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Computer Vision System for Airport

QUALITY MEASUREMENT AND INDUSTRIAL IMAGE PROCESSING

In order to increase the safety of flights, in addition to control tower facilities of the airports, systems of computer vision are included. Their purpose is to solve an entire complex of tasks:

- the space nearby an airport monitoring;
- an automatic detection of airplanes in the zone of an airport;
- identification of airplanes by their silhouettes and onboard identifiers;
- interaction with radar-tracking systems.

In this system the first 3 above mentioned items are realized. The developed system is based on the fully-connected multilayer feedforward artificial neural networks (fig. 1) with sigmoid activation function. Training process is provided for conjugate gradient algorithm (fig. 2) [1]. The implementation of the system makes it possible to perform a code parallelization and to reach a necessary speed of execution. This type of neural networks is simple to implement, easily adapts to new objects, and provides high accuracy of identification (up to 100 %).

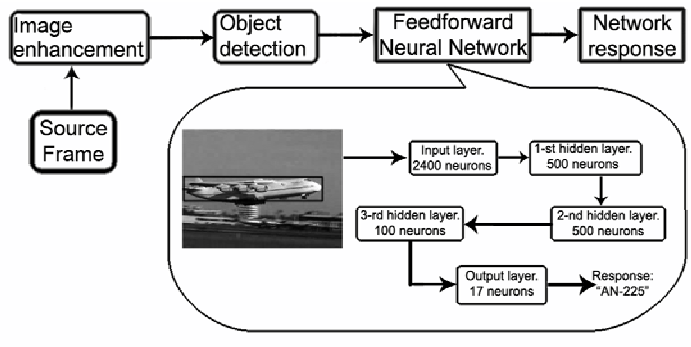

Fig. 1. Schematic diagram of the system.

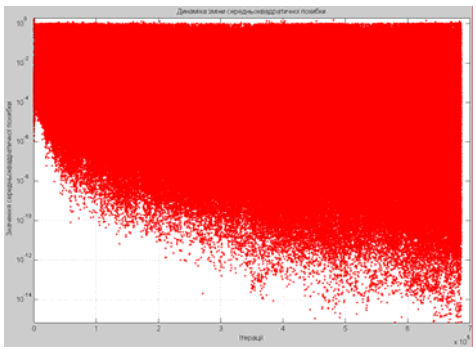

Fig. 2. Training process of the network.

For the purpose of automation of airplane detection process, the system includes input frame image enhancement and automatic object detection units (fig. 1). Image enhancement unit is adapted to work in cooperation with object detection unit. In

cooperation they provide:

- visual detection of moving and static airplane silhouettes;
- proper operation of the system under conditions of low visibility;
- vibrations of cameras suppressing.

Experimental tests of the system were carried out using the silhouettes of airplanes of ANTONOV ASTC (Kyiv, Ukraine). Airplanes of ANTONOV ASTC include the greatest transport airplanes AN-124 "Ruslan" and AN-225 "Mriya". Over one and a half thousand airplanes of different types have been exported to more than 50 countries all over the world. Altogether there have been constructed more than 22000 of "Antonov" airplanes.

The system operates with 2D static grayscale images (frames) at the size of 128*96 pixels. These images are processed by image enhancement and object detection units. The detected objects are scaled to 60*40 pixels dimension (fig.1). The model of the airplane on an input frame is the result of identification.

The system is designed so, that the image enhancement and object detection units can be turned off. In this case, the system operates with scenes that are scaled to 60*40 pixels. At the same time, the speed of identification rises but the quality of identification decreases.

The experimental checks of the nowadays system realization on ANTONOV ASTC airplanes indicated 80% of true results achievement, at the root-mean-square error deviation of training process equal to $4{,}4*10^{-8}$ in the last epoch [2]. Time of identification in case of the system implementation on the basis of the signal processor ADSP BF-535 takes 0,02 s. A necessary data memory size needed for neural network implementation is 29 063 276 bytes. The demands of the system for the speed of information interchange are completely provided for by standard peripheral interfaces.

References:

[1] S. Haykin, "Neural networks: a comprehensive foundation, second edition" Prentice Hall, 1999, pp. 43-44.
[2] Олексів М., Пуйда В. «Підсистема ідентифікації силуетів літаків АНТК ім. О. К. Антонова і номерів їх бортів» Вісник НУ “Львівська політехніка” “Комп’ютерні науки та інформаційні технології” № 604, 2007, с. 228-231.

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