

# Development of Application for Recognition of Object Groups in the Image

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## Abstract

In this article, we solve the actual problem of recognizing the object group in the image. The solution to this problem resulted in an application developed on the basis of a neural network for automatic object recognition. We considered the problem of recognition of cars and trucks on images of any size. The developed application creates a neural network, allows it being trained, as well as using the trained network to solve the recognition problem. In this work, we created a convolutional neural network that allows detecting the features of cars under consideration and classifying them. The network architecture was selected in such a way that the result of its work was adequate. When selecting, we considered feed-forward neural networks, since they showed themselves in the best way in solving such problems. To select the structure and build this network, we studied the corresponding theoretical material about the main types of neural networks, as well as about the algorithms for their training. To train this network, we used an error backpropagation algorithm based on the gradient descent method when finding the minimum of the activation function. An important point is tracking of the network training results; to calculate the accuracy and error indicators (in time), the developed application creates the corresponding graphs. To recognize cars on an arbitrary image, it was divided into admissible parts, and then the image was transmitted in parts to the trained network. The network operation result is displayed using the graphical interface of the application. The objects "passenger car" and "truck" are localized and assigned to the corresponding class.

**Keywords:** convolutional neural network, feedforward network, fully connected layers, image subsampling, backpropagation algorithm.

## I. INTRODUCTION

In recent decades, the world is rapidly developing the intelligent information systems (IIS) [1, 2]. They have found application in many spheres of social life and in many subject areas. Now, the IIS help to find the necessary information on the Internet, predict the weather, determine the state of a person from a photograph, assess the enterprise's personnel, regulate traffic, etc. [3-5]. These are exactly the tasks where it is necessary to process a large amount of data to achieve the

final goal. And the result will largely depend on how accurately and quickly all the necessary data was analyzed. For this purpose, the IIS should be based on a computer with high computing capabilities and (most importantly) have a sufficiently large database of the required data.

One of the main IIS tools are neural networks (NN) and the current increase in interest in them is due to the fact that there are the necessary tools for their development and use now [6]. Namely, large data sets for analysis and accurate decisions, as well as the computing power of computers. Due to this, the artificial neural networks began to be used in many information systems.

Neural networks solve a large number of tasks: forecasting, approximation, recognition. At the moment, one of the most pressing problems is the problem of the so-called object recognition (or object detection) [7, 8]. Many companies and universities devote their resources to solve these problems and apply them in real life. For example, the car controlling IS, which is also based on a neural network that recognizes such objects as roads, cars, pedestrians, is now actively developed. However, there are various structures of neural networks that solve this problem and have different results. And it is not known in advance which of the structures will give the best result. Therefore, this direction requires constant improvement and refinement, the creation of new various structures to solve the assigned tasks.

## II. METHODS

Let us consider the problem in the following setting. It is necessary to determine location of the "car" and "truck" objects groups in the image and carry out their classification. Input data are RGB color images of any size. The image can have the following formats: JPG, PNG. Output data are images with localized and classified "car" and "truck" objects.

To solve this problem, we created an application in C++ in Qt Creator. The main component of this application is a neural network that automatically recognizes objects belonging to the above groups. In the work, a convolutional neural network of direct propagation is being created; the network is trained and tested, and then used to recognize the object groups.







