Handwritten digit recognition is a challenging task with various applications, such as bank cheque processing [23] and postal mail sorting [2]. Feature extraction plays an important role in the effectiveness of such systems. A number of methods have been proposed, including Zernike moments [3], direct matching [9], Fourier descriptors [12], geometric moment invariants [21], shape context [4], zoning [8] and biologically motivated features [10]. For a thorough overview of recent advances in the recognition of Western Arabic and Farsi handwritten digits we refer the reader to [16,22] and [20,5], respectively.

[Proposed Approach]

We use trainable COSFIRE feature detectors of the type introduced in [1]. They are automatically configured to be selective for parts of given training digit images. The automatic configuration process extracts information about the local geometric arrangement of contour segments. COSFIRE filters are in- spired by the properties of a specific type of shape-selective neuron in area V4 of visual cortex, which exhibit selectivity for parts of (curved) contours or for combinations of line segments [18].

The response of a COSFIRE filter in a given point is computed as a function of the shifted responses of simpler (in this case orientation-selective) filters. Us- ing shifted responses of simpler filters, such as Gabor filters that we use in this study, corresponds to combining their respective supports at different locations to obtain a more sophisticated filter with a bigger support. The specific func- tion that we use here to combine the responses of Gabor filters is geoemetric mean, essentially multiplication, which has specific advantages regarding shape recognition and robustness to contrast variations. One consequence is that a COSFIRE filter produces a non-zero response only when all constituent parts of a pattern of interest are present.

The rest of the paper is organized as follows: in Section 2 we present the COS- FIRE filter and demonstrate how it can be configured and used to detect features of handwritten digits. We also show how the responses of multiple COSFIRE fil- ters can be used to form a shape descriptor of a handwritten digit.In Section 3, we evaluate the effectiveness of our method on two data sets of handwritten digits: Western Arabic (MNIST) [15] and Farsi [13]. We provide a discussion in Section 4 and draw conclusions in Section 5.