EDGE DETECTION USING NEURAL NETWORKS

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ABSTRACT

In this paper, we propose to use of artificial neural networks for edge detection in natural images. Instead of training a neural network on images generated by a Laplacian mask, we train a typical feed-forward back propagation neural network on human generated base truth cases. Our experimental results show that a neural network trained with human generated results can be used for edge detection.

Index Terms**—** edge detection, computer vision, artificial neural network

1. INTRODUCTION

Artificial neural networks have previously been shown to work well at detecting edges using a training image generated by a Laplacian mask [1]. In this paper, we train the artificial neural network on human-generated data to accomplish the edge detection task. The remainder of the paper is organized as follows: section 2 presents the process of setting up the neural network and preparing the images for processing. Section 3 demonstrates the effectiveness of the network. Section 4 concludes with possible future work.

2. TRAINING

In order to accommodate the computational complexity of processing an image and still have a significant number of test cases, each image was broken into 3x3 over-lapping grids. The network was set up with 9 input nodes, one hidden layer with 12 nodes, and 1 output node. Training iterations was set to 500 epochs. A tan-sigmoid transfer function is used.

To further accommodate computational limitations the images were eroded to thicken the line, and then resized to 0.3 times the size of the original. The lines were thickened to prevent losing edges due to resizing.

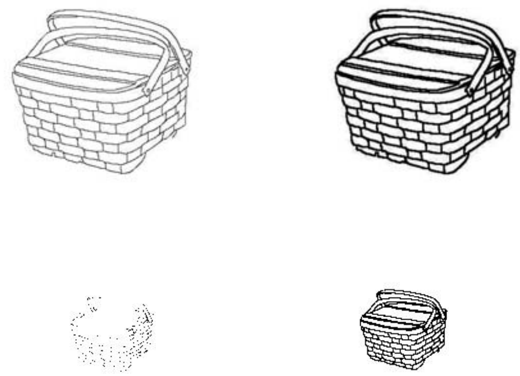

Figure 1: Desired output (top left); eroded output (top right); resized without eroding (bottom left); resized with eroding (bottom right). [2]

Resizing the image, without erosion, results in lighter pixels that are lost when converting the image to binary. If the threshold is adjusted high enough to prevent gaps, the resulting edges are thicker than the results from the process using erosion.

The input images and ground truth contour maps come from an online database of 40 images. [2] Of these images, 7 were used for training(basket, bear, bear_3, bear_8, brush, elephant, and elephant_2). Before resizing the images are grayscale images dimensioned 512x512.

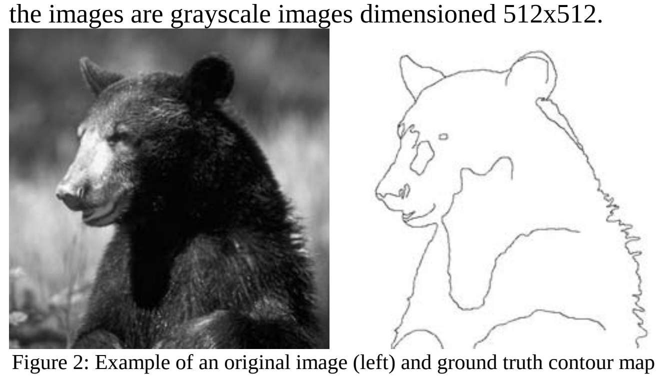

Figure 2: Example of an original image (left) and ground truth contour map (right). [2]

3. EVALUATING THE RESULTS

Figure 3: Three examples of natural images(left); and their corresponding outputs(right).

The neural network produces very strong edges for most contours and geometric objects (buildings and lights), but performs less well on the highly textured rock face.

The output image is inverted to compare against the results of an image generated by a Laplacian mask. In order to compare the output against Canny edge detection, the output image was processed using non-maximum suppression.

Compared to the image generated by the Laplacian mask, the neural network output has sharper details, most noticeable in the horns and branches of the tree. Compared to Canny edge detection the non-suppressed version of the neural network output more accurately captures the face and back.

4. CONCLUSION AND FUTURE WORK

After training with only a small number of images a neural network is able to give better results than a Laplacian mask generated image. While the network-created results lack the continuous lines and cleanliness of Canny edge detection they do exhibit more accurate edges.

It is expected that experimentation with different neural network construction will enable a larger training set to be used, yielding superior results. Further post processing work to the neural network output will also improve the quality of edge detection.

Figure 3: Comparison with other edge detection methods. The original image (top left); the neural net output (top right); the neural network inverted (center left); a Laplacian mask generated image (center right); the inverted neural network after non-maximum suppression(bottom left); and the results from Canny edge detection on the original image (bottom right).
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5. REFERENCES

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