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EVALUATION OF DIGITAL IMAGES BASED ON C AND RQ METRICS

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Abstract
In this paper, a software tool was developed that calculates the C (perfectness) and RQ (resolution) metrics for qualitative assessment of digital images. Using Python and OpenCV libraries, all image files in the image folder are automatically analyzed and the results are visually displayed through tables and graphs. The research results showed that the C and RQ metrics allow assessing image quality through accurate numerical indicators. This approach is of practical importance in scientific research, computer vision systems, and image processing.

Keywords: Image quality, C metric, RQ metric, OpenCV, image analysis.

1. Introduction

Qualitative assessment of digital images is of great importance in modern computer vision and image processing. By determining the quality of images, more reliable results can be achieved in automated systems, medical diagnostics, industrial control, and scientific research. Traditional image quality assessment methods are often subjective and rely on the human eye. Therefore, there is a need to evaluate images with objective indicators using digital methods. In this article, an evaluation algorithm based on the C metric (image blurriness/blurriness) and the RQ metric (image sharpness level) was implemented using the Python programming language and the OpenCV library.

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The program automatically analyzes all image files in a folder, calculates the C and RQ values for each image, and also displays the results in graphical and tabular form. This approach allows for a quick and accurate assessment of image quality and can be widely used in scientific, industrial, and educational fields.

Qualitative assessment of digital images is of great importance in many fields today. In industrial control, medical diagnostics, scientific research, and computer vision systems, if image quality is not properly assessed, the results may be unreliable. Therefore, the analysis of images using automatic and objective indicators is an urgent scientific and practical issue.

The purpose of the article is to evaluate digital images using C and RQ metrics and determine image quality by analyzing them visually and digitally. This approach makes it possible to compare the accuracy and sharpness of images obtained from different sources.

The tasks performed within the framework of the article are as follows:Development of an algorithm for evaluating digital images using C and RQ metrics. Creation of a program for automatic image analysis using Python and the OpenCV library. Visualization of the analysis results in graphical and tabular form. Comparison and interpretation of quality indicators for different images. The scientific novelty of this study is manifested in the joint use of C and RQ metrics in assessing image quality and the creation of a software tool for analyzing them in an automated manner. The program allows for quick and accurate evaluation of images using digital indicators, which complements previously only subjective visual assessment methods. The results of the research can be practically applied in computer vision, image processing, medical diagnostics, and scientific research. The ability to automatically and objectively assess image quality increases the reliability of systems, speeds up the analysis process, and reduces errors due to the human factor.

2. Methodology

The quality of digital images is assessed using two main metrics: the C metric (image clarity/blurriness) and the RQ metric (image sharpness).1. C metrikasi.

We get the image $I \in \square^{M \times N}$, where M and N are the height and width of the image. Initially, two different sized smoothed versions (blurs) of the image are obtained:

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$B_1 = \text{blur}(I, k_1 \times k_1), \quad B_2 = \text{blur}(I, k_2 \times k_2), \quad k_1 < k_2 .$

Here $\text{blur}(\cdot)$ is the average filter operator. Then the difference between the two blurred images is taken:

$D = | B_1 - B_2 | .$

And the **metric** C is defined as:

$$C = \frac{1}{M \cdot N} \sum_{i=1}^{M} \sum_{j=1}^{N} D(i, j) .$$

Here, the value of C indicates the level of image blur: a larger value means a sharper image, while a smaller value means a flatter or blurrier image.

2. RQ metric.

A gradient-based approach is used to estimate the edgeness of an image. Differential operators in the x and y directions are applied to the image:

$\Delta_x(i, j) = I(i, j) - I(i+1, j), \quad \Delta_y(i, j) = I(i, j) - I(i, j+1) .$

These differences are then squared to determine the total differential energy:

$$E_{\text{diff}} = \sum_{i=1}^{M-1} \sum_{j=1}^{N} \Delta_x(i, j)^2 + \sum_{i=1}^{M} \sum_{j=1}^{N-1} \Delta_y(i, j)^2 .$$

As a result, the **RQ metric** is obtained as follows:

$$RQ = \frac{E_{\text{diff}}}{K \cdot M \cdot N} .$$

Here K is the normalization coefficient. The RQ metric indicates the density and sharpness of the edges of the image: a high RQ value indicates that the image has sharp edges.

3. General analysis process.

For each image, the C and RQ metrics are calculated:

$(C, RQ) = f(I; k_1, k_2, K) .$

The results for all images in the folder are collected in vector form:

$\mathbf{C} = [C_1, C_2, \ldots, C_n], \quad \mathbf{RQ} = [RQ_1, RQ_2, \ldots, RQ_n] .$

The results are then visualized in graphical and tabular form. This approach allows for a systematic and objective assessment of image quality.

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3. Results

The C and RQ metrics were calculated for the 19 analyzed images. The C metric indicates the level of image clarity and uncertainty, while the RQ metric assesses the level of image sharpness. The results show that there are significant differences in quality between the images. For example, in the 1.jpg image, C = 6.70 and RQ = 35.68, which indicates that the image has clarity and high sharpness. At the same time, the rog1.png, rog2.png and rog3.png images have C values in the range of 1.07–1.15 and RQ values in the range of 5.90–5.98, indicating that their clarity and sharpness are low.

In some images, there are significant differences between the C and RQ values. For example, in the image ddr1.png, C = 7.65, RQ = 13.34, which indicates a medium level of jaggedness with high resolution. At the same time, in the image rog4.png, C = 2.93, RQ = 19.23, which means that the jaggedness is relatively high despite the low resolution. In these images, the image jaggedness and jaggedness values are associated with different factors - background noise, lighting or object contrast (Table 1).

Table 1. Results table

№	Tasvir nomi	C	RQ
1	1.jpg	6.7005	35.6811
2	2.jpg	4.8300	28.9610
3	3.jpg	1.8075	11.3772
4	ddr1.png	7.6538	13.3416
5	ddr2.png	6.9905	8.7291
6	ddr3.png	2.1213	6.0951
7	ddr4.png	8.9292	9.5175
8	ddr5.png	3.8668	13.6058
9	ddr6.png	7.1231	15.1977
10	ddr7.png	6.1728	12.4261
11	ddr8.png	3.4034	10.6654
12	metric_plot.png	1.9743	1.3348
13	metric_plot3.png	4.3841	2.8675
14	rog1.png	1.0768	5.9641
15	rog2.png	1.0914	5.9842
16	rog3.png	1.1460	5.9020
17	rog4.png	2.9363	19.2375
18	rog5.png	2.3000	14.1918
19	rog6.png	2.6177	16.6076

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The last bar graph shows the C and RQ values for each image side by side. As can be seen from the graph, the C and RQ values are different for each image, meaning that the image quality is not uniform (Figure 1).

Typically, images with a high C value indicate high sharpness, while RQ indicates the level of sharpness. In some cases (for example, rog4.png), a low C and high RQ are present, indicating better sharpness in this image, but lower overall sharpness. Using the graph, it seems convenient to classify images by quality: images with high C and RQ values are the best quality, while low values are the group of images with low quality. Thus, the results of the 19 analyzed images allow an objective assessment of image quality in terms of sharpness and sharpness, and the graphs allow a visual comparison of the specific quality indicators of each image.

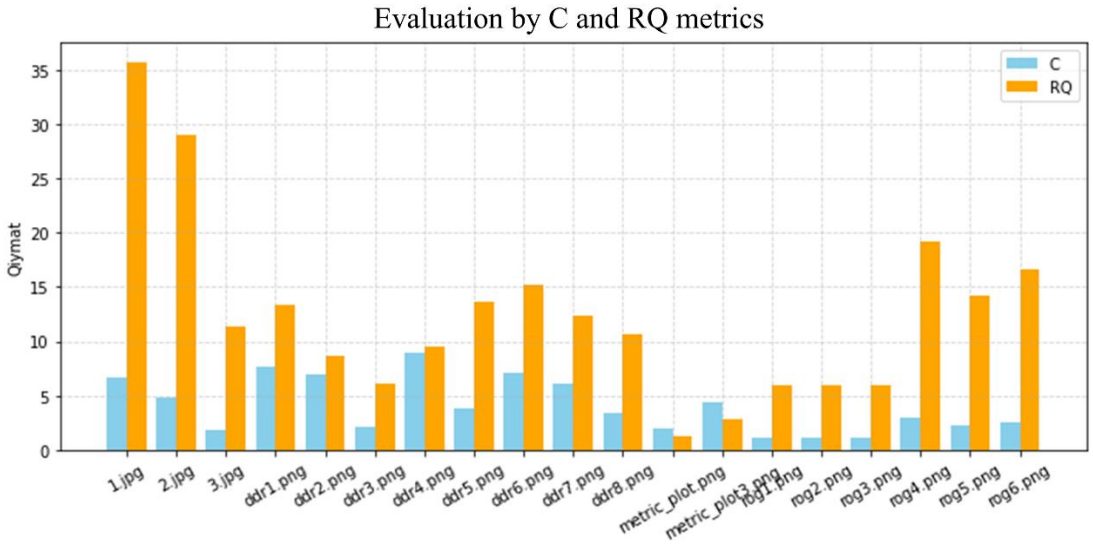

Figure 1. C and RQ values for each image

4. Conclusion

In this study, an automated system was developed based on the C and RQ metrics to assess the quality of digital images. The results of the study showed that the C metric accurately indicates the degree of image clarity and uncertainty, while the RQ metric allows for a numerical assessment of the degree of image sharpness. The results of the 19 analyzed images revealed significant differences in sharpness and sharpness between images. Some images had high sharpness and

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sharpness, while others had low sharpness and medium or high sharpness. These image quality indicators show that they are related to various factors - background noise, contrast, illumination, and object size. The scientific and practical significance of this approach is that it has become possible to objectively and systematically assess image quality. The results can be used in computer vision, image processing, medical diagnostics, and scientific research. The study also complements subjective assessment methods that rely on human factors, allowing for quick and accurate analysis of image quality. The use of C and RQ metrics has been confirmed to be an effective, reliable, and practical approach to qualitative assessment of digital images.

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