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MATLAB-BASED APPLICATIONS FOR IMAGE PROCESSING AND IMAGE QUALITY ASSESSMENT

Abstract: MATLAB is a high-level technical computing language. Its user-friendly syntax, rapid prototyping ability, wellwritten documentation and all-in-one platform features has made it preferred by many users. Moreover, users can take advantage of built-in compilers to generate stand-alone applications. Otherwise, The Image Processing Application helps user to easily modify images, the Image Quality Adjustment Application enables to create series of pictures with different quality. The Image Quality Assessment Application contains objective full reference quality metrics that can be used for image quality assessment. The Image Quality Evaluation Applications represent an easy way to compare subjectively the quality of distorted images with reference image. The purpose of this paper is to show some typical examples from this field where the applications can be useful. It means that the experimental results in this paper are just a selection from the wide range of possible use

Keywords: *MATLAB, image, processing, aplications, quality*

1. INTRODUCTION

Image processing has currently become one of the most significant fields of computer sciences. Computer programs and equipments developed in line with the advancement in technology have simplified the image-involving performances and attracted greater attention to these issues. Besides, researches have been conducted on the ways of benefiting from image processing techniques in daily life. Image processing technology has provided innovations and benefits in the fields of medicine, security, manufacturing and science.

It is not easy to develop, actualize or give the training on image processing applications by employing classical programming languages and techniques. Therefore, function libraries addressing to image processing algorithms have been annexed to these programming languages and turned into available tools and moreover, special programming languages for these processes have been developed.

MATLAB is a technical programming language and environment [1-9]. Possessing available algorithms and functions addressing to a wide range of application areas from control systems to communication, statistics to financial analyses MATLAB is endowed with functions and tools geared towards image processing. By means of these tools MATLAB has been one of the most preferred application domains in the development of image processing

applications. The superior aspect of MATLAB when compared to other application development platforms is its wide capacity of mathematical operations. Operations that can be performed in other programming languages only after writing long lines of codes can be actualized via calling one single function with MATLAB's available mathematical algorithms.

MATLAB possesses a variety of algorithms and functions addressing to diversified set of application areas. In addition to image processing tools, MATLAB provides space to perform applications in many fields ranging from control systems, communication, artificial neural networks and statistics. Via MATLAB, it is possible to perform operations through code writing as well as creating various applications through preparing simulations. Furthermore by connecting the simulations with systems through required equipment, real-time applications can be actualized. MATLAB saves the processed variables as matrix. It enables to display any desired time the values possessed by these matrices, transmit to external environments and receive data from external environment.

2. IMAGE PROCESSING TOOLS OF MATLAB

By virtue of image processing tools it provides, MATLAB has become the most selected application development tool in this field. MATLAB's mathematical power, process capacity, available algorithms and design tools provide an ideal environment in image processing applications.

Via MATLAB an image file is taken to application environment as matrix. Processes applied on this matrix can be displayed as an image on the matrix received at the end of applied algorithms. MATLAB image processing functions can be categorized with respect to their functions as below;

1) Image downloading functions: Used to transmit image files to MATLAB environment.
2) Displaying functions: Used to display image matrices as images on screen.
3) Image writing functions: Used to save image matrix as file.
4) Image transformation functions: Used to transform image types to one another.
5) Spatial transformation functions: Used to perform spatial processes on image.
6) Image analysis and statistical functions: Functions that perform image analysis and obtain statistical values.
7) Image arithmetic functions: Enables to perform arithmetic operations for images.
8) Image setting and improvement functions: Used to improve the images.
9) Linear filtering and transformation functions: Used to form and perform linear filtering.
10) Formal process functions: Used to perform formal processes with respect to image type.
11) Domain-based, nethood and block process functions: Functions that enable to perform processes for any part of the image.
12) Color map functions: Functions that perform processes related to color maps.

One of the hardest challenges faced in MATLAB image processing applications is the problems encountered in performing the processes via code writing and resulting loss of time. Identification and application of parameter choices of the spelling rules related to functions to be used shall trigger some loss of time. It becomes particularly difficult to perform via code writing the processes requiring more than one process application hence error contingency increases. Also in the

failure to receive desired result, during each parameter change and selection of a different algorithm, the code is to be regulated, reordered and the result is to be displayed. Incurring loss of time prevents to perform further applications as well as hindering the identification of correct methods and parameters**.**

Tools formed in the relevant studies enable performing basic image processes without code writing. Via tools, it is possible to perform spatial transformations such as image sizing and image rotation; image analysis can be conducted via limit drawing and statistical data can be obtained. Sound can be attached to the image via using several algorithms and different types of filters can be applied. Via tools parameter entries and algorithm selections, text boxes can be easier with radio buttons and error contingency is decreased. The possibility to save as file the images received with these processes provides assistance in evaluating obtained results**.**

3. IMAGE IMPROVEMENT AND DEVELOPMENT

Image improvement and development can be employed to examine different states of images. In image improvement various filters are used to filter the image from sound, to set the image brightness. In cases needed, sounds can be attached to the image via several algorithms.

The tool can use 4 different filters to filter the image from sound. To perform this filtering size of mask matrix should be entered. It is appropriate to select size of mask matrix from odd number such as 3*3, 5*5, 7*7. Identified mask matrix scrolled over image matrix and values constituting image matrix can change in line with filtering algorithm.

In the aftermath of identifying mask size, according to selected filter, image matrix and mask size is transmitted to the function of relevant filter. Filtered matrix is obtained as feedback value.

Via using interface it is feasible to attach sound on the image through various algorithms. Sound algorithms that can be applied via interface are salt & pepper, speckle, Gaussian and Poisson algorithms. Selected algorithms are applied to the image by using default values. Algorithms in sound attachment section are applied by using default values of tool box in MATLAB image processing. For salt-pepper sound, 0.05 density; for Gaussian sound 0.01 variance value; for Speckle 0.04 variance value is applied. In Figure III.8, samples with sound attachment are demonstrated.

Brightness of a Gray level image can be changed by the ratio of set coefficient which should be between interval [-1, 1]. Once the coefficient is between interval [-1, 0), image brightness lessens and the image darkens. If coefficient is between (0, 1], interval brightness increases. To set the brightness *brighten* function is called. Image matrix and coefficient are sent as parameter.

With feedback value image matrix of which brightness is changed can be obtained. Subsequent to setting the brightness real image and its new form with a new brightness is displayed with their histograms. As can be seen in the histogram of image with increased brightness level, there is a corresponding increase in its distribution interval.

4. ANALYSIS OF IMAGE

Histogram is a graphic demonstrating the distribution of values in a data set. Histogram of image is the graphic presenting the distribution of image matrix elements formed with pixel values. By examining histogram graphic, it is possible to gather information on which pixels with certain level of brightness are denser on the image. For Histogram graphic, *imhist*

function is called. Image matrix is sent as parameter to function. Feedback is a graphic picture in which histogram is set.

Contour is the closed border curve of the figure in image. Via contour graphics, formality of the figure can be retrieved. By deleting the background of image, contour is drawn on white background. Contour of grey level images can be retrieved.

Border curve of image consists of change points of regions locally continuous and distinctively visible when compared to the surrounding area. Image border can be retrieved by using 5 different algorithms respectively Sobel, Prewitt, Roberts, Log (Laplacian of Gaussian) and Canny algorithms. Border graphic is drawn in white color against dark background. Border retrieval processes are performed as MATLAB default settings with automatic threshold value set according to the image on vertical and horizontal direction. Image matrix, selected method are sent as parameter to *edge* function. As feedback value, a matrix of which border image consists of 0 and 1. is obtained.

It is hard to perform image processing techniques via implementing classical structured programming languages. These challenges exhibit themselves mostly as the necessity of intense mathematical processes, high quantity of data to be processed, complexity of algorithms and requirement to test the correctness of application program at every step. Thence image processing applications call for adequate application experience and intense concentration in the fields of mathematics and programming. Testing, connecting and analyzing different processes therefore demand time-consuming efforts.

MATLAB and similar programs provide solution for such challenges. In addition to mathematical process environment it forms, MATLAB also presents modern algorithms in fields such as image processing as available functions. Additionally via visual interface design means, available functions can be connected and a purpose-specific software tool can be formed.

5. CONCLUSION

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REFERENCES:

[1] Çelik, H. H., & Demir, Ö. (2005, September). *Görüntü İşleme Eğitimi İçin Görsel Bir Ara Yüz.* First International Vocational And Technical Education Technologies Congress, Istanbul, Turkey.

[2] Eddins, S., & Orchard, M. (1994). *Using MATLAB and C in an Image Programming Lab Course.* International Conference on Image Processing, Austin, USA.

[3] Krasula, L., Klima, M., Rogard, E., & Jeanblanc, E. (2011). MATLAB-based applications for image processing and image quality assessment – Part I: Software description. *Radioengineering, 20*(4), 1009-1015.

[4] Murty, A. V., & Karam, L. J. (2010, June). *A MATLAB-Based Framework for Image and Video Quality Evaluation*. Second International Workshop on Quality of Multimedia Experience,Trondheim, Norway.

[5] Parker, J. R. (1997). *Algorithms For Image Processing and Computer Vision*. Wiley Computer Publishing.

[6] Rogard, E. (2007). *Image Quality Assessment: The implementation of metrics by analysis with Matlab*. CTU report, September 2007.

[7] Rogard, E. (2007). *User guide of the Image Processing Toolbox*. CTU report, June – September 2007.

[8] Jeanblanc, E. (2009). *User guide of MATLAB Toolboxes*. CTU report, June – September 2009.

[9] Sheıkh, H. R., & Bovik, A. C. (2006). Image information and visual quality. *IEEE Transaction on Image Processing, 15*(2).