Using Receptive Fields in Machine Learning Methods for Processing Images Represented by Samples of Random Counts

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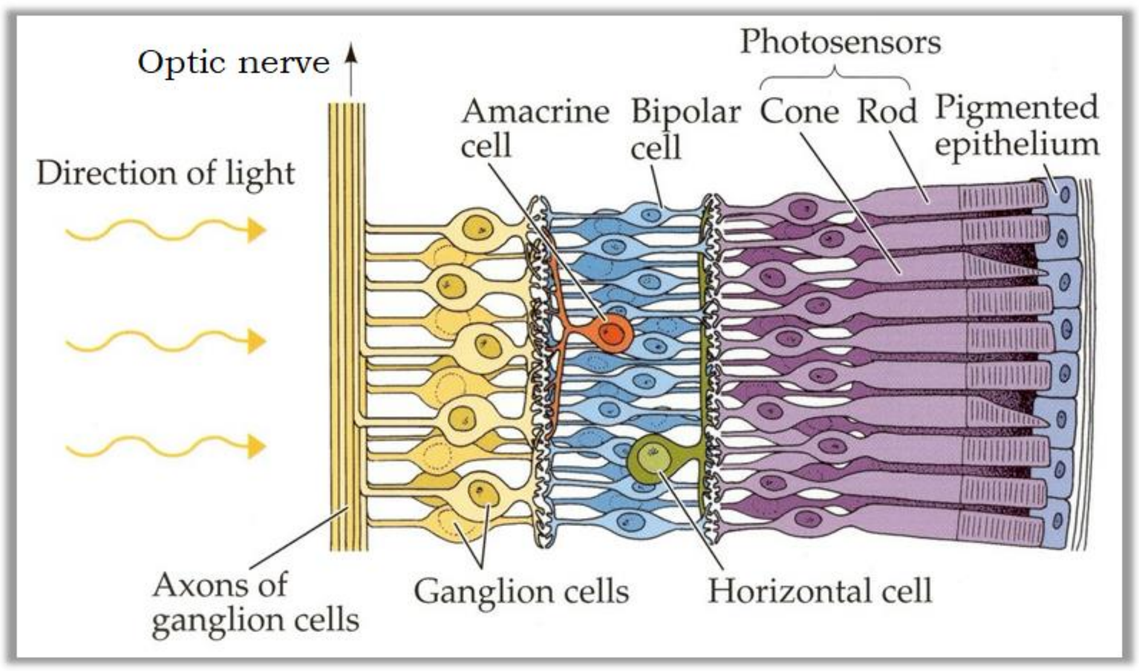
Annotation

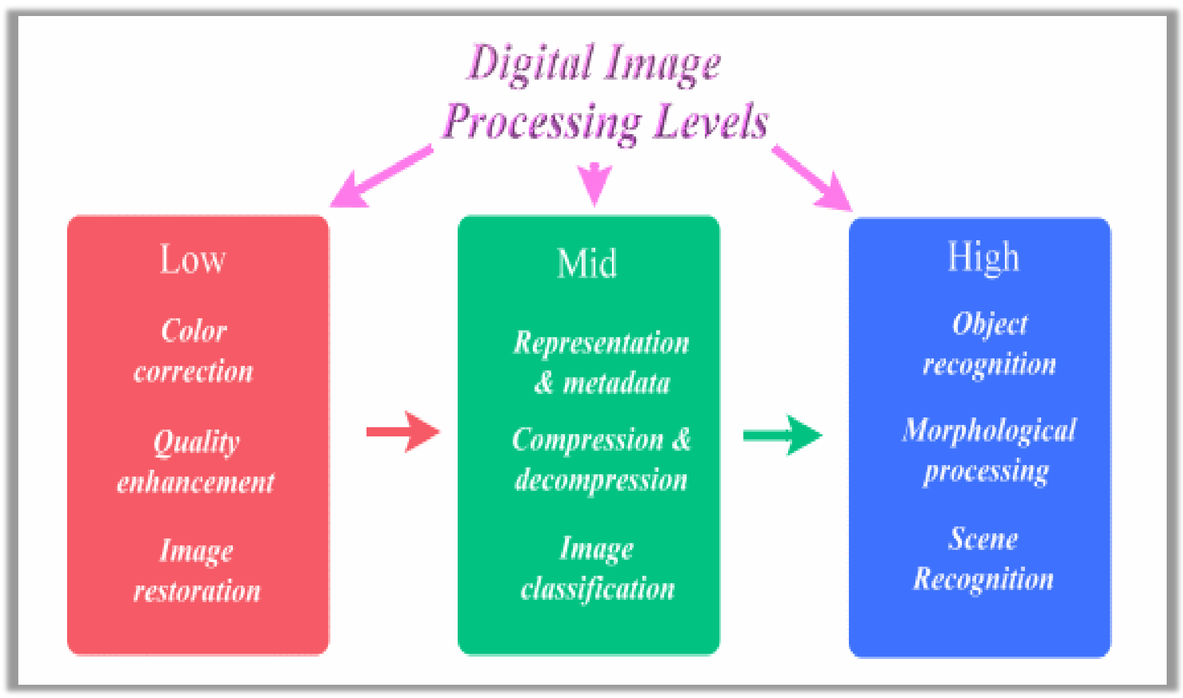
The article proposes and substantiates a method for processing images obtained by forming samples of random counts using receptive fields. This method is based on the known facts of sensory neurobiology, in particular in the field of functional features of the neurons of the human visual system. The proposed method will allow the efficient processing of the sampling representations of images by means of machine learning.

Human Visual System



In the human visual system, the light coming from the outside World is registered by the special cells called photoreceptors. These cells are the main components of the outer layer of the retina, and are divided into rods, cylindrical cells, and cones having a conical shape.

Digital Image Processing Technologies



- The first level of processes usually includes operations related to the preprocessing of input data.
- The second level consists of procedures for segmentation, classification of images by common features, recognition of individual elements, and bringing them into a form convenient for possible further computer processing.
- The third level of processing covers tasks such as semantic analysis of recognized objects. High-level processing implies some "comprehension" of what was recorded in the image, which can be associated with human vision.

Image coding by count sample

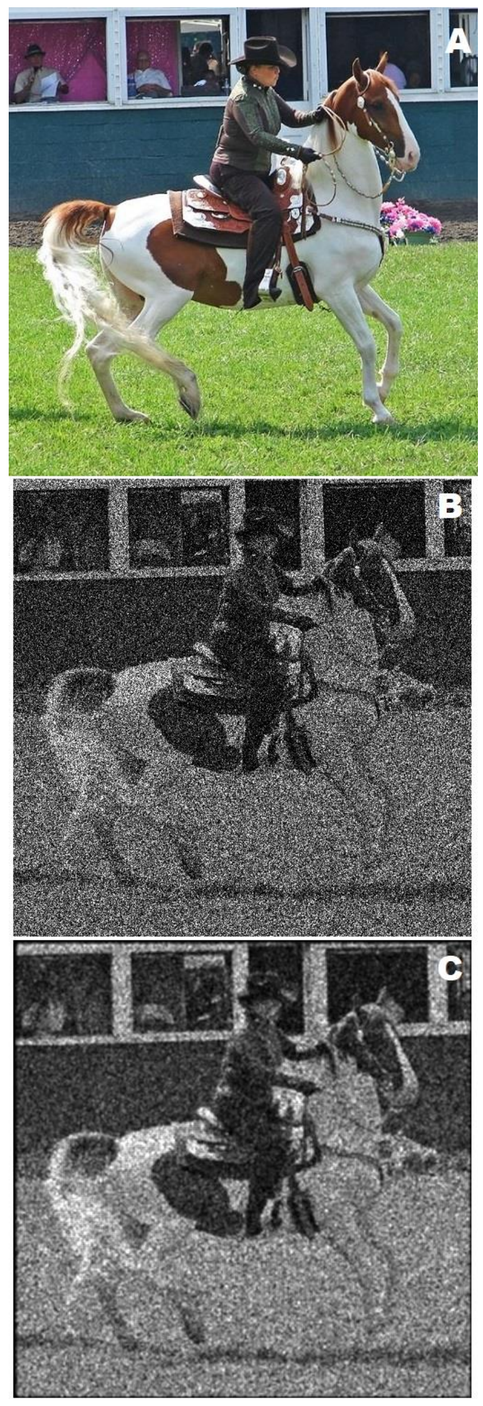
The algorithmic implementation of sampling procedure was based on acceptance-rejection method, reduced to the random selection of uniformly distributed in the region Ω (of area $s \times s$, with coordinates – floating-point numbers) random vectors $\overrightarrow{x_j}$ and including them into the sample of counts X_k while performing the test $u_j < n_j$ where j - index of containing $\overrightarrow{x_j}$ image pixel, and u_j - is the realization of a uniformly distributed on $(0, 2^v)$ random variable

Formation of a parametric model

A. The original color image from Emotive2000 database. The image was set in JPG format with dimensions of 900x884 pixels and had a color depth of 24 bits.

B. The sample representation with size of 500.000 counts, carried by sampling with deviation.

C. Formation of a parametric model with components ordered in the nodes of the lattice structure



Conclusion

The new algorithm of image preprocessing was developed. A parametric model of the original image has been formed, which, we believe, will allow using machine learning tools such as convolutional neural networks for recognizing objects, highlighting features and events in images, as well as evaluating and analyzing images.