DOI: https://doi.org/10.30837/csitic52021232892

Accelerated Localization of the Iris as an Element of the Biometric System

Olesia Barkovska[1]

Yevhenii Bas[2],

[1,2]*Kharkiv National University of Radio Electronics, 14 Nauky Ave, Kharkiv UA-61166, Ukraine, d_ec@nure.ua*

Abstract. *This work is devoted to the topic of localization and recognition of the unique and complex pattern of the iris, which is one of the elements of the biometric identification system along with such characteristics as fingerprints, palm prints, gestures, and facial features. The paper examines the performance of the algorithm for the localization and separation of the iris on the central and graphic processors using CUDA technology.*

Keywords: *iris, computer vision, biometric athentication, iris recognition, OpenCV, CUDA.*

I. Introduction

Biometric authentication based on the iris, namely, a random pattern in the iris that remains unchanged throughout a person's life, has recently become increasingly important, but it is an algorithmically complex process and computationally expensive [1]. Pre-processing of the original image of the iris of the eye consists in noise reduction, conversion to grayscale, localization of the borders of the iris in the image of the eye, which require high computing capabilities of the hardware base. The use of graphics processors based on the parallel nature of computations and technology for solving general-purpose tasks on CUDA graphics processors can provide a reduction in computation time when solving the problem, which justifies the relevance of work [2].

Iris recognition is one of the elements of the biometric identification system together with such characteristics as fingerprints, palm prints, gestures, and facial features because of their unique and complex pattern [4].

II. Aims and Tasks of the Work

The aim of this work is to analyze the performance of the algorithm for the localization and separation of the iris on the central and graphic processors using CUDA technology.

III. Task Fulfillment

Localization of the iris consists of the following steps:

- blur (image filtering for the purpose of noise reduction);
- intensity adjustment (image enhancement by placing the image intensity values in a new range);
- selection of boundaries (places with abrupt changes in the intensity of the image);
- pupil and iris detection.

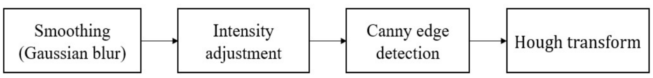

Figure 1. Iris localization algorithm

Once the location of the pupil is detected, an iris search procedure is performed by analyzing changes in pixel intensity from the pupil to the edge of the image. To find the boundaries of the iris, it is enough to know the coordinates of the center of the pupil and its approximate radius. This allows you to build concentric circles of growing radius, for each of which the total pixel intensity is calculated. Analysis of the difference in intensities of each circle, in comparison with the previous one, allows you to identify the border of the iris. Taking into account that the border is a change in intensity from dark tones to light ones, we find that the circle, the change in intensity of which is maximum, will be the circle that covers the iris [3].

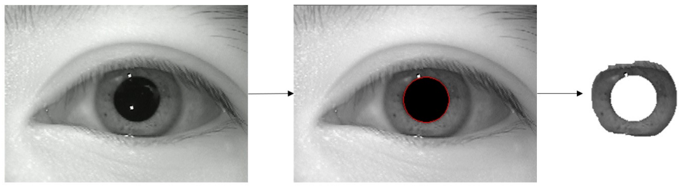

Figure 2. The result of the iris localization algorithm

Parallelization of the algorithm

Parallelization of the considered algorithm for localization of the iris of the eye consists in decomposition of the stream of input frames by calculators, taking into account the use of shared memory for each computational CUDA block. The problem satisfies the conditions for the absence of data dependence and divergences, therefore, it can be solved in parallel [2].

To carry out a computational experiment, computers were available, the characteristics of which are shown in Tab. 1.

Table 1. Development environment specifications

CPU	Intel Core i5-4210U (1.7 - 2.7 GHz)
GPU	nVidia GeForce 840M
GPU characteristics	384 cores CUDA, 1029 MHz, 2 Gb DDR3
RAM	12 Gb
OS	Windows 10

The resulting acceleration is defined as the time ratio of the sequential implementation to the parallel one. The results are shown in Figure 3 and Table 2.

The results obtained confirm the efficiency of using massively parallel systems for big input image processing .

Table 2. Time of problem solving on CPU and GPU for images of different sizes

Image size	Execution time, sec		Acceleration
	CPU	GPU	
2560x1600	2.967	0.435	6,82

1200x800	2.572	0.383	6,71
767x528	2.532	0.378	6,69
640x480	2.312	0.372	6,21
440x292	2.221	0.365	6,008

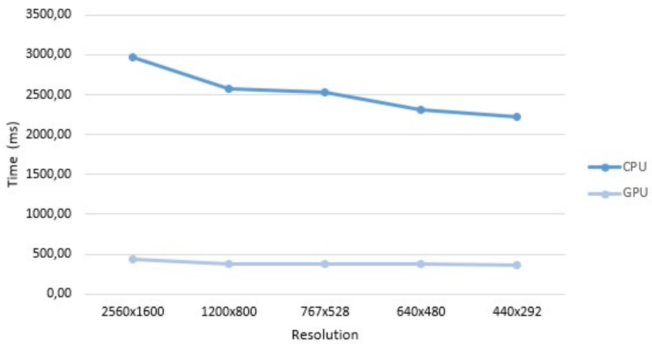

Figure 3. Resulting acceleration

Analysis of the results shows that the use of the computational resource of the GPU to perform the circular Hough transform and adjust the image intensity depending on the current gray levels of the image is reasonable for all image sizes, reaching a maximum of 6.82 for images with a size of 2560x1600.

IV. CONCLUSIONS

During the work, the sequential and parallel algorithms for determining the location of the iris were compared. Parallelization took place on a GPU using the Nvidia CUDA software and hardware parallel computing architecture. Based on the results, acceleration can be observed even when processing a single image. As the number of images or image resolution increases, the acceleration increases, reaching 6.82.

Further research in this area will be associated with the study and acceleration of the classification methods of iris images that were localized in this paper for further use in multifactorial biometric identification systems.

REFERENCES

[1] O. Barkovska, N. Axak, D. Rosinskiy and S. Liashenko, "Application of mydriasis identification methods in parental control systems," 2018 IEEE 9th International Conference on Dependable Systems, Services and Technologies (DESSERT), Kyiv, UKraine, 2018, pp. 459-463, doi: 10.1109/DESSERT.2018.8409177.

[2] P. Kumari and S. R. Naidu, "Fast Approach for Iris Detection on GPU by Applying Search Localization for Circular Hough Transform," *2018 International Conference on Advances in Computing, Communications and Informatics (ICACCI)*, Bangalore, India, 2018, pp. 774-778, doi: 10.1109/ICACCI.2018.8554430.

[3] L. Yuan and X. Xu, "Adaptive Image Edge Detection Algorithm Based on Canny Operator," 2015 4th International Conference on Advanced Information Technology and Sensor Application (AITS), Harbin, China, 2015, pp. 28-31, doi: 10.1109/AITS.2015.14.

[4] O.Barkovska, I. Movsesian., N. Yeromina, O. Liashenko, D.Tkachenko, "System of individual multidimensional biometric authentication" International Journal of Emerging Trends in Engineering Research, 2019, 7(12), pp. 812–817, DOI: 10.30534/ijeter/2019/147122019.