SECTION 4.

ENGINEERING

THE METHODIC OF TEST THE TIME DEPENDENCE OUTPUT ON THE QUALITY OF THE SOURCE DATA IN THE PATTERN RECOGNITION SYSTEM

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Introduction

The question of the quality of training algorithms is an urgent scientific problem in the construction of intelligent information systems, within which the problems of recognition, identification and classification are solved [1, p. 103-113]. Creating new algorithms for testing the quality of image recognition is a difficult task. In order for the algorithm to be in demand, its effectiveness must be confirmed by experiments on real data. The experiments should be easily reproducible so that any previously obtained result can be double-checked, and standardized so that the results obtained by different researchers are comparable.

Problems in this area include: insufficient descriptions of the testing methodology, the use of random sampling into training and control, without remembering the partition ratio. The initial data during testing may also vary due to pre-processing before testing.

There is no single methodology for comparing algorithms for testing recognition quality and processing time. The experience gained in the development of learning and recognition algorithms [2, p. 360-363; 3, p. 28-32; 4, 66-72] was applied in a unified methodic for the comparative evaluation of image recognition algorithms by processing time.

Testing methodology

The methodology for assessing the dependence of the time of the output of the image processing results on the quality of the source data is proposed to put the model of the interaction of the recognition system with a distorting external environment (a set of distorting factors).

The external environment affects the original image I using the vector of gradation distortion of the studied parameter:

$$\bar{S} = S_1 .. S_i ... S_n \tag{1}$$

where *n* is the number of gradations (discrete changes) of the studied parameter.

The recognition result of R is a decision to identify (evaluate by an expert) an image obtained based on processing and analysis of certain informative features.

R is associated with a functional dependence with the degree of environmental impact S and distorted values I of certain image parameters:

$$R = F(\bar{I}, \bar{S}) \tag{2}$$

Basically, the impact of the external environment leads to the following types of image distortion:

image height
image width
tilt (rotation).
brightness
contrast (blur)
number of colors (saturation)

The degree of environmental impact on the image recognition system is expressed numerically through the quantitative components of the vector.

For experimental studies, the number of parameters is limited to three:

image height distortion
image width distortion
image tilt distortion

We set the image with height he, width be as a reference, and determine the quantitative parameters of the external environment. The modulus of Si allows us to talk about the percentage distortion of the degree of the studied parameter relative to the reference value. For example, if the image he = 100 mm is elongated (compressed) in height by 10 percent, then

hi = 110 mm (hi = 90 mm) and Si = 0.1.

To obtain an estimate of the dependence of the time of the output of the image processing results on the quality of the initial data in the image recognition system, we define a linear dependence for changing the gradations of the height, width and slope of the image. Then the vector components S for the corresponding parameters are expressed as follows.

For image height distortion:

$$S_i = \frac{|h_i - h_e|}{h_e} \quad (3)$$

where hi is the height of the i-th instance of the test image.

For image width distortion:

$$S_i = \frac{|b_i - b_e|}{b_e} \quad (4)$$

where bi is the width of the i-th instance of the test image.

For distortion of the image slope, we set αe = 100, which corresponds to a zero image slope, then

$$S_i = 1 - \frac{|\alpha_i - \alpha_e|}{\alpha_e} \quad (5)$$

where, α is the modulus of the angle of inclination relative to the central axis of the image.

We introduce the following notation:

k - number of distorted parameters of the tested image j = 1..k, in our case k = 3,

n - number of discrete changes (gradations) of the j-th parameter,

then i = 1 ... n (n-number of discrete changes (gradations) of the j-th parameter).

By setting discrete values of the vector S parameters, one can vary the degree and types of environmental influences on the original image.

Therefore, for one parameter and one image, the methodology for assessing the dependence of the time of the output of the image processing results on the quality of the source data in a distorting environment will operate according to the following algorithm:

1) set the j-th image parameter for distortion
2) set the next value of i (select the i-th gradation of distortion of the j-th image parameter).
3) fixing of ti, j - the time interval that the system required to process the image with the distortion specified on the basis of gradation i from clause 2
4) if not all of the n gradations are selected, then go to step 2 (to the next gradation of image distortion)
5) repeat steps 1-4 for all n gradations of the current j-th parameter
6) go to the next parameter from k
7) if j = k, return the processing results

Thus, after performing all the procedures of the methodology indicated above, we obtain sets of T (i, j) values by which it is possible to construct a time graphical dependence on the processing results on the quality of the source data.

With a slight modification of the method described above, you can get an assessment of the recognition quality for the image processing system depends on the degree of distortion of the original data.

Conclusion

Based on the proposed methodology, a set of 600 retinal images available to the authors was tested. As a result of experimental studies, the dependences T (i, j) of the output time of the processing results (in processor cycles) on the quality of the initial data are obtained. Distortion of the input image was set in height, width, and angle of inclination. A distinctive feature of the proposed technique is the ability to reflect the T (i, j) family in the same coordinate system and on the same scale. The studies were carried out as part of task 1.1.01 SPSI RB "Photonics, optoelectronics and microelectronics" (subprogram "Photonics").

References:

1. D.N. Adzinets, Tatur, M.M. On the systematization of data and knowledge classification methods / / Informatics. - 2010. - No. 3 (27). - S.103-113.
2. Mikhail Tatur, Marina Lukashevich, Dzmitry Adzines and Yerzhan Seitkulov. Data Mining Processing Based on Problem-oriented Machine Architecture Proceedengs of the International Conference on Information and Digital Technologies. 2015 7-9 July 2015 Zilina, Slovakia.pp.360- 363. ISBN 978-1-4673-7185-8. IEEE Catalog Number CFP15CDT-USB.
3. Yuri Vetroff, Dmitry Adzinets. Handwriting recognition method in real-time mode based on distributed neural networks. Central European Researchers Journal, Vol. 1, No. 1, 2015 p.28-32.
4. Andrei Zhabinski, Dzmitry Adzinets. Using appearance for improving facial expression recognition // Central European Researchers Journal , Vol. 1, No. 1, 2015 p. 66-72.