Image Edge Detection as Part of the Feature Extraction for Neural Network Realized with LabVIEW Application

Liljana Docheva[1]

Abstract – **Edge detection is often used in the areas of machine vision, intelligent systems, object recognition etc. This article presents a short introduction to convolution implementation for edge detection using Labview. Labview block diagram for implementation of different two-dimensional convolution kernels, applied to test images, is given. The behaviour of the kernels is investigated in case of the coefficients value in order to improve the quality of edge detection. The obtained results are presented and discussed.**

Keywords **– Image processing, Local operators, Edge detectors, Convolution kernels, Convolution matrix, Labview.**

I. Introduction

Image data are very high dimensional. For this reason, feature extraction is often a necessary step before neural network training for successful object recognition. The goal of feature extraction is to find a subset of variables based on image data. One can present to the neural network inputs for learning speed increasing. When it's used neural network for object recognition it's necessary to extract those features that preserve the class separability well [1], [8]. Edges are very important feature in image recognition problem and often are used like one of the relevant features.

There are various program applications that provide an environment for implementation of different digital signal processing tools. Each of them has their own characteristics and advantages. LabVIEW is measurement and automation programming language that allows construction of different architectures by building different virtual instruments. Because of ability to develop data flow that are highly parallel in structure LabVIEW can be successfully used for building neural networks [3].

In this article is described image edge detection with different two-dimensional convolution kernels. The aim of this research is to explore the most appropriate operators for realization by means of LabVIEW. These operators will be applied in neural network realized for image processing with LabVIEW [3].

II. Convolution Based Operators for Edge Detection

There are too many ways to perform edge detection: fuzzy logic based algorithms, local operators, wavelet based algorithms and other. Wavelet based techniques characterize the nature of the transition for each edge in order to distinguish different types of edges. Local operators are applied to the input image to create the output image with pixels, obtained as weighted combination of the input pixels in the neighborhood. This article describes the most common methods - gradient and Laplacian. The gradient method searches for maximum and minimum in the first derivative of the image. The Laplacian method is looking for zerocrossings in the second derivative of the image [5], [7].

This article describes the most common methods - gradient and Laplacian. The gradient method searches for maximum and minimum in the first derivative of the image. The Laplacian method is looking for zerocrossings in the second derivative of the image [5], [7].

Convolution is an important operation that is used to decide various image processing problems. Two dimensional convolution is defined as follows [6]:

$$R(i,j) = \sum_{m=-N}^{N} \sum_{n=-N}^{N} I(m,n)K(i-m, j-n), \quad (1)$$

where I(m,n) is a pixel of the input image with coordinates (m, n). Correspondingly R(i,j) is a pixel of the resulting image with coordinates (i,j) and K(i-m, j-n) is the convolution kernel.

The Laplacian L(i,j) of an image is given by [4]:

$$L(i,j) = \frac{\partial^2 I}{\partial i^2} + \frac{\partial^2 I}{\partial j^2}, \quad (2)$$

where I(i,j) are the pixel intensity values.

III. Edge Detection with LabVIEW

Fig. 1 depicts one way to build block diagram of edge detector, realized with LabVIEW.

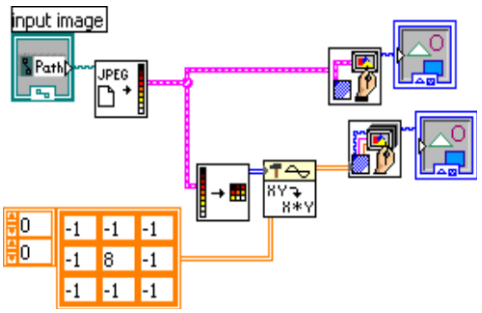

Fig. 1. Block diagram of edge detector realized with LabVIEW

[1]Liljana Docheva is with the Faculty of Telecommunications at Technical University of Sofia, 8 Kl. Ohridski Blvd, Sofia 1000, Bulgaria.

In order to realize the kernel, the convolution virtual instrument is used. For edge detection implementation the following virtual instruments are still required:

- Read JPEG File to read a JPEG file,
- Unflatten Pixmap to converts a cluster of image data into a 2D array,
- Draw Flattened Pixmap to draw a 24-bit RGB pixmap into a picture,
- Draw Unflattened Pixmap to convert a pixmap into a picture image.

For edge detector testing the image with inhomogeneous background and with noise is used. One is shown in Fig. 2. Two-dimensional convolution kernels are applied.

Fig. 2. Input image for edge detector

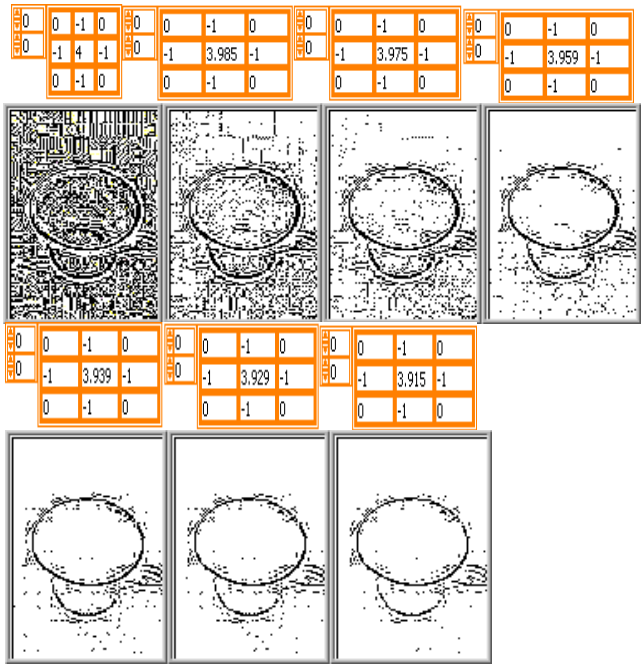

Fig. 3. The results of the Labview realization of the first

Laplacian operator application for edge detection.

The results of the first edge operator application are presented in Fig. 3. From the Fig. 3 first picture can be seen the LabView implementation of Laplacian filter don't give satisfactory results, when the image is with added noise. With modified filter coefficients the resulting image edge detection is improved. From the next six Fig. 3 pictures can be seen the relationship between the filter coefficients decrease and edge detection improvement. When filter coefficients decrease (Fig. 3 from left to right), reducing of false edges is observed. Further reduction of the coefficients would cause the contours rupture. From the seven operators shown in Fig. 3, the last is best suited for neural netlork aplication, because of reducing of false edges.

The second Laplacian operator application to the test image is shown in Fig. 4. In this case the more filter coefficients decrease is required for the false edges decrease (Fig. 4 from left to right). It can be seen that the seventh operator is best suited for neural netlork aplication.

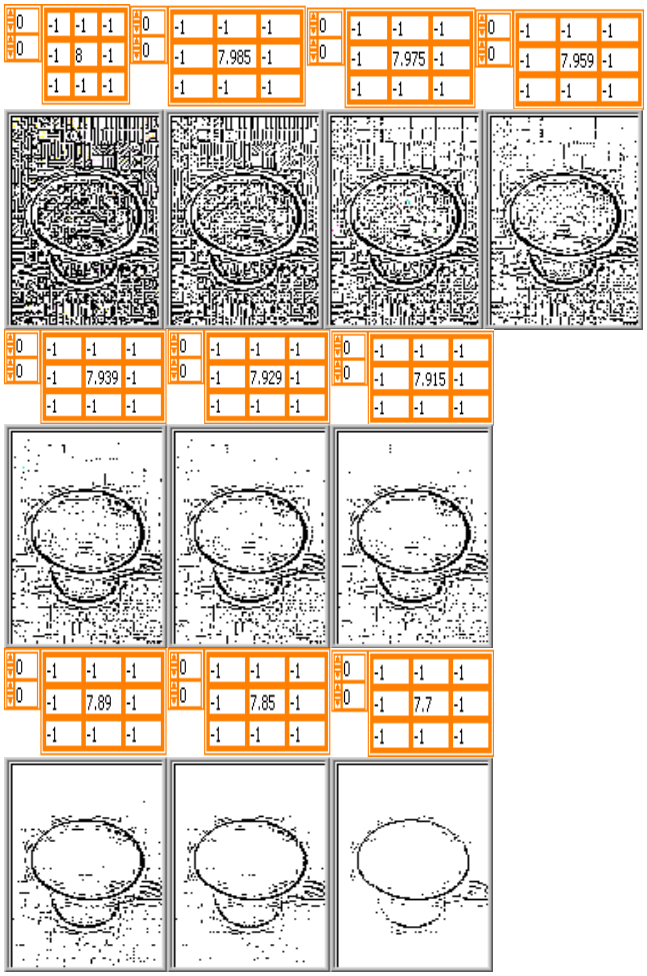

Fig. 4. The results of the Labview realization of the second Laplacian operator for edge detection

The third Laplacian operator application to the test image is shown in Fig. 5. It is easy to see that the decreasing of the coefficients causes the contours rupture. Therefore, these operators are not appropriate for neural netlork aplication.

These results can be compared with those obtained with the Sobel operator. Fig. 6 depicts the results of the Sobel operator and the modified Sobel operator edge detection. The first two pictures (from left to right) show the effect of the horizontal and vertical lines separation respectively. The third picture presents the combined image. It can be seen from the next six pictures that application of experimentally obtained modified Sobel operator results in false edges reduction, but in the last modified operator contours rupture is observed. Therefore one is not quite suitable for neural network application.

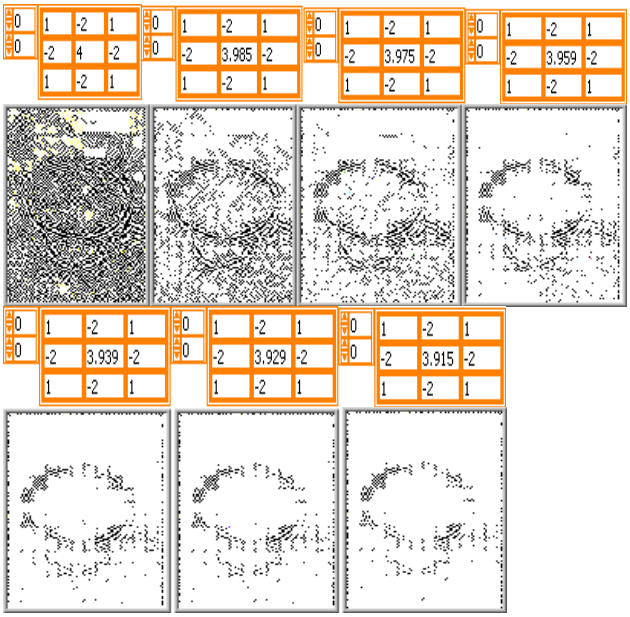

Fig. 5. The results of the Labview realization of the third Laplacian operator for edge detection

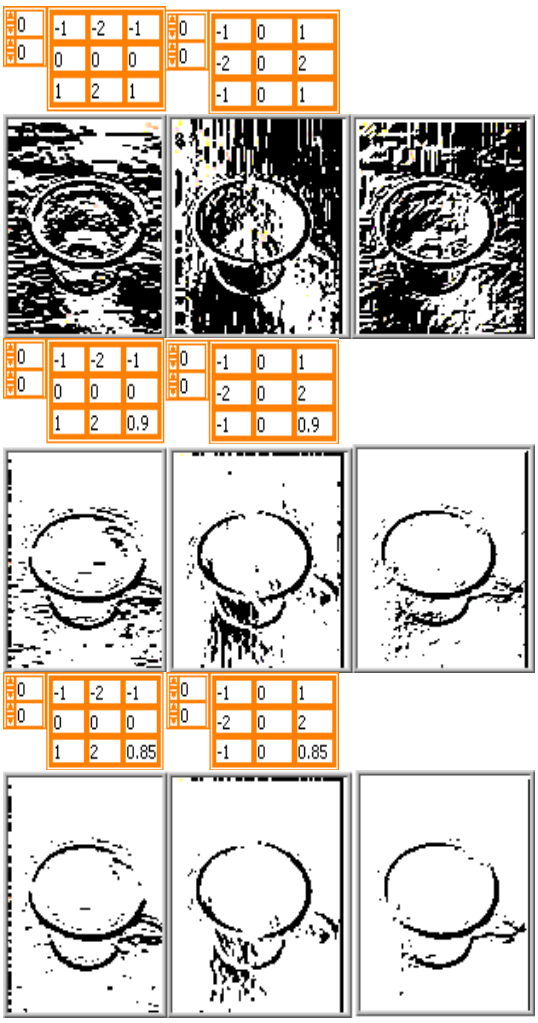

Fig. 6. The results of the Labview realization of the Sobel operator for edge detection

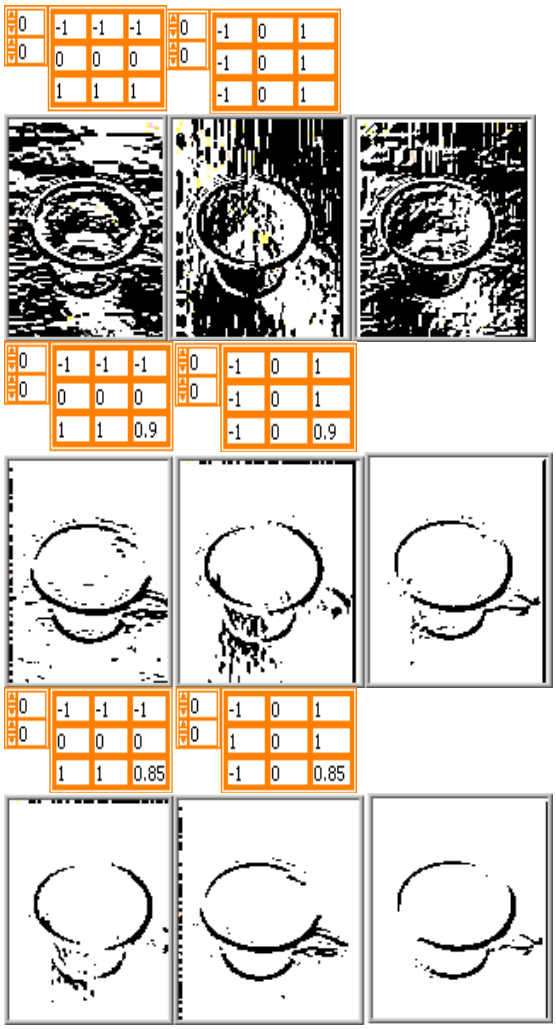

Fig. 7. The results of the Labview realization of the Prewitt operator for edge detection

The separated edges with the Prewitt operator and the modified Prewitt operator are shown in Fig. 7. The results are similar to that obtained by the Sobel operator. Modified Prewitt operator is not quite suitable for neural netlork aplication because of contours rupture is observed.

From Figs. 6 and 7 comparison is observed more visible contours rupture for modified Prewitt operator.

From the results shown above can be seen that LabView implementation of the first two Laplacian filters after modification (Fig. 3 and Fig. 4) are most appropriate to be applied to the neural network, realized with LabVIEW. They can be used for feature detection or other image processing purpose.

IV. Conclusion

In this article LabView implementation of two-dimensional convolution kernels is presented. There are detected edges of image with inhomogeneous background and added noise. The first case the Laplacian filter detects edges better then the others considered local operators. But the presence of noise

and inhomogeneity in image background strongly affects the quality of edge detection.

It is shown that, a little modification of the LabView implemented convolution kernels coefficients is sufficient to improve the quality of the edge detection. But for the third Laplacian operator (Fig. 5) the decreasing of the coefficients causes the contours rupture. Contours rupture is observed in modified Prewitt operator (Fig. 7) and modified Sobel operator (Fig. 6) too. Therefore, these operators are not appropriate for neural netlork aplication.

The most appropriate operators for neural network, realized with LabVIEW application are the first two Laplacian filters after modification (Fig. 3 and Fig. 4). Ones will be applied to the neural network realized with LabVIEW for image recognition purpose.

REFERENCES

[1] M. Egmont-Petersen, D. de Ridder, H. Handels, "Image processing with neural networks—a review", Pattern Recognition 35 (2002), pp. 2279–2301.

[2] Ch. Relf (2003), *Image acquisition and processing with LabVIEW*, CRC Press, 2004

[3] L. Docheva, A. Bekjarski, "Implementation of Analog Neural Networks with Labview", XLVII International Scientific Conference Information, Communication And Energy Systems And Technologies, vol: 2, pp. 367 – 370, June 28-30, Veliko Tarnovo, Bulgaria, 2012.

[4] R. Maini, H. Aggarwal, "Study and Comparison of Various Image Edge Detection Techniques", International Journal of Image Processing (IJIP),Volume (3) : Issue (1).

[5] D. Rao, S. Patil, N. Babu, V. Muthukumar, "Implementation and Evaluation of Image Processing Algorithms on Reconfigurable Architecture using C-based Hardware Descriptive Languages", International Journal of Theoretical and Applied Computer Sciences, GBS Publishers and Distributors (India) Volume 1 Number 1, 2006, pp. 9–34.

[6] R. Ingold, *Image Processing: Local Operators*, 2004.

[7] G.T. Shrivakshan, C. Chandrasekar, "A Comparison of various Edge Detection Techniques used in Image Processing", IJCSI International Journal of Computer Science Issues, Vol. 9, Issue 5, No 1, September 2012, pp. 269-276.

[8] I. Draganov, A. Popova, "Handwritten word segmentation combining self-organizing neural networks and heuristic rules", In Proceedings of the Technical University – Sofia, Bulgaria, Vol. 57, No. 1, pp. 148-153, 2007.