Bypassing reCAPTCHAV2 from Google Using Supply Chain of Neural Networks and Machine Learning

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Abstract- **Until recently, the search engine did not understand what exactly was depicted in the photo, which it gave out in the results, but only focused on the words that were found in the text next to this image or that were written in its alt or title attributes (img tag). Modern algorithms of search engines allow finding not only text files, and files marked with text tags, but also similar images. For these purposes, there are several services on the supply chain of network. Search by the user of the Internet of all images from one series or search for an analogue of an object on a photo by driving words into the search string will not be successful. Currently, search on the sample image (photos or any other image) is supported by both search engines leading in Russia - Google and Yandex. But as an alternative, there are services that structure the Internet for easy retrieval of information that the user needs. And at the moment there are social bookmarks, catalogs, torrent trackers, forums, specialized search engines, file sharing. The authors implemented a program that will take a link to the image at the input, and in return give a response from the API in json format.**

Keywords: *search, supply chain, neural networks, search engine, Internet.*

1. Introduction

One of the most powerful services for checking the uniqueness of images with the function of finding similar files is the TinEye Reverse Image Search (tineye.com) project. In order to find similar images with this service, upload the image, or insert its url into the input field, and then click on the "Search" button. In a split second, the system will present search results that can be sorted by quality, relevance and size. Searching for more than two billion images, TinEye indicates the unique address of each of them in the search results [1], [2]. Most recently, the image search feature was implemented in the most powerful search engine Google. In the search results window, you can sort the image by relevance, themes, size, and color. In this case, color images can be filtered by the prevailing color. The type of pictures (faces, photos, pictures) can also be selected. In addition to the services described above, you can use tools such as alipr.com, pickitup.com, as well as the Russian-language project piccolator.ru, which specializes in finding similar images. Their work is carried out on a similar principle.

2. Methods

An artificial supply chain of neural network (ANN, a neural network) is a set of neurons connected to each other. As a rule, the transfer (activation) functions of all neurons in the network are fixed, and weights are parameters of the network and can change. The work of the neural network consists in converting the input vector into an output vector, and this transformation is given by the network weights [3]. Training of artificial neural networks. Among all the interesting properties of artificial supply chain of neural networks, none captures imagination as much as their ability to learn. Their training to such an extent resembles the process of intellectual development of the human personality, which may seem that a deep understanding of this process has been achieved. But, being careful, you should restrain euphoria. The possibilities of learning artificial supply chain of neural networks are limited, and many complex tasks need to be solved to determine whether we are on the right path. The purpose of training. The network is trained to give the desired (or, at least, consistent with it) a set of outputs for a number of inputs. Each such input (or output) set is treated as a vector. Training is carried out by sequential presentation of input vectors with simultaneous adjustment of scales in accordance with a certain procedure. In the process of learning, weights of the network gradually become such that each input vector produces an output vector. The training of artificial supply chain of neural networks is carried out by sequential presentation of input vectors with simultaneous tuning of scales in accordance with a certain procedure. The technology of learning with the teacher of an artificial neural network usually involves the presence of two identical sets: a set of training examples that is used to configure the network and a set of test cases that is used to assess the quality of the network. The technology of training with a "teacher" of an artificial supply chain of neural network usually involves the presence of two identical sets:

• The set of training examples that is used to configure the network.

• Multiple test cases, which is used to assess the quality of the network.

The elements of these two sets are pairs (X, YI), where

• X - input, for the trained neural network;

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• YI - ideal (desired) network output for input X;

The error function E is also defined. This is usually the mean square error:

$$E = \frac{1}{P}\sum_{i=1}^{P}(d_i - y_i)^2 \qquad (1)$$

Where, P - the number of examples processed by the neural network;

- y_i - the real output of the neural network;

- d_i - the desired (ideal) output of the neural network;

- The general scheme of training "with the teacher" is as follows:

1. The weight coefficients of a neural network are established in a certain way, usually by small random values.

2. At the entrance of the neural network in a certain order are given training examples. For each example, an error E (learning error) is calculated and a correction is performed for a certain algorithm. The purpose of the procedure for correcting weights is to minimize the error E.

3. Verification of the correct operation of the network - control entries are sent to the entrance in a certain order. For each example, the error EG (generalization error) is calculated. If the result is unsatisfactory, then a variety of training examples or network architecture is modified and the training cycle is repeated. The procedure for training an artificial supply chain of neural network is reduced to the procedure for correcting the weights of its connections. The purpose of the procedure for correcting weights is to minimize the error function E. In the Rosenblatt method, in the case of a single-layer network, the desired output values of the neurons of a single layer are known, and the adjustment of the weights of the synaptic connections goes in the direction minimizing the error at the network outlet [4]. The method of training Vidrou-Hoff is also known as delta rule (delta-rule). The method of training Vidrou-Hoff aims to minimize the error function E in the space of weight coefficients (2).

$$E = \sum_{k=1}^{P} E(k) = \frac{1}{2}\sum_{k=1}^{P}(d^2 - y^2)^2 \quad (2)$$

Where,

- P - the number of examples processed and the network

- $E(k)$ - error for the k-th example

- y^k - real network output for the k-th example

- d^k - desired (ideal) network output for the k-th example

Minimization of E is carried out by the method of gradient descent (2):

$$w_j(t+1) = w_j(t) - a \cdot \frac{\partial E(k)}{\partial w_j(t)} \qquad (3)$$

Where,

$$\frac{\partial E(k)}{\partial w_j(t)} = \frac{\partial E(k)}{\partial y^k} \cdot \frac{\partial y^k}{\partial w_j} = (y^k - d^k) \cdot x_j^k$$

(4)

A network having two or more layers is already problematic to teach by the methods described above, since in the multilayered networks only the output of the last layer of neurons is known. The solution of this problem was proposed by D. Rumelhart and co-authors in 1986. The error back propagation method is an iterative gradient learning algorithm for a multilayer artificial supply chain of neural network without feedbacks. In training, the task is to minimize the error function.

$$E = \frac{1}{2}\sum_{j=1}^{P}(y_j - d_j)^2 \quad (5)$$

Where,

- y_j - the real value of the j-th output of the network;

- d_j - ideal (desired) value of the j-th output of the network;

Minimization of E is carried out by the method of gradient descent. The main idea of this method was the propagation of error signals from the outputs of the network to its inputs, in the direction opposite to the direct propagation of signals in the usual mode of operation [5]. The process of learning "without a teacher" is reduced to adjusting the weight coefficients. But unlike training with a teacher, there are no standard outputs and weights change according to an algorithm that takes into account only input signals and signals derived from them [6]. Hebb's method is based on the biological phenomenon of learning through repetition and addiction. The quality of the network learning depends directly on the number of examples in the training sample, and also on how fully these examples describe this task. The essence of training the supply chain of neural network of Kohonen consists in the adjustment of weights, in which close input vectors will activate the same neuron Kohonen [10]. Learning the Kohonen layer is a self-learning, proceeding without a teacher. In this regard, it is difficult to predict in advance which Kohonen neuron will be activated by a given input vector. From the learning process it is only required that as a result of the training different input vectors are separated. When learning the Kohonen layer, an input vector is fed to the input and its scalar products with weight vectors associated with all Kohonen neurons are calculated. A neuron with the maximum value of a scalar product is declared a "winner" and its weight is adjusted. If each Kohonen neuron was associated with one input vector, then the Kohonen layer could be trained by one calculation per weight. The weights of the winner neuron would be equated with the components of the learning vector. Typically, the training set includes many similar input vectors, and the network must be trained to activate the

same Kohonen neuron for each of them. In this case, the weights of this neuron should be obtained by averaging the input vectors, which must activate it. So, the classical learning algorithm for the Kohonen layer looks like this:

- Assign weighting coefficients to some initial values. A common practice when working with supply chain of neural networks is to assign weights to small random values.

- Submit a vector to the input of the neural network $\vec{x_i}$ from the learning set X.

- Calculate the yield of the Kohonen layer and determine the "winning" neuron k, neuron with maximum yield.

Adjust the weights of the "winning" neuron using the following formula:

$$\vec{W}_k = \vec{W}_k + \beta(\vec{x}_i - \vec{w}_k)$$

Where: β – coefficient of learning speed.

The weight correction is written in the form of a vector expression. A training schedule is often used when $\beta = \beta(t)$ monotonically decreases.

Requirements to $\beta(t)$ the same as in the case of a multilayer perceptron.

The weights are adjusted so that the weights vector approaches the current input vector. The coefficient of learning speed controls the speed of approximation of the core of the class (the vector of weights) to the input vector. The algorithm is executed until the weights change. It is important to note that all the information that the network has about the task is contained in the set of examples. Therefore, the quality of network learning directly depends on the number of examples in the training sample, and also on how fully these examples describe this task. For example, it makes no sense to use the network to predict the financial crisis if the training sample of crises is not represented. It is believed that a full training requires at least a few dozen (or better hundreds) of examples. ReCAPTCHA is a system developed at the University of Carnegie - Mellon to protect websites from Internet bots and simultaneous assistance in digitizing the texts of books [7]. Emgu is a cross-platform mediator for the .Net family of languages for the OpenCV library for image processing. OpenCV (Open Source Computer Vision Library, open source computer library) is a library of computer vision algorithms, image processing and general-purpose numerical algorithms with open source.

3. Results and discussion

Currently, the user is offered to check in the checkbox, after clicking on the checkbox, the user can choose to select all the pictures, or select all the images where there are palms (example in Figure 1).

Figure 1- Images of palm trees

When selecting images that match a certain criterion, we use a supply chain of neural network from the Microsoft Computer Vision API (we use one large company to bypass the protection of another). We implement a simple program that will take a link to the image at the input, and in return will give a response from the API in json format. From the whole answer, we are only interested in what is in the text parameter (Figure 2) [11].

```
var sw = new Stopwatch();
sw.Start();
var req = new HttpRequest
{
    Cookies = new CookieDictionary(),
    UserAgent = HttpHelper.RandomUserAgent()
};
var pagetext =
    req.Get("https://www.microsoft.com/cognitive-services/en-us/computer-vision-api").ToString();
var token = pagetext.LastSubstring("var antiForgeryToken = '", "'");
textBox1.Text = req.Post("https://www.microsoft.com/cognitive-services/Demo/VisionDemo/Analysis",
    $"smartCropping=true&imageData={textBox2.Text}&dataType=imageUrl&__RequestVerificationToken={token}").ToString();
sw.Stop();
textBox3.Text = sw.ElapsedMilliseconds.ToString();
```

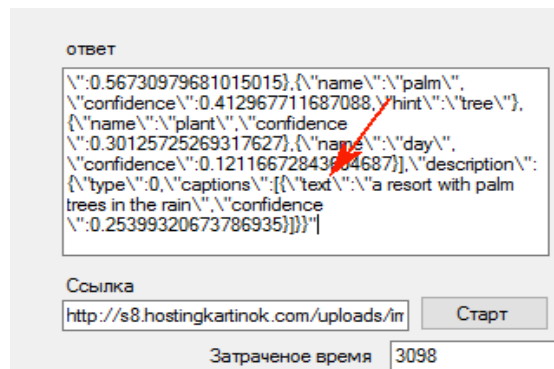Figure 2 Response from the json format API

Figure 3 - Answer from the API

After the program ran all 9 images, the following results were obtained. A vintage photo of a boat

1. a sandwich cut in half
2. a view of a mountain
3. a resort with palm trees in the rain
4. a clock tower in the middle of a field
5. a view of a mountain
6. two giraffes in a fenced in area
7. a bench in front of a palm tree
8. a large long train on a steel track

As a result, there were exactly 2 necessary pictures (4.8), and 9 picture had poor image quality, because it is remotely similar to the train. It took less than 30 seconds to view 9 pictures. For better and more accurate recognition, you can request new pictures when it is not possible to determine the correct number of correct answers or use a synonym dictionary for a criterion that is given, which is also not difficult [8]. If there is a picture with a size of 450 by 450 pixels, which is divided into 12 areas (Figure 4), from which we usually need to select those areas in which the road sign enters the program to determine the sign itself and its dimensions, so the authors use the emgu wrapper for Open CV.
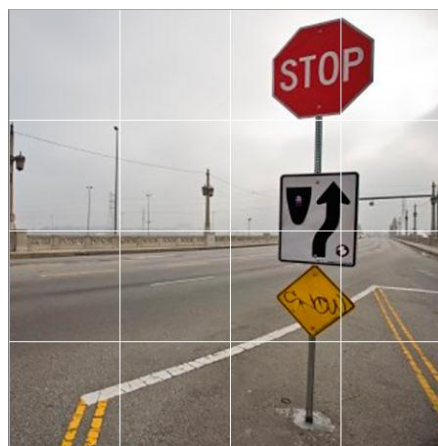

Figure 4 - Images of traffic signs

4. Conclusions

The written program, which has a road sign model (Figure 4), is able to determine its size and location (Figure 6).
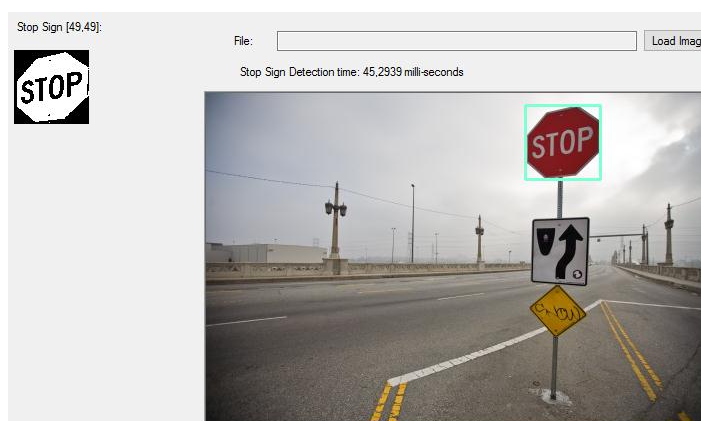

Figure 5 - Road Sign Model

Figure 6 - Dimensions and location of the road sign

It can be concluded that with the help of modern neural networks it is possible to bypass modern means of protection from robots without problems.

5. Summary

Implemented by the authors of the program, which at the entrance takes a link to the picture, and in response gives answers much simplifies the process of searching for pictures on the Internet. After all, using the existing services described above, to find similar images becomes less attractive to the user of the network. And their work is carried out on a similar principle.

Quite recently, search engines did not understand what exactly was pictured in the photo, and the results they gave out were oriented only on the words that were found in the text next to this image or which were written in its attributes. Time does not stand still and dictates to us more advanced methods and ways of solving problems related to the process of searching for necessary graphic information on the Internet.

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References

[1] Abu S., Shami, M., Ouda, A., *"Optimal and suboptimal resource allocation techniques in cloud computing data centers",* Journal of Cloud Computing, Vol 6, No. 1, 6, 2017.

[2] Sohn, K., Kim, Y.Y., Saxena, N. *"A new cross-layer qos-provisioning architecture in wireless multimedia sensor networks",* KSII Transactions on Internet and Information Systems.

[3] Maculan, N., Souza, P., Candia, V.A. *"An approach for the Steiner problem in directed graphs",* Annals Operations Research, Vol 33, 471-480, 1991.

[4] Ivanov, F.I., Zyablov, V.V. *"Low-Density Parity-Check Codes Based on Steiner Systems and Permutation Matrices",* Problems of Information Transmission. Vol 49, No. 4, 41-56, 2013.

[5] Ivanov F.I., Zyablov V.V. *"Low-Density Parity-Check Codes Based on Steiner Triple Systems and Permutation Matrices, Proc. of 36-th*

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conference *"Information technologies and systems (ITAS)",* Kaliningrad, Russia, 2013.

[6] Courant, R. *"What is Mathematics, R. Courant, H. Robbins*", Oxford University Press, 556, 1996.

[7] Yang, Z.X. *"Geometry Experiment Algorithm Steiner Minimal Tree Problem",* Journal of Applied Mathematics, Vol 2013, 1-10, 2013.

[8] Grigoreva, D.R., Basyrov, R.R., Faizullina A.G., Sharipov R.S. *"Use of Shteiner problem in solving practical problems of road construction*", Modern Applied Science, Vol 9, No.4, 294-302, 2015.

[9] Faizullina, A.G., Grigoreva, D.R. *"The degree of particication indicator of sales of livestock products in the main social factors",* Journal of Organizational Culture, Communications and Conflict, Vol 20, 68-78, 2016.

[10] Tempelmeier, H. *Inventory management in supply networks*, Books on Demand Norderstedt, 2011.

[11] Surana, A., Kumara, S., Greaves, M., and Raghavan, U.N. *"Supply-chain networks: a complex adaptive systems perspective,"* International Journal of Production Research, Vol. 43, No. 20, 4235-4265, 2005.