УДК: 004.8:004.932

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ARCHITECTURE OF CONVOLUTIONAL NEURAL NETWORKS AND THEIR APPLICATION IN GRAPHIC EDITORS

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Анотація

У роботі розглянуто архітектуру згорткових нейронних мереж та особливості їх використання в сучасних графічних редакторах. Описано структуру основних шарів CNN, принцип виділення ознак із зображення та процес навчання моделей. Проаналізовано можливості застосування згорткових мереж для автоматичного виділення об'єктів, покращення якості зображень, ретуші та стилізації. Показано, що інтеграція CNN у графічні редактори суттєво спрощує обробку зображень та підвищує ефективність роботи користувача.

Ключові слова: згорткова нейронна мережа, CNN, обробка зображень, графічні редактори, машинне навчання, штучний інтелект.

Abstract

The paper considers the architecture of convolutional neural networks and their application in modern graphic editors. The structure of CNN layers, the principle of feature extraction from images and the training process are described. The use of convolutional networks for automatic object selection, image enhancement, retouching and stylization is analyzed. It is shown that the integration of CNN into graphic editors significantly simplifies image processing and improves user efficiency.

Keywords: convolutional neural network, CNN, image processing, graphic editors, machine learning, artificial intelligence.

Modern graphic editors are actively developing together with artificial intelligence technologies. If earlier most operations were performed manually and required a high level of skills from the user, today many processes are automated. One of the key technologies that provides such automation is convolutional neural networks. A convolutional neural network (Convolutional Neural Network, CNN) is a type of artificial neural network that specializes in image analysis. Its architecture is designed in such a way as to work efficiently with two-dimensional data, extracting important features: contours, textures, color transitions and other visual characteristics. Unlike traditional image processing algorithms, CNNs do not require manual definition of features – they are formed automatically during model training [1]. The architecture of a convolutional neural network consists of several main types of layers. The general structure of the model is shown in Figure 1.

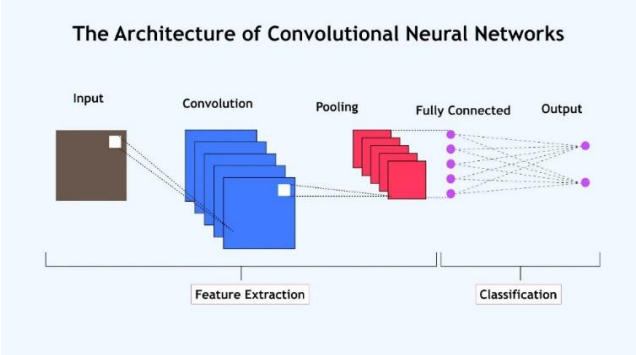

Figure 1 – Architecture of a Convolutional Neural Network

Figure 1 illustrates the general architecture of a convolutional neural network. The model processes the input image sequentially through convolutional and pooling layers, where important visual features such as edges, textures and shapes are extracted and gradually combined into more complex representations. At the final stage, fully connected layers perform high-level analysis and generate the final output, which may correspond to classification, segmentation or another image processing task. This structure demonstrates how CNNs transform raw pixel data into meaningful information used in modern graphic editors. The first are convolutional layers, which analyze small fragments of the image and form so-called feature maps. At the initial stages, the network recognizes simple elements, for example lines or edges. At the next levels, more complex structures are formed – parts of objects or complete images of objects.

After convolutional layers, pooling layers are used. Their main purpose is to reduce the dimensionality of data and highlight the most important information. This allows reducing the amount of computation and making the model more resistant to minor changes in the image, for example to a slight shift or rotation [2]. At the final stage, fully connected layers are used, which perform the final analysis and form the final result. In graphic editors, this can be determining the boundaries of an object, classifying an image, or creating a new image based on processed data.

In graphic editors, CNNs are used to perform many intelligent functions. One of the most common is automatic object selection. The user needs to perform only a few actions, after which the system independently determines the contours of the object, separating it from the background. This greatly simplifies work with compositing and background replacement [3]. Another important direction is image segmentation – dividing it into separate areas. This technology is used for accurate editing of certain parts of the image without affecting other areas. For example, you can change the color of the sky or the lighting of a face without affecting other elements. Convolutional neural networks are also used to improve image quality. They can remove digital noise, increase sharpness, and restore damaged areas of photos. In scaling tasks, the technology of increasing resolution without loss of detail is used. This is especially relevant for printing large formats or creating high-quality digital materials [4]. In the field of retouching, CNNs allow automatically smoothing skin imperfections, correcting lighting and color balance. The network analyzes the image structure and makes changes in such a way as to preserve the naturalness of the result. This significantly saves time compared to manual processing. Compared to classical image processing methods, which are based on fixed algorithms, CNNs have a significant advantage in adaptability. They are able to learn from new data and improve results over time. However, the use of such models requires significant computing resources, especially at the training stage. Prospects for the development of convolutional neural networks are associated with increasing accuracy and speed, as well as integration with other artificial intelligence technologies. In the future, even greater automation of graphic editors can be expected, when most technical operations will be performed without user participation, leaving only creative decisions. Thus, convolutional neural networks play an important role in the development of modern graphic editors. They provide high-quality image processing, simplify complex editing processes and expand the possibilities of digital creativity.

LIST OF REFERENCES

1.Szeliski R. Computer Vision: Algorithms and Applications (2nd Edition). – Springer, 2022. URL: https://szeliski.org/Book/ (accessed: 28.02.2026).

2.Krichen M. Convolutional Neural Networks: A Survey // Computers. – 2023. URL: https://www.mdpi.com/2073-431X/12/8/151 (accessed: 28.02.2026).

3.Adobe Inc. From Sensei to Adobe AI (overview page). – 2025. URL: https://business.adobe.com/products/sensei.html (accessed: 28.02.2026).

4.Gendy G. et al. Lightweight image super-resolution based on deep learning // Information Fusion. – 2023. URL: https://www.sciencedirect.com/science/article/abs/pii/S1566253523000386 (accessed: 28.02.2026).

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