edges in a image is generally accomplished by applying a convolution mask to the entire image. This paper defines a Concentric Pattern Eraser (CPE) and a Concentric Pattern Detector (CPD). We will show that generating alternative convolution masks, the CPE is capable of erasing basic concentric shapes while the CPD is capable of detecting them. The CPD and CPE can be used at early stages for recognizing traffic signs since they present basic concentric shapes.

2 CPD–CPE Generation

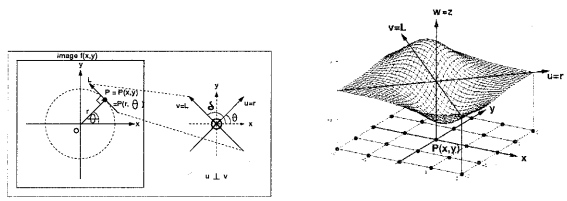
Convolution masks used in Operators like Sobel or Roberts can detect if a pixel belongs to a vertical, horizontal, or diagonal-oriented edge. This is easily achieve by simple rotation of the predetermined values of the convolution masks. But if we want to detect if a pixel belongs to an edge, let say, with orientation of $\frac{\pi}{8}$, the simple method of rotation can not be applied due to the discrete nature of the values. When using the CPE or CPD, a convolution mask is generated for every pixel in an image. The explanation becomes easier with an example. For this example please refer to Fig.1a. Suppose that for a pixel **P**, we want to generate a convolution mask capable of erasing/detecting that pixel if is part of an edge with angle orientation equal to θ. To achieve our goal we need to a) define a reference point **O** that will help us to determine the orientation of the pixel(for this work the central point of the image was taken) and b) generate the values for the convolution mask. These values were sampled from a 2D function. This function was placed in the coordinate system with axis (u, v) as shown in Fig.1a. The origin of this system was placed on the pixel **P** and axis v has an orientation equal to δ. We called that function a **base function** and is defined in the following section.

2.1 Definition of a Base Function

The **base function** is a combination of two Gaussian functions and is defined to be:

$$g(u,v) = e^{-\frac{(u)^2+(v-\mu)^2}{K}} - e^{-\frac{(u)^2+(v+\mu)^2}{K}}, \quad (1)$$

where the peek is $(0, \mu)$, the bottom is $(0, -\mu)$ and K is constant. For example, the base function shown in Fig.1b is used to generate a convolution mask capable of detecting all the pixels that belong to an edge with orientation of $\frac{\pi}{4}$.



(a) (b)

Figure 1: Explanation figures. (a) Coordinate system (u, v), (b) Base function.

3 Simulation Results

For this paper basic simulations were realized. We have used basic shapes that are concentric to the central point of the image. All the image are in black and white and 255×255 pixels in size. Controlling the angle of rotation of the base function, we produced a set of CPDs and CPEs. Figures 2b and 2c

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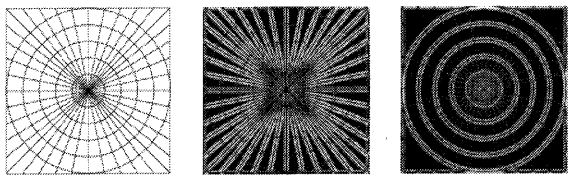
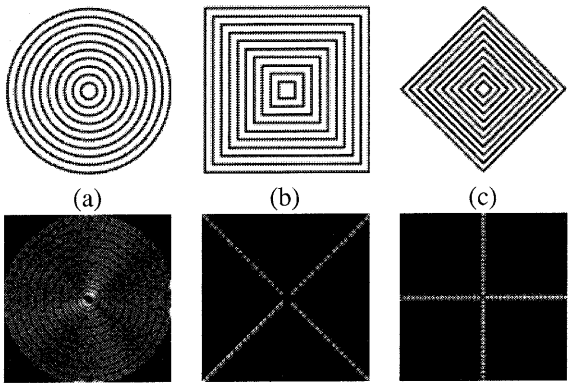


(a) (b) (c)

Figure 2: Simulation results using a CPD. (a) Original image, (b) CPD adapted for lines, (c) CPD adapted for circles.

displays the use of CPD and Figures 3d through 3f displays the use of CPE. Figure 4 displays the simulation results on traffic signs. We have used traffic signs because a) they present basic shapes and, b) we consider that the CPD and the CPE can be used in a bigger system to classify and recognize traffic signs. Since traffic signs gave us important information, an automated navigation system should used the same information.



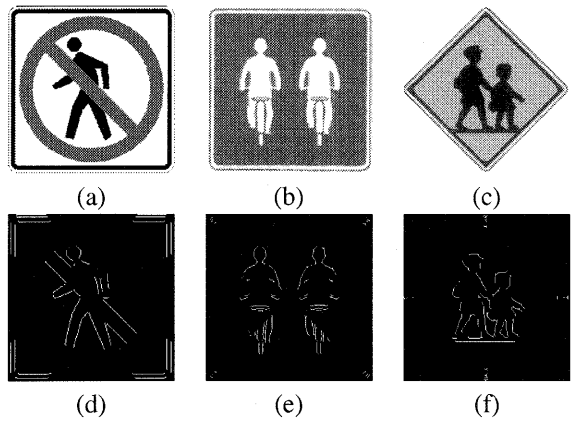
(a) (b) (c)

(d) (e) (f)

Figure 3: Simulation results using a CPE. (a)–(c) Original images, (d) CPE adapted for circles, (e) CPE adapted for squares, (f) CPE adapted for diamonds.

4 Conclusions

This paper has described a method to generate convolution masks for the CPE and CPD. Also we have shown that the CPE and CPD can erase/detect concentric shapes. CPD and CPE can be considered as special cases of a extended method for convolution masks generation, capable of detecting/erasing any shape. The strong condition imposed here is that we must have a reference point inside the image. As a future work we want to overcome this limitation.



(a) (b) (c)

(d) (e) (f)

Figure 4: Simulation with traffic signs. (a)–(c) Original images, (d)–(f) results using CPE.

We believe that this method of detecting/erasing selected shapes can be used to eliminate undesired data from an image. Also in problems of image segmentation that involves superimposed shapes.

References

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