Матеріали IV Всеукраїнської науково-технічної конференції ТЕОРЕТИЧНІ ТА ПРИКЛАДНІ АСПЕКТИ РАДІОТЕХНІКИ, ПРИЛАДОБУДУВАННЯ І КОМП'ЮТЕРНИХ ТЕХНОЛОГІЙ 2019

УДК 004.932

Роман Мельник, проф., Руслан Тушницький, доц.
Національний університет "Львівська політехніка"

ЗНИЖЕННЯ ВПЛИВУ ОЗНАК СЕРЕДНЬОЇ ІНТЕНСИВНОСТІ ДЛЯ ПОРІВНЯННЯ ОБЛИЧ

Розглянуто особливості індивідуальної інтенсивності пікселів у стовпцях і рядках. Особливості були застосовані до граней з різними коефіцієнтами експозиції. Для зменшення різниці між ознаками, зумовленими різними рівнями інтенсивності, була запропонована зміна інтенсивності та сегментації.

Ключові слова: ознаки середньої інтенсивності, освітлення, потемніння, сегментація, бінаризація.

Roman Melnyk, Ruslan Tushnytskyy

INFLUENCE REDUCTION IN MEAN INTENSITY FEATURES FOR FACES COMPARISON

Face mean intensity features of pixels in columns and rows are considered. The features were applied to faces with different exposure coefficients. To reduce a difference between the features caused by different levels of intensity changing of intensity and segmenting approach was proposed.

Keywords: mean intensity features, lightning, darkening, segmenting, binarization.

Introduction. Today face recognition techniques are widely used in various fields, e.g. social networks, smart homes, smartphones, secure systems etc. The development of the recognition algorithm is accompanied by several basic stages: detection, normalization, formation of characteristics, comparison. Often methods of recognition and classification use several algorithms at the same time for several approaches and techniques i.e. image processing, machine learning, neural networks etc, to achieve successful results. The works [1 – 3] provide a brief overview of the methods for faces detecting and recognizing. Among the most used and perspective approaches, we note the following: applying for the face recognition problem of neural networks algorithms [4, 5]; applying Support Vector Machine supervised learning models [6, 7]; applying Kernel Discriminant Analysis [6, 8]. The methods discussed are considerably expensive for computing resources, which reduces their practical use. Therefore, we propose a new approach for the formation of properties based on the segmentation of a three-dimensional object in the metric and intensity space. Our method allows us to build a set of features for face identification and classification.

Distance between intensity features of faces. Let us calculate mean value of pixel intensity in the columns and rows of the image pixels matrix:

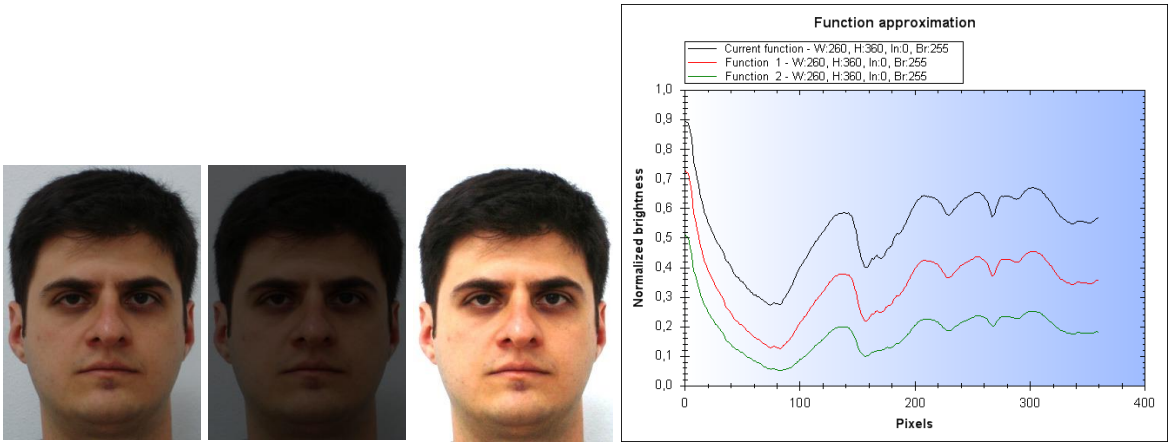
$$y_j = 1/H\{\sum_{i=1}^{H} b_{i,j}\}, \quad x_i = 1/W\{\sum_{j=1}^{W} b_{i,j}\} \tag{1}$$

where $b_{i,j}$ is pixel intensity in i-row and j-column ($1 \le i \le H$, $1 \le j \le W$), W and H represent the number of columns and the number of rows respectively.

In the experiment we use three faces 1a with different exposure coefficients from a library of images [9] (Fig. 1, *a*). For these three images we calculate mean intensity values in rows (1). Corresponding plots are presented in Fig. 1, *b*. The two axes are: OX - H – a number of rows, OY – 255 - intensity.

To measure a distance between three plots we use the following formulas:

$$L_y = 1/W \sum_{x=1}^{W} |f_1(x) - f_2(x)|, \qquad L_x = 1/H \sum_{y=1}^{H} |f_1(y) - f_2(y)| \qquad (2)$$



a *b*

Fig. 1. Images of the face 1a: with differen exposure – *a*; mean intensity value in rows for three 1a face images – *b*.

The distance between the graphs by rows of the three images 1a are given in Table 1.

Table 1.

Distances by mean intensity in rows

	original	dark	light
original	--	0,158	0,1942
dark	0,158	--	0,3522
light	0,1942	0,3522	--

Then we change intensity of the presented faces: the dark face was lightened with coefficient -30 and the light face was darkened with coefficient +30. Corresponding plots of intensity are given in Fig. 2, *a*. The distance between the graphs by rows of the three images 1a are given in Table 2.

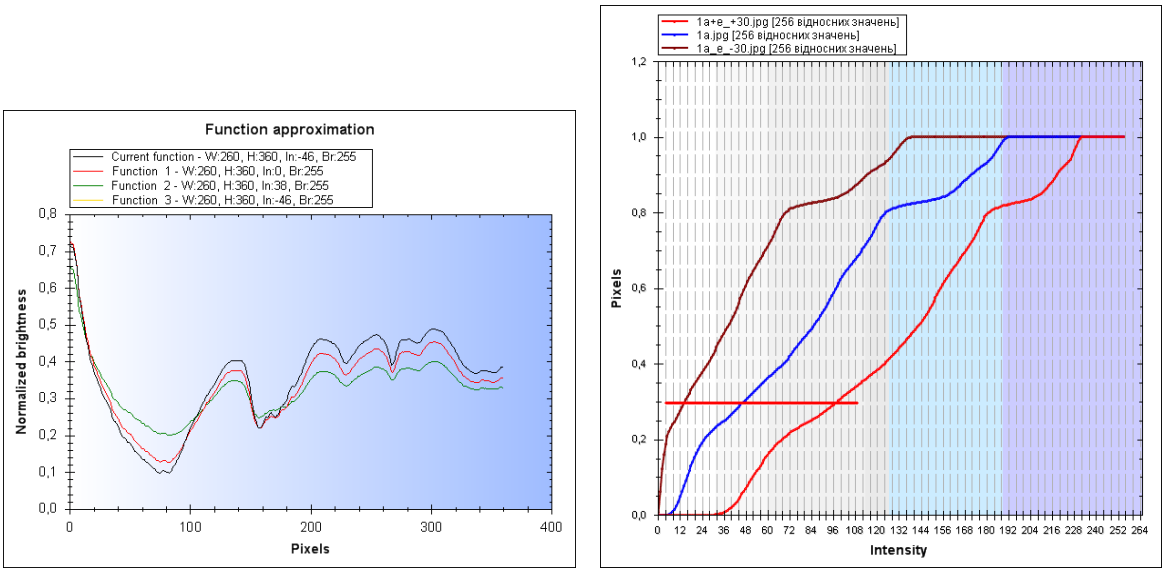
Table 2.

Distance by mean intensity in rows

	original	dark	light
original	--	0,0359	0,0257
dark	0,0359	--	0,0593
light	0,0257	0,0593	--

Distance between intensity features of segmented faces. We calculate the cumulative histograms for every face presented for the experiment in Fig.1. They are given in Fig. 2, *b*.

The main information for the recognition of the face image is placed in its central part, namely the shape and coordinates of the eyes, nose and mouth and their mutual positioning. These main objects are as a rule in black and dark colors. So, to segment the image we choose the thresholds. In Fig.2, *b* we select the level of segmented images as 0.3. Then we find the corresponding values of threshold: 17, 50 and 99.



a *b*

Fig. 2. Mean intensity value in rows for the 1a face images with changed intensity – *a*; cumulative histograms for the 1a face images – *b*

Fig. 3. Images of the segmented faces 1a :with different exposure

For these three images we calculate mean intensity values in rows (1). Corresponding plots are presented in Fig. 4. The two axes are: OX - *H* – a number of rows, OY – 255 - intensity. For more distinct peculiarities of the plots to underline the specific points we also can transform the images to binary view.

The distance between the graphs by rows of the three images 1a are given in Table 3.

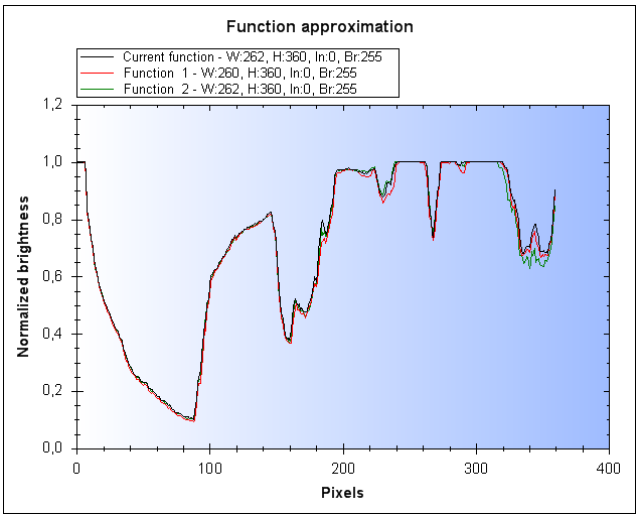


Fig. 4. Mean intensity value in rows for the 1a face segmented images with differen exposure

Table 3.

Distances by mean intensity in rows

	original	dark	light
original	--	0,0118	0,0118
dark	0,0118	--	0,0105
light	0,0118	0,0105	--

The result in the Table 3 show minimal distances between the images originally having different exposure coefficients.

Sa we see from the plots Coordinates of peaks in the mean intensity features indicate vertical positions of eyebrows, eyes, nose and mouth.. These coordinates could be accepted as face features independent of intensity. Also height and width of peaks give information about a number of pixels and their intensity of the main objects on the face.

Conclusion. The simple statistic features for identification of a face have been suggested, To exclude an influence of intensity transformation of images are made : adjustment of intensity to close values or segmenting the images to the equal values of pixels remaining in th segments. . The statistical feature by rows can be used to classification of faces using the developed algorithm.

References

1. E. Hjelmåsa1, B. KeeLowb, "Face Detection: A Survey", Computer Vision and Image Understanding, vol.83, iss. 3, 2001, pp. 236-274.

2. W. Zhao, R. Chellappa, P. J. Phillips, A. Rosenfeld, "Face recognition: A literature survey", ACM Computing Surveys, vol. 35, is. 4, 2003, pp.399-458.

3. A. F. Abate, M. Nappi, D. Riccio, G. Sabatino, "2D and 3D face recognition: A survey", Pattern Recognition Letters, vol. 28, issue 14, 2007, pp. 1885-1906.

4. M. Wang, W. Deng, "Deep Face Recognition: A Survey", Computer Vision and Pattern Recognition, 2019, https://arxiv.org/abs/1804.06655.

5. Y. Zhao, Z. Zhen, X. Liu, Y. Song, J. Liu, "The neural network for face recognition: Insights from an fMRI study on developmental prosopagnosia", NeuroImage, vol.169, 2018, pp.151-161.

6. M. Al-Dabagh, M. Alhabib,F. AL-Mukhtar, "Face Recognition System Based on Kernel Discriminant Analysis, K-Nearest Neighbor and Support Vector Machine", International Journal of Research and Engineering, vol.5, no.3, 2018, pp. 335-338.

7. N. P. Gopalan1, S. Bellamkonda, "Pattern Averaging Technique for Facial Expression Recognition Using Support Vector Machines", I.J. Image, Graphics and Signal Processing, vol.9, 2018, pp.27-33.

8. A. Iosifidis, M. Gabbouj, "Scaling up Class-Specific Kernel Discriminant Analysis for large-scale Face Verification", IEEE Trans. on Information Forensics and Security, vol. 11, issue 11, 2016, pp.2453- 2465.

9. FEI Face Database, 2019, https://fei.edu.br/~cet/facedatabase.htm.