



TITLE: Design and Implementation of a Spiking Neural Network with Integrate-and-Fire Neuron Model for Pattern Recognition

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ABSTRACT

In contrast to the previous artificial neural networks (ANNs), spiking neural networks (SNNs) work based on temporal coding approaches. In the proposed SNN, the number of neurons, neuron models, encoding method, and learning algorithm design are described in a correct fashion. It is also discussed that optimizing the SNN parameters based on physiology, and maximizing the information they pass leads to a more robust network. Inspired by the "center-surround" structure of the receptive fields in the retina, and the amount of overlap that they have, a robust SNN is implemented. It is based on the Integrate-and-Fire (IF) neuron model and uses the time-to-first-spike coding to train the network by a newly proposed method. The Iris and MNIST datasets were employed to evaluate the performance of the proposed network whose accuracy, with 60 input neurons, was 96.33% on the Iris dataset. The network was trained in only 45 iterations indicating its reasonable convergence rate. For the MNIST dataset, when the gray level of each pixel was considered as input to the network, 600 input neurons were required, and the accuracy of the network was 90.5%. Next, 14 structural features were used as input. Therefore, the number of input neurons decreased to 210, and accuracy increased up to 95%, meaning that an SNN with fewer input neurons and good skill was implemented. Also, the ABIDE1 dataset is applied to the proposed SNN. Of the 184 data, 79 are used for healthy people and 105 for people with autism.

One of the characteristics that can differentiate between these two classes is the entropy of the existing data. Therefore, Shannon entropy is used for feature extraction. Applying these values to the proposed SNN, an accuracy of 84.42% was achieved by only 120 iterations, which is a good result compared to the recent results.

BIOGRAPHY

Parvaneh graduated with MSc in Electrical Engineering (communication-system) from Isfahan University of Technology, Iran. She is interested in the field of computational neural science, wrote her Master's thesis in this field, and then published a paper in the International Journal of Neural System. She is trying to update her knowledge in this field day by day and wants to continue her study in the field of Neuroengineering at the Technical University of Munich.

