# NEURAL NETWORK FOR IMAGE PROCESSING AND ANALYSIS BASED ON FPGA TECHNOLOGIES

Kozhemiako A. V., Bezkrevnyi O. S.
Supervisor – Ph.D., assistant professor Kozhemiako A. V.
Vinnytsia National Technical University
(21021, Vinnitsa, st. Khmelnytsky highway, 95, Department of Laser and Optoelectronic Technology, tel. 0432 598-450)
e-mail: alexvntu@gmail.com

One of the promising areas in the field of image processing and analysis is the hardware implementation of neural network for processing and analyzing of images based on FPGA technologies. The structural scheme of the multifunctional calculator was developed. It contains MxN cells in the matrix form, a shaping block of features that has N control nodes, input of clock impulses, reset input, output of the common feature of zero and outputs of the zero features by columns and rows of matrix. The described structure is a classifier and it is programmed in the FPGA crystal. Classifier works in two modes: training (adaptation) mode and operational mode.

The main task is to provide processing and analysis of images in real time. Hardware implementation may have a lot of applications: biomedical engineering, aerospace etc. Required time operational characteristics of the system is ensured by parallelism of data and parallel execution of image processing operations. Before image getting to the input of neural network structure is considered image obtained from the camera is preprocessed on a microprocessor. It should accelerate the operation of the device and allow to allocate more memory of FPGA for the classifier.

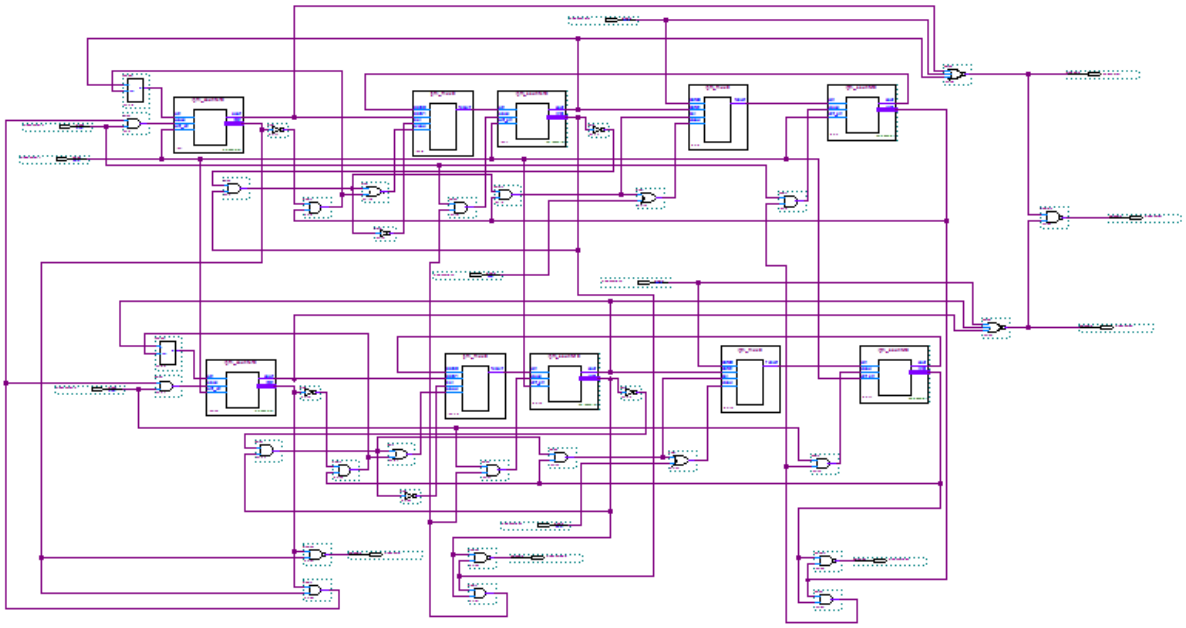

Fig. 1 - Functional scheme of the classifier.

A classifier is programmed in the FPGA crystal whose structure is shown in Fig. 1, which plays a major role, as the result of its functioning is the classification vector.

The classifier works in two modes: learning mode (adaptation) and working mode. In the learning mode (adaptation) through the input block the values of the components of the training vector $X_k$ , multiplied by the weight coefficients $w_{ij}$ , are sequentially fed . At the first step, weights $w_{ij}$ have initial values, and in the process of learning are consistently configurable. In the classification block, the weighted learning signals $w_{ij}$ $x_i$ are processed, which are fed to its inputs in the form of a matrix of size M×N , where M is the number of classes of images, N is the dimension of the input vectors .

In the operating mode inputs are fed to the investigated N-dimensional object (image) Z , the multiplication of each element of the vector Z is performed on the corresponding integer values of the weights corresponding to it , which in the form of a matrix of weights W of size M×N were formed in the mode of learning and stored. We obtain an input vector in the form of a matrix $A_0$ of size M×N , which forms an M-dimensional signal of the input object Z to a certain class of M of defined classes. The signal of the end of the classification process is the presence of a single "End" signal.

In future classifier is modified to increase the productivity and processing speed. This can be achieved by increasing the number of logical cells.

References:


1. Martynyuk T. B., Kozhemyako A. V., Krupelynitsky L. V., Perebeinis O. M., Bezkrevnyi O. S. Implementation models of the matrix calculator for the biomedical data classifier // Information Technology and Computer Engineering. – 2016. – No. 2 (36). – P.43-51. - ISSN 1999-9941.
2. Rangayyan RM Biomedical signal analysis. Practical approach / RMRangayyan ; per. from english A.P.Nemyrko. - M .: FIZMATLIT, 2007. - 400s. - ISBN 978-5-9221-0730-3
3. Junckerov VI Mathematical and statistical processing Dunn's medical y ledovanyy with IP / VI Junckerov , SG Grigoriev. - SPb : VMedA , 2002. -266 p. - ISBN 5-94277-011-5.
4. Martynyuk T.B. Schematic solutions of base blocks for image classifier / T.B. Martynyuk, GD Doroshenkov , O.M. Hutsol // Bulletin of the Vinnytsia Polytechnic Institute. - 2012. - No. 3. - P.132-141. - ISSN 1997-9266.
5. Martynyuk T.B. Formalization of the Object Classification Algorithm / Martynyuk T. B., Kozhemyako A. V., Kupershtein, L.M. // Springer New York LLC – 2015 – 751-756 p. - ISSN: 10600396