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INVESTIGATION OF IMAGES FILTRATION METHODS IN COMPUTER SYSTEMS AND SPECIAL PURPOSE NETWORKS

It is known that human eyes are less sensitive to color, than to their brightness. In the RGB color space, all three components are considered equally important, and they are usually stored with the same resolution. However, you can display a color image more efficiently, separating the brightness from color information and presenting it with a higher resolution than color. RGB space is well suited for computer graphics, because it uses these three components for color formation. However, RGB space is not very effective when it comes to real images. The fact is that to save the color of an image, you need to know and store all three components of the RGB, and if one of them is missing, it will greatly distort the visual image representation. Also, when processing images in RGB space, it is not always convenient to perform any pixel conversion, because, in this case, it will be necessary to list all three values of the RGB component and write back. This greatly reduces the performance of various image processing algorithms.

Research bases

Previous Images Filtration

Selection of the bright component. It is known that a color image requires at least three numbers per pixel to accurately convey its color. The method chosen to represent the brightness and color is called the color space [1].

There are three most common color models: RGB (used in computer graphics); YCbCr (used in video systems); CMYK (used in the color press).

All color spaces can be listed from the RGB space that can be obtained from the camera or scanner.

RGB space is well suited for computer graphics, because it uses these three components for color formation [2]. However, RGB space is not very effective when it comes to real images. The fact is that to save the color of an image, you need to know and store all three components of the RGB, and if one of them is missing, it will greatly distort the visual image representation. Also, when processing images in RGB space, it is not always convenient to perform any pixel conversion, because, in this case, it will be necessary to list all three values of the RGB component and write back. This greatly reduces the performance of various image processing algorithms. For these and other reasons, many video standards use brightness and two signals that carry information about the red and blue components of the signal, as a color model other than RGB. The most famous among such spaces is YCbCr [3].

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According to the recommendation of the ITU R BT.601 [4] the following ratios are proposed k_r=0,229: and k_b=0,114. The multiplier k_g is derived from the relation $k_r+k_g+k_b=1$. Using these values, it is obtained a wide spread formula:

$$Y=0,299\cdot R+0,587\cdot G+0,144\cdot B. \quad (1)$$

In order to process images in this work, the bright component of the YCbCr color space is used. Accordingly, in order to reach this, by using the formula 1 in the software Mathcad 15. Noises in images no system provides the perfect image quality for the object sunder research. Images during the process of forming their systems (photographic, holographic, and television) are usually exposed to various occasional interference or noise. A fundamental problem in the field of image processing is the effective noise removal, while preserving the image's parts which are important for further recognition. The complexity of the solution to this problem depends much on the noise's nature. In contrast to the deterministic distortions described by the functional transformations of the original image, additive models, pulse and multiplicative noise are used to describer and influences [5].

The most common type of interference is the random additive noise, which is independent from the signal. The additive noise model is used when the signal at the system's output or at some transformation stage. It can be considered as the sum of the useful signal and some random signal. The additive noise model describes well the effect of the film graininess. The fluctuation noise in the radioengineering systems, quantization noise in analog-to-digital converters, and the like.

Aditive Gaussian noise is characterized by adding to each pixel images of values with normal distribution and with zero mean values. Such noise, usually, occurs during the digital image formation. Basic images information is contours of objects.

Classic linear filterscan effectively eliminate, but the degree of small parts blurriness the image may exceed the permissible values.

Pulsed noise is characterized by the replacement of pixels' part in the image, with the values of a fixed or random variable. The automated digital image quality assessment carried out using the metric of objective image quality – Peak Signal to Noise Ratio (PSNR):

$$PSNR=10\cdot\log\left(\frac{255}{\sqrt{\frac{1}{N}\sum_i^N (X_i-Y_i)^2}}\right), \quad (2)$$

here are X_i - pixel of the image with which it is compared;

Y_i - pixel of the image being compared;

N - the number of image pixels.

In the image, such interferences look like isolated contrast points, an example of output and distorted impulse noise of an image with a density of 5%. Peak signal to noise ratio in this case: PSNR=9,213. Pulse noise is typical of devices for inputting images from a television camera, image transfer systems via radio channels, as well as for digital imaging and transfer systems. The use of linear filtration in this case is ineffective - each of the input pulses gives feedback in the form of a pulse filter's characteristic, and their aggregate contributes to the noise spread in the entire area of the image. To remove impulse noise, a special class of nonlinear filters based on rank statistics is used. The common idea of such filters is to detect the position of the pulse and replace it with the estimated value, while maintaining other pixels of the image unchanged.

Median image filtering

A successful solution to solve an impulse noise is to use median filtration proposed by John Tuke [6] for the analysis of economic processes. It should be noticed that median filtration is a heuristic processing method, its algorithm is not a mathematical solution to a strictly formulated problem. Therefore, the researchers pay much attention to the analysis of the image effectiveness processing on its basis and comparison with other methods.

When applying a median filter, each image pixel is sequentially processed. For median filtration, a two-dimensional window (filter aperture) is used, usually has a central symmetry, with its center located at the current filtration point. The dimensions of the aperture are among the parameters that are optimized in the process of analyzing the algorithm efficiency. Image pixels, that appear within the window, form a working sample of the current step.

However, as discussed above, median filtering smoothens the image borders to a lesser degree than any linear filtering. The mechanism of this phenomenon is very simple and is as follows. Assume that the filter aperture is near the boundary separating the light and image's dark areas, with its center located in the dark area. Then, most likely, the work sample will contain more elements with small brightness values, and, consequently, the median will be among those elements of the work sample that match this area of the image. The situation changes to the opposite, if the aperture center is shifted to the region of higher brightness. But this means the presence of sensitivity in the median filter to brightness variations [7].

Filling the values operation of the median filter for the pixel value of the elementary object will correspond to the following expression:

$$y_k=x_{i,j}, \left\{i=k-\left\lfloor\frac{k}{m}\right\rfloor\cdot m,\ j=\left\lfloor\frac{k}{m}\right\rfloor,\ k=0..(2m+1)^2-1\right\}, \quad (3)$$

here are $x_{i,j}$ – the value of the pixel of the original image with coordinates i and j;

y_k – a set of pixels' values included in the function's structure of the median filter;

k – pixel values' index of the median filter;

m – the radius of the median filter.

Therefore, it will be the solution of processing one pixel. In order to find the following values, the window function shifts to the right and when the image border reaches down one pixel down and moves from the original zero position on the horizontal axis until the image boundary is reached. In the end, an array containing the found values of the median filter will be formed. In this work, the median filtering is implemented using the software package Mathcad 15.

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