Improved Algorithm for Creating a Template for the Information Technology of Biometric Identification

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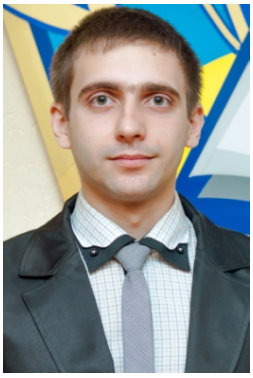

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Abstract
The modern tasks of identification of objects require a fine precision and efficiency of their decision. Biometric information technologies are actively applied in different security systems and access control. The most perspective approaches in this case are the methods of creation of a standard of the image based on removal of an ideal picture and/or record of the biometric characteristic of the person. The systems based on these methods are convenient, safe and reliable. In article the universal algorithm is developed for creation a template (the person or object). We will apply the improved algorithm of creation a template not only to the person, but also to other objects of identification or recognition.
Key words: TEMPLATE, IDENTIFICATION, RECOGNITION, BIOMETRY, PROCESSING OF THE IMAGE, VIOLA-JONES, SOBEL OPERATOR

Introduction

Now information technologies are actively applied in different security systems and access control. It is first of all connected to that the modern tasks of recognition, identifications and authentications of the person require enough fine precision and efficiency of their decision in real time. As a rule, the listed tasks are difficult and multiple-factor. One of the most perspective approaches in this case are the methods of

creation of a standard of the image based on removal of an ideal picture and/or record of the biometric characteristic of the person (BCP). In case of use of the BCP for its identification there is a probability of an error of system. It is connected to misuse of technology, conditions of an environmental situation and the most important quality of a sample. Relevance of this subject is caused by obvious movement of the modern monitoring systems of access towards biometric identification of the person due to its convenience, safety and reliability.

Extended dynamic range and grayscale image

Considering different types of images for icon compression for our task of establishment of standard, half-tone image matches because it has sufficient quality for identification of the person and the small volume of the occupied memory space is an important index for further storage of standards in a database.

Before squeezing the image in grayscale, the first improving for creation a template is offered – to receive a picture with extended dynamic range. Extended dynamic range is necessary optimum to display the video signal from two cameras containing the maximum quantity of the details of the person seen in the ready combined picture on the display. With the purpose of extended dynamic range of the image, and also for suppression of bright point sources (relight and the bleed of bright objects) the shooting mode by the normal camera and IR was realized: one frame displayed a color normal picture, and the following frame was created by means of the IR filter. Combining of two such images allows displaying in an optimum way well and badly illuminated areas, to receive more "deep" picture, as in day, and night time [1]. The result of receiving such picture using compression of the grayscale image is provided in a figure (fig. 1, 1).

Viola-Jones method

From the turned-out picture we need to select area, which is unique and suitable for further creation of a template. For this purpose we apply Viola-Jones method – establishing for object search on the image in real time [2].

The basic principles on which the method is based:

a) images in integral representation that allows calculating quickly necessary objects are used;
b) Haar-like features by means of which there is a search of the necessary object (in this context, a face);
c) use boosting to select the most suitable characteristics for the desired object in this part of the image;
d) all signs arrive on an input of the classifier which gives result "true" or "false";
e) stages of signs for fast discarding of windows where a face isn't found are used.

Training of classifier very slow, but search results of the person are very fast for this reason this method of facial recognition on the image was selected. Viola-Jones is one of the best indexes on a ratio efficiency of recognition/speed of operation. Also this detector has the lowest probability of false detection of the person. The algorithm even well works and recognizes features at a small angle, approximately to 30 degrees. In case of slope angle more than 30 degrees the percent of detection sharply falls. And it doesn't allow detecting in standard implementation the turned face of the person under arbitrary angle that considerably complicates or does impossible use of algorithm in the modern production systems taking into account their growing needs.

In a general view, the task of detection of the person and features of the person on the digital image looks quite so:

a) there is an image on which there are required objects. It is provided by a two-dimensional array of pixels the w × h size, where each pixel matters from 0 to 255 if this black-and-white image;
b) as a result of the operation, the algorithm shall define faces and their lines and mark them – search is carried out in the active area of the image by rectangular signs by means of which the found person and its lines are described:

$$\text{rectanglei} = \{x,y,w,h,a\}, \quad (1)$$

where x, y – coordinates of the i-th rectangle center, w – width, h – height, a – angle to the vertical axis of the rectangle images [3].

The result of application of the Viola-Jones method to beforehand is provided to the prepared image in a figure (fig. 1, 2).

Sobel operator

Weakening of action of noises is reached by filtering. In our case it is applicable the

second improving, using filtering by Sobel edge detection (Sobel operator) to already selected area Viola-Jones.

The Sobel operator [4] is used in image processing, particularly within edge detection algorithms. Technically, it is a discrete differentiation operator, computing an approximation of the gradient of the image intensity function. At each point in the image, the result of the Sobel operator is either the corresponding gradient vector or the norm of this vector. The Sobel operator is based on convolving the image with a small, separable, and integer valued filter in horizontal and vertical direction and is therefore relatively inexpensive in terms of computations.

The operator uses two 3 × 3 kernels which are convolved with the original image to calculate approximations of the derivatives - one for horizontal changes, and one for vertical. If we define A as the source image, and G_x and G_y are two images which at each point contain the horizontal and vertical derivative approximations, the computations are as follows:

$$G_y = \begin{bmatrix} -1 & -2 & -1 \\ 0 & 0 & 0 \\ 1 & 2 & 1 \end{bmatrix} * A \quad \text{and} \quad G_x = \begin{bmatrix} -1 & 0 & 1 \\ -2 & 0 & 2 \\ -1 & 0 & 1 \end{bmatrix} * A, \tag{2}$$

where * denotes the 2-dimensional convolution operation.

The *x*-coordinate is defined here as increasing in the "right"-direction, and the *y*-coordinate is defined as increasing in the "down"-direction. At each point in the image, the resulting gradient approximations can be combined to give the gradient magnitude, using:

$$G = \sqrt{G_x^{\,2} + G_y^{\,2}}, \tag{3}$$

Using this information, we can also calculate the gradient direction:

$$\Theta = \arctan\left(\frac{G_y}{G_x}\right), \tag{4}$$

where, for example, Θ is 0 for a vertical edge which is lighter on the right side.

Unlike Laplace filters results of the filter of Sobel differ significantly. Sobel's filter tends to be less sensitive to noise of the image in comparison with Laplace filter. The found lines of boundary not yes sir granulated, as lines of the remaining existing filters of separation of boundaries.

The result of use of the filter of Sobel to beforehand is provided to the prepared image in a figure in normal and inverse options (fig. 1, 3).

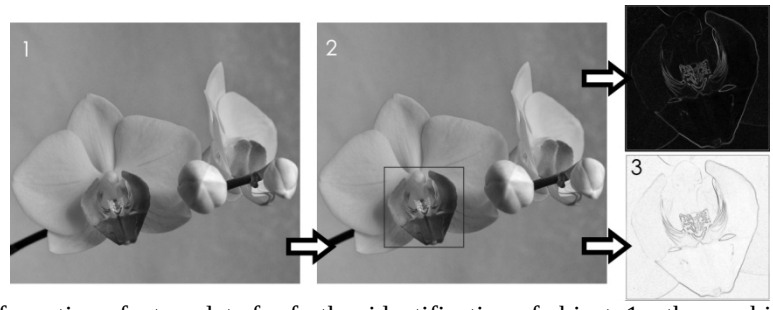

Figure 1. Process of creation of a template for further identification of object: 1 – the combined IR picture using compression of the grayscale image; 2 – application of the Viola-Jones method; 3 – the Sobel operator in normal and inverse options

Conclusion

The developed algorithm for creation a template for the IT of biometric identification, using several methods, has essential advantages. Due to improving of the existing approaches, it is possible to reduce some number of people or objects which identification is impossible, and considerably to increase security of information resources from illegal access in general. The reference sample has a resolution of 500 × 500 pixels and the size of 150 Kb that is ideally suited for the modern DB. At it all boundaries for further biometric clearly are visible to identification of the person. As practice (the image of a flower of fig. 1) showed, we will apply the improved algorithm of creation a template not only to the person, but also to other objects of identification or recognition.

References

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