IMPLEMENTATION OF ARTIFICIAL NEURAL NETWORK ON FIELD PROGRAMMABLE GATE ARRAY (FPGA) IN ODOR IDENTIFICATION SYSTEM

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ABSTRACT

The usage of the FPGA (Field Programmable Gate Array) for neural network implementation provides flexibility in programmable systems. For the neural network based instrument prototype in real time application. With low precision artificial neural network design, FPGAs have higher speed and smaller size for real time application. This research present the digital implementation of artificial neural network using FPGA including of nonlinier activation function. Very High Speed Integrated Circuit Hardware Description Language (VHDL) codes are used to implement the neuron using XC3S500E-FG320 Xilinx FPGA device with Xilinx ISE Webpack 8.2i software. To improve the speed of operation a lookup table (LUT) method is used. This method is used to choose the FPGA capacity for a given application. Number of LUT is used for the 3 neurons in input layer and 4 neurons in output layer with 1 neuron in the hidden layer is 1407 LUT, for 5 neurons in the hidden layer is 4549 LUT, for 10 neurons in hidden layer is 6378 LUT and for 15 neurons in the hidden layer is 10084 LUT. Odor identification system is equipped with quartz resonator sensor array, signal conditioning circuit, FPGA based processing and display. The Multi Layer Perceptron (MLP) model with Back Propagation (BP) training method is used to odor classification. Artificial neural network consisting of 3 neurons in input layer, 10 neurons in the hidden layer and 4 neurons in output layer is implemented on the FPGA. The success rate of artificial neural network for identifying ammonia is 93%, pertamax is 90%, for alcohol is 92%, and 85% for kerosene.

Keywords: Odor, Odor Identification System, Artificial Neural Network, and FPGA.