

Real-time edge detection

Application

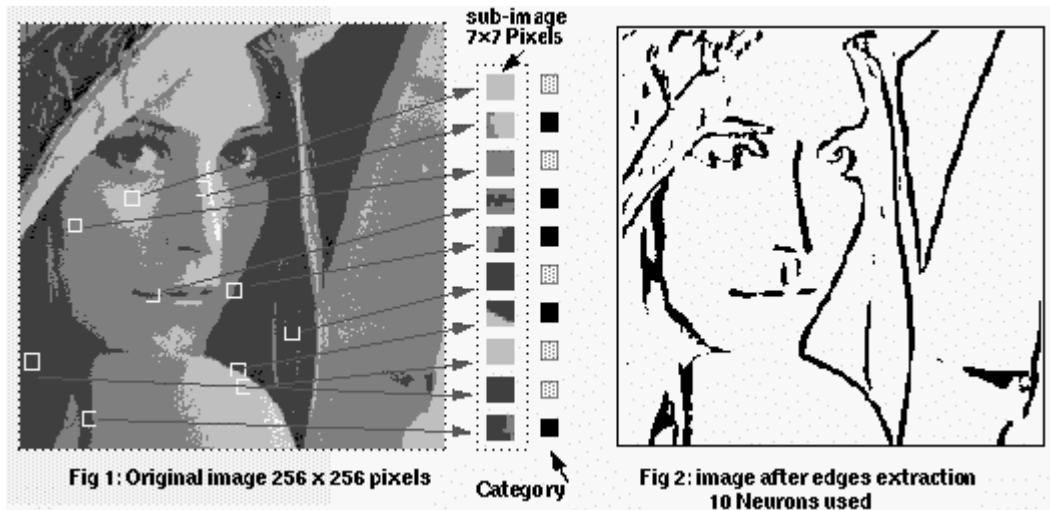
This application demonstrates the use and performance of a CogniMem® (CM1K) chip as a real-time image processor. The idea is to build knowledge where the input vectors are blocks of $n \times n$ pixels taken in a reference image. Their categories are the values of the central pixels of each block taken in a filtered image. We use the example of an edge detection filter but the concept applies to any type of image transformation whether a pixel-by-pixel or neighboring operation, linear or non-linear.

Methodology

- **Learning Phase:** Training is performed by selecting sub-images of $n \times n$ pixels at relevant locations in the image and sending them to the CogniMem along with a category equal to "Contour" or "Non-Contour".
- **Recognition Phase:** For each pixel in an image, CogniMem compares its sub-images with the sub-images stored in the network. The nearest sub-image match permits CogniMem to color the pixel in black if it is in the contour category or in white if it is a non-contour.

Results

This application was done by IBM Labs in Paris.



For an image 256×256 and a sub-image area of 1×1 , 65,536 classifications are necessary for a contour extraction and they are performed in 250 milliseconds. The neurons of the CM1K chip yield good results for this kind of application. It is always possible to increase the quality of the results by increasing the number of neurons in the network, and this without impact on performance. Another possible approach is to quadruple the classification speed by working with a sub-image area of 4×4 pixels instead of 1×1 , but at the expense of accuracy.

Note that the above classification is limited to two categories "Contour" and "Non-Contour". A more sophisticated edge detection filter could be similarly built by learning a dozen categories such as sharp-left edge, blurry-top edge, and more. For a given image and sub-image size, the CogniMem engine will produce the same speed performance whether the network describes two or a dozen edge categories.