A METHOD FOR IMAGE SEGMENTATION BASED ON HISTOGRAMS – PRELIMINARY RESULTS

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Abstract. *We present a novel method of image segmentation. While the method resembles to the known ones based on histograms, it is still different in the use of the gray level distribution and produces results that, in some cases, may be considered an improvement over the known methods.*

Keywords: *image segmentation, histogram thresholds, image processing*

I. Introduction

Segmentation represents the division of the image into areas by certain criteria. Usually, segmentation monitors the extraction, identification or recognition of an object in an image. The areas or the regions that compose a picture are called segments. Humans are able to separate objects in an image. It is because his prior knowledge necessary for understanding the objects and scenes. Developing segmentation algorithms that can "interpret" the images by extracting significant objects remains an unsatisfactory solved task.

The interpretation of an image is dependent on the objective analysis and on the person who makes the analysis.

There are many methods of image segmentation; the choice of technique depends on [1]:

1. the nature of the image: lighting non-homogeneous, the presence of noise, glare, textured pattern, blurred;
2. operations that are planned after segmentation: location, extent, pattern recognition, interpretation, diagnosis, quality control etc.;
3. primitives to extract: outline, regions, shapes, textures;
4. operating constraints: computational complexity, real-time function, memory size available .

The methods of segmentation can be grouped into four major categories:

1. region-based segmentation. There are for example: region-growing [2], [3], split and merge [4], clustering method: k-means, fuzzy C-means [5];
2. edge-based segmentation [6];
3. thresholding - segmentation based on classification or thresholding of pixels according to their intensity [7], [8], [9];
4. segmentation based on cooperation between the first three segmentations methodes [10].

The paper deals with a novel way of using the global statistics of gray images for image segmentation. The statistics $p(G)$, where G is the gray level, is empirically represented by the histogram, $n(G)$. In the distribution function, instead of finding the "valleys" or approximating it with a set of Gauss functions, as in other methods, we identify the intervals of almost constant probability. These are the intervals X_k satisfying one of the sets of conditions $\forall x_1, x_2 \in X_k \quad |p(x_1) - px_2)| < \delta$ and $length(X_k) > \lambda G_{\max}$, $0 < \lambda < 1$, with δ and λ predetermined parameters of the procedure, or $\forall x_1, x_2 \in X_k \quad STDV(X_k) < \delta$ and the second condition identical to the above. Once the intervals X_k

are determined, the partition of the gray interval $[0, G_{\max}]$ is completed with the remaining intervals. The segments of the image $G(i, j)$ are performed according to the intervals X_k so determined. By varying the parameters δ and λ, several segmentation results can be obtained.

II. Proposed method

2.1 Basic algorithm

The segmentation methods based on histogram usually determine the thresholds as being the minimum values of the histogram. We propose another method of determining the thresholds that is illustrated in the flowchart in figure 1.

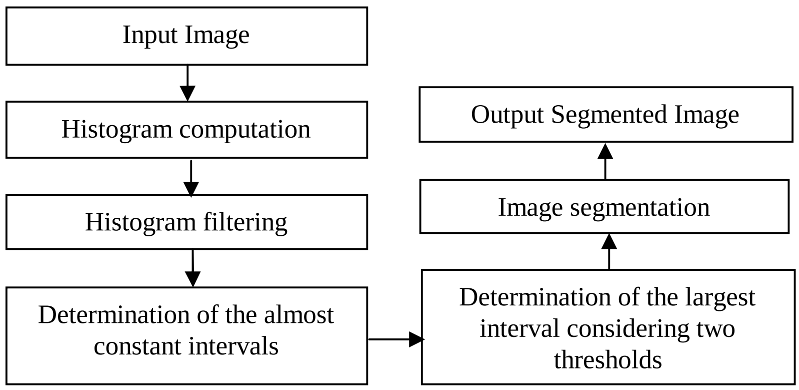


Fig. 1 Flowchart of the proposed method used for image segmentation;

The first steps of the method are represented by the computation of the image histogram, the filtering of the histogram using average and median filters, and the determination of the probability intervals that are almost constant. For obtaining a smooth histogram we applied the average filter twice and then the median filter, using a window of 11 samples, respectively 5 samples.

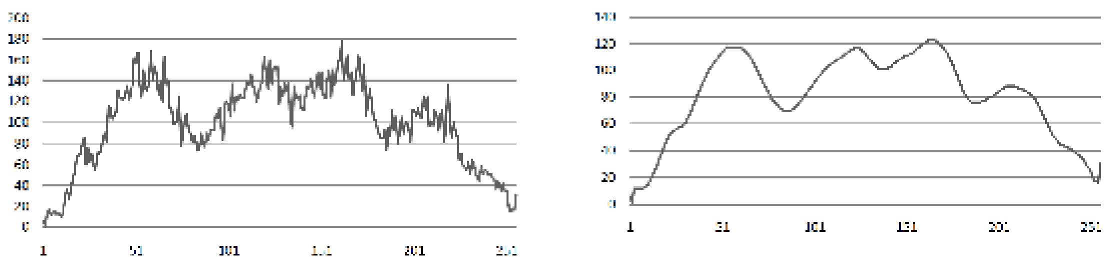


Fig. 2 Example of the original and filtered image histogram.

The almost constant intervals were determined using an overlapping window of 24 samples considering the following rules:

(a) if $\frac{V_{\max} - V_{\min}}{Nw} < 1.5$ then the interval is considered constant, where $V_{\max}$ and $V_{\min}$ are the maximum and minimum values of the window and Nw is the number of elements of the window. If two successive windows have this property we define the interval as being composed by both windows.

(b) else the interval is considered not to be constant.

If we obtained several constant intervals, for the case with two thresholds we select the largest one, and its limits are considered thresholds.

The segmentation is performed according to the example of pseudocode, were **Th1** and **Th2** are the limits of the largest quasi-constant interval and **g(i,j)** is the pixel value of the image:

if $g(i,j) < \text{Th1}$ then $g(i,j) \in$ segment1

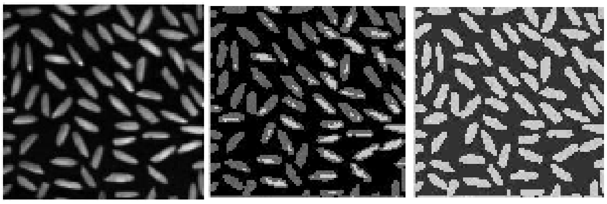
if $g(i,j) \geq \text{Th1}$ && $g(i,j) \leq \text{Th2}$ then $g(i,j) \in$ segment2

if $g(i,j) > \text{Th2}$ then $g(i,j) \in$ segment3

If we use n thresholds, then there are $n+1$ segments.

2.2 Results

We briefly illustrate the results obtained by proposed method and its variants and compare the segmentation results obtained with this method with several ones reported in the literature.



a b c

Fig. 3 **a** Original 'rice' image; **b** segmented image with proposed method, 2 thresholds; **c** segmented image with proposed method, 1 threshold; Compare with results in [6], [11].

To compare with results from other sources, it was necessary to obtain a binary image that means to use only one threshold, was chosen left limit of the quasi-constant interval. The obtained results with the proposed method are similar to those from other sources.

a b

Fig. 4 **a** Original 'Lena' image [12]; **b** segmented image with proposed method, 6 thresholds; Compare with results in [7], [11].

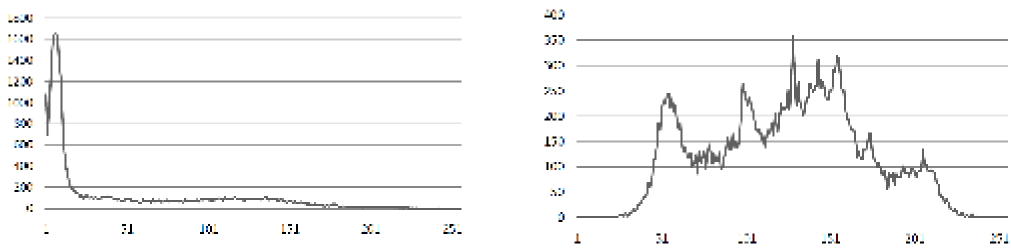


Fig. 5 Original images histogram of the pictures in the figures 3 and 4. Left – histogram of 'rice' image, right – histogram of 'Lena' image.

III. Conclusions

We developed a new method for image segmentation based on the thresholds of the histogram. Compared to the other existing methods, the presented one gives better results for the cases when the image histogram has quasi-constant intervals. We obtained less favorable results when the quasi-constant intervals are only at the beginning or at the end of the histogram. The main advantage of the proposed method is that it is simple and computationally fast, but it needs to be improved for obtaining better results for all type of images.

IV. References

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Authors' contributions

HN. Teodorescu proposed the method – the main steps of the algorithms, the theme of this work and some of the pictures for testing, contributed to the interpretation of the results and to writing this paper.

M. Rusu wrote the code, experimented and contributed to the interpretation of the results, to writing the paper.