Building System To Improve The Quality Of Digital Educational Images Used In The Production Of Electronic Courses

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Abstract

The aim of the research is to build a system to improve the quality of digital images used in the production of electronic courses, as this proposed system relied on digital image processing using recursive curve modification histogram techniques (through a set of stages including the stage of converting the color image to a gray scale image, then the stage Removing noise from the image, then the stage of resetting the contrast of the image Histogram Equalization Technique, with a judgment or decision on the importance of the improved image resulting from the system automatically, by comparing the (SSIM) value between the original image and the enhanced image and coming up with a decision before outputting The image on the screen and how useful it is, or keep the original image.

Keywords: Quality; Digital Educational Images; Image processing; Electronic Courses .

1. Introduction

Higher education institutions, regionally and globally, are witnessing a great development in the employment of e-learning techniques. The traditional educational methods are no longer sufficient to provide learners with the skills necessary to work and compete in the age of technology, and e-learning has become a necessity imposed on us by contemporary technology; Therefore, societies and governments tended to adopt e-learning and apply it in various educational institutions. Because it has different multimedia to develop the elements of the educational process, and make it more effective. Electronic courses are one of the most important technological innovations because of their educational advantages, such as providing opportunities for learners to obtain a huge amount of information and in multiple forms quickly and easily at any time, place and bad in collective or individual ways, and to practice valuable information and communication technology skills at the same time. The electronic course is multimedia, including images. The image used within electronic courses is no longer an additional means, but rather it has become important in the educational process due to the roles it plays, among which we mention: it arouses the learner's interest in knowledge, which achieves his goals, makes the learner more willing to accept the knowledge material as it helps to increase his experiences It motivates the learner to involve all the senses in study and comprehension. It encourages his mind towards thinking, analysis, and evaluation in order to reach solving problems of all kinds. It also helps in diversifying learning methods and confronting individual differences between learners [1]. Image processing technology constitutes a fundamental research area within engineering, computer science, and other disciplines. Image processing is a way to perform some operations on it, in order to get an improved image or to extract some useful

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information from it. There are three general stages that all types of digital data must undergo: pre-processing, optimization, presentation, and information extraction [2]. Because of the importance of the electronic course, the research focused on improving the contrast of the blurred images in the computer networks course and increasing their quality in order to benefit from them for students. The research suggested building a system to improve the quality of digital images used in the production of electronic courses, for fourth year students, department of computer teacher preparation, faculty of specific education, damietta university.

2. Literature Rewiew

The purpose of the study is to use seven traditional basic filters to remove noise from digital images that were subjected to salt-and-pepper-type noise and the type of blur in order to improve them and to make a hybrid (merging) between them and the concepts of fuzzy logic by adding the double bell-shaped membership function, and as a result (merging) seven Filters fuzzy with the dual bell function, as well as the hybridization was done using the double chirpy function to form seven sigmoidal fuzzy filters [3].This study aimed to improve image contrast using smart computing techniques. The study emphasized the improvement of some images that are tainted by blurring when taking a picture in cloudy weather, bright or dark locations, or taking a picture from a distance, which led to blurring of the image details. Therefore, the researcher in this research proposes a new way to improve the contrast in gray scale images by using two applications of Mathematical Digital Transformations (FDCT-USFFT) and (FDCT-Wrap), and the results proved that the proposed techniques gave better results compared to Histogram Equalization, and by comparing between Suggested techniques The results showed that FDCT-Wrap is better than FDCT-USFFT on the basis of improving the contrast in gray scale images [4].

This study dealt with the use of adaptive optimization techniques in digital image processing, where the problem of the study was the deterioration of digital images with noise during acquisition, transmission, or storage.Many images such as medical images, satellite images, and aerial images suffer from poor contrast, blurring and noise and therefore there is a need to improve the original image, also non-linear filters suppress impulsive noise to a large extent, while they fail to preserve important details For images such as edge information i.e. suppressing noise by blurring the image، Which makes it less clear and leads to a decrease in the amount of information on the image instead of an increase in its quality, so the researcher proposed three adaptive enhancement techniques in filtering images and suggests improving contrast to remove defects by traditional techniques, which resulted in proving that the three proposed enhancement methods are effective and give better results from other modern technologies [5].This paper discusses evaluating the quality of the test images as a function of the intensity of illumination. The problem of the study was the researcher's observation of the imaging systems, which do not give perfect and perfect images, but often give images with specific clarity, that is, they do not give images with sharp edges, but rather wide edges that have something of a blur.The most important details and information of the image are contained in the areas of the rims, but with that, most of the evaluation criteria for the image do not depend on determining the quality of the rims in the image and measuring its sharpness, but rather depend on the general evaluation or evaluation of the areas of the homogeneous image, so the researcher suggested several new methods Such as (direct variance technique, statistical variance technique, diagonal variance technique) to calculate the variance in the edge areas based on the highest and lowest intensity of the edge points and on the statistical characteristics of these areas, which resulted in proving that the techniques of calculating the variance based on the detection of edges are considered one of the most efficient standards in Evaluation of image quality compared to techniques for computing general contrast [6].This study relied on improving color images from substitution noise using the method of inverse weighted distance supplemented IDWI, where the problem of the study was the noise that affects color images, as the researcher considers it one of the most important defects that affect digital images, so the researcher proposes in this research a new algorithm to improve the distorted color image This algorithm is based on the method of inverse weighted distance interpolated IDWI. And the direct processing method using RGB basic space, and the results proved that by comparing the results, it appeared that the proposed filter, which adopts the IDWI method, has a high efficiency in improving color images that are tainted by salt and pepper noise in terms of preserving color details compared to other filters [7].This study dealt with techniques for improving the contrast of digital images, where the problem of the study was the researcher's observation of some shortcomings in the available techniques to improve the contrast of

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images and their need for development, so the researcher suggested developing a new technique to improve the contrast of digital images whose contrast is low automatically, this technique was compared with five previously existing techniques, by applying it to 46 gray and 14 color digital images and evaluating its performance.This developed technique consists of two techniques: histogram equalization and fast gray level aggregationstudy dealt with techniques for improving the contrast aggregation. And it was developed to improve the images whose histograms have a very high component in the left part of its components, and this technique was compared with five previous techniques, and six criteria were adopted to compare the performance of these different RGB technologies, and the results proved that the proposed technique for improving the contrast is more performance and improvement of the five other techniques under study as it works automatically [8].This study obstacles to designing electronic courses in the College of Education at the University of Hail from the point of view of the faculty members: The problem of the study was that there were shortcomings in the design of electronic courses at the College of Education, where faculty members face many obstacles to designing their electronic courses, as it praises the importance of images representing the content in a way good and clear, while avoiding additions, to be well-defined and readable, and not to be large in size for ease of downloading, and to be presented in a functional form integrated with the texts.And that there is simplicity, contrast, clarity, organization and not exaggeration in the use of colors, so the researcher investigated the obstacles and tried to classify them and identify the fundamental causes of these obstacles by looking at previous studies on the subject of research and conducting several questionnaires for faculty members, which resulted in the approval of faculty members That the design and technical obstacles occupy the second place after the obstacles of devices and tools, and finally personal and personal obstacles, and the nature of these obstacles must be examined in front of those concerned with the development of e-learning to overcome and advance it [9].

3. Research Questions

The research problem can be identified in the following main question:

What is the proposed system based on image processing to improve its quality in the production of electronic courses?

4. Research aims

The research seeks to achieve the following objectives:

a. Identify the defects that appear in the digital educational images used in the production of electronic courses.
b. Preparing a list of the most important standards for production of digital educational images
c. Presenting a proposed system based on image educational processing to improve its quality.
d. Measuring the effect of the proposed system in improving the quality of educational images in accordance with image quality standards.

5. Method

Research Methodology is:

a. 1-The analytical descriptive approach represented in the survey of previous Arab and foreign studies related to research variables, analysis and use of them to highlight the research problem, prepare the theoretical framework, analyze the educational digital images used within one of the electronic courses, and extract a set of criteria to determine the efficiency and quality of the images to be stored in a database of the system and study the methods of Digital image processing.
b. 2-Experimental approach in The proposed system is designed and its effect on improving the quality of digital images. The research sample Some digital pictures (20 pictures) from the electronic course "Computer Networks", which is a course that includes a set of digital pictures that can be identified.
c.

6. THEORETICAL FRAM WORK

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6.1 Digital Educational images

Digital images are one of the main components of multimedia; the work isn't completed without it .A photo has its own language . it's rich of thousand of words . The usage of images in curricula is considered to be very important by educators. The visual elements have occupied an important place in the teaching process. In addition to the integration between those visual elements represented in educational images with attached texts. Digital images makes a revolution in the teaching process because of what it can provide of great possibilities, such as flexibility, accessibility and publish ability. It is the image processed by the computer that the computer can (deal – handle) with it after receiving from digital camera or the scanner, then The computer divides the image into thousands of pixels which forms the image, and then processed each point of it individually which provides effective control on the image [10].

6.2 Importance of digital image educational processing

The importance of digital image processing lies in its use in several fields, such as:

- Improving graphic information to facilitate its interpretation and understanding for humans.
- Processing the image data for storage purposes on different media quickly and in minimal size.
- Sending the image from one place to another with the lowest possible bandwidth.
- Automatic perception of the image and its contents without human assistance (help) and image processing to make it suitable for some other applications.

We use digital image processing to change most of the image properties, that include:

- Reduce image noise.
- Increase the clarity of details.
- Adjust and improve the image contrast properties.

6.3 Contrast

Contrast is the amount of difference between the different illumination of the image elements. It's defined as "the ratio between the illumination of the objects and that of the ground on which the objects lie."

As the sensitivity to contrast depends on the spatial distribution of the light and dark areas of the image. It is a processing process that occurs on digital image data in which the data is improved and replaced with new data which makes the image clearer and facilitates the process of interpreting the contents of the image and identifying the targets which cover it more accurately [11].

6.4 Causes of the variance imbalance of contrast:

The intensity of the lighting or the brightness available when taking the image with the camera is one of the most important things that affect the quality of the image. If the user (does not have experience in how to deal with light) he will finally get an image either dark or high-light, that's because of the poor color distribution of the image taken As a result of the lack of appropriate lighting around the image when it was taken [12].

Good contrast is the one in which there are different levels of illumination between each other in a way that make the image clear. Whenever there is sufficient lighting, the image becomes clear, with color contrast and acceptable luster, while bad contrast happens when the difference between the levels of illumination is either a little so that makes the image faded which makes Its features can't be distinguished, this condition is called low contrast, or the difference is great that makes the image very dark or bright on other areas. This condition is called high contrast. In both cases, the image has bad visual appearance which leads to the necessity of handling this problem [13].

6.5 Contrast Enhancement

It is a process that is performed on images to increase the clarity of the desired details (features) of the image. The human visual sensor system has a specific ability to detect and distinguish small variations in the intensity and colors of the elements, so most contrast enhancement techniques work to enlarge the local contrast in intensity and color in the image. It is good that most of these

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techniques depend on parameters that can be controlled experimentally and determined to obtain the best improvement [14].

6.6 E-courses

sees the electronic course as "a course based on the process of integration between educational material and e-learning technology in its design, creation, application and evaluation. the student can study technologically and interactively its content with the help of a faculty member at anytime and anywhere he wants" [15].The main objective is to improve the educational process and the transition to e-learning and to prepare and qualify students for the labor market. Therefore, educational institutions had to ensure that they adhere to the educational needs of students. It helps each learner to proceed with his learning at a standard that suits his ability and level of achievement, also it gives the slow learner more time for learning, and makes the low-achieving learner avoids feeling inferior, in the case of comparing him to another superior; that's Because it is not based on comparing the level of the learner's achievement to the level of another learner.it works to effectively integrate students together in solving their problems and developing their thinking skills [16].

7. The Proposed System

In building this proposed system, the researcher relied on the processing of digital images automatically with a judgment and decision on the importance of improved image from the system, and the extent of the benefit from it or keeping the original image.

Mains Stages of the proposed system

The proposed system consists of five main stages:

1) The first stage: Through which the image is acquired.
2) The second stage: Image pre-processing.
   This stage includes three sub- Steps:
   - Step1: Converting a color image to a gray scale image.
   - Step2: Removing noise from the image.
   - Step3: Histogram Equalization Technique.
3) The third stage: Image quality measurement (SSIM) Structural Similarity Index Measure.
4) The fourth stage: compare the SSIM value between the original image and the improved image.
5) The fifth stage: calculating the PSNR value for the original image and the improved image. Illustrated in figure(1).

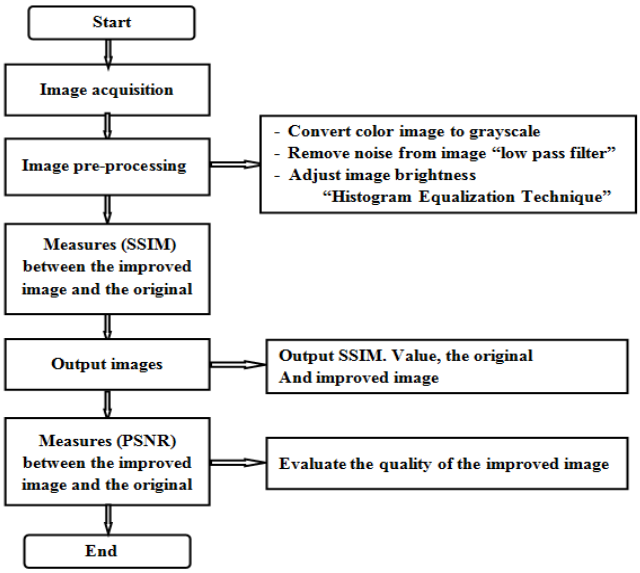

Figure1: Illustrated the algorithm of the proposed system

1) The first stage: Through which the image is acquired

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This stage is of image acquisition, the image is passed to the proposed system through the command imread( ); The system is designed to deal with different types of images ('double', 'single', 'int16', 'uint8', 'uint16'), and put them into a variable to deal with them in the next stages within the system.

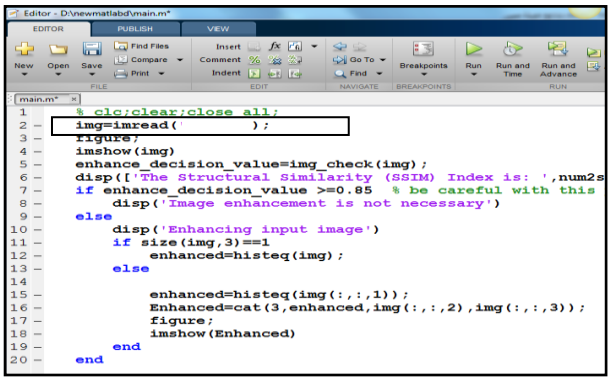

Figure2: The image is acquired

2) The second stage: Image pre-processing.

This stage is considered the stage of image pre-processing, in which extraneous errors resulting on the image from the imaging or transfer process via the Internet are processed and the digital image is returned to the supposed form of it .This stage includes three sub- Steps which are :

- Step1: Converting a color image to a gray scale image.

During this Step if the image is grayscale from the beginning, we move to the second process directly, but if the image is in color, it is converted to a grayscale image for making processing easy.

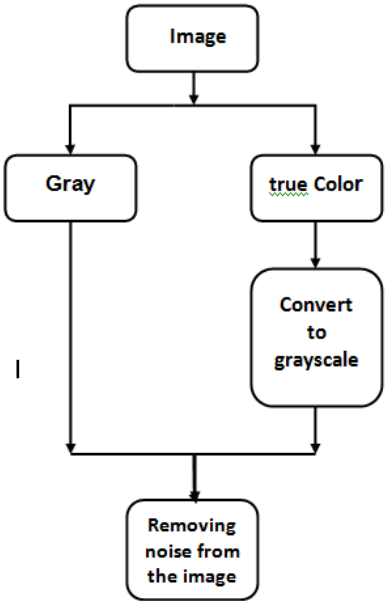

Figure3: Step1 Converting a color image to a gray scale image

- Step2: Removing noise from the image.

In this Step Removing noise from image. Where it is filtered from the interference resulting from the process of filming or transmission via the Internet (low pass filter).

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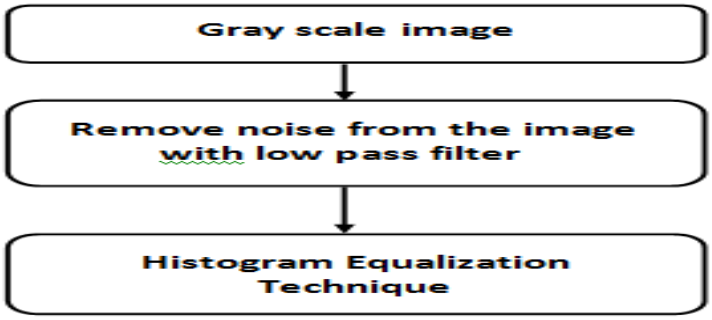

Figure4: Step2 Removing noise from the image.

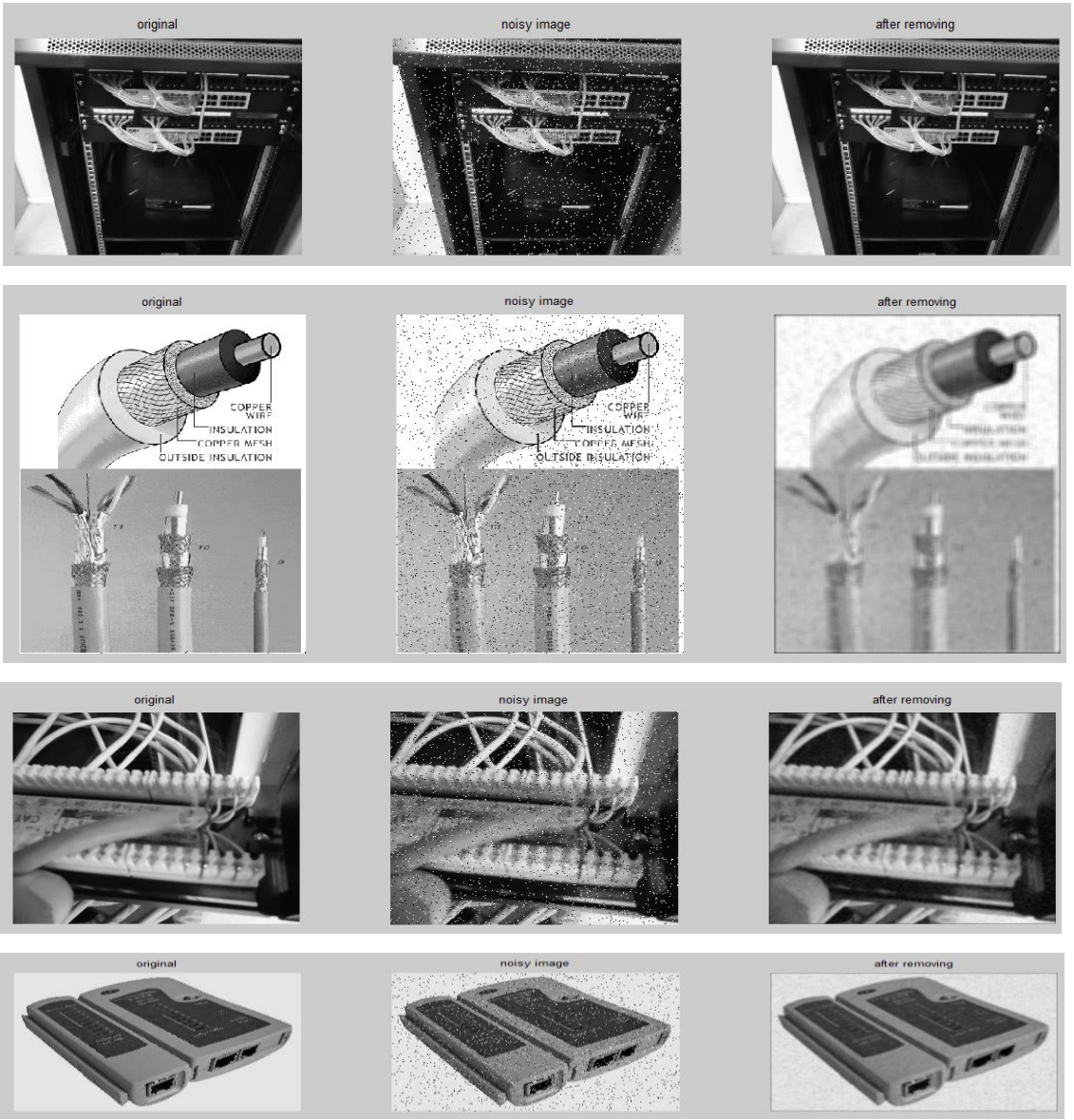

Figure5: Results of Removing noise from the image.

- Step3: Histogram Equalization Technique.

In this Step, the contrast of the image is reset histogram equalization Technique, due to the poor color distribution of the image taken as a result of the lack of appropriate lighting in the vicinity of

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the image while capturing. Good contrast is the one in which there are different levels of illumination between them in a way that makes the picture clear. Whenever there is sufficient lighting, the picture becomes clear and has color contrast and acceptable luster. As for the bad contrast, it arises when the difference between the levels of illumination is either so small that it makes the picture faded colors that cannot be Distinguish its features, and this case is called low contrast, or the difference is so great that it makes areas of the image very dark and other areas are bright. This case is called high contrast. In both types, the image has a visual appearance that is not good, which led to the need to address this problem.

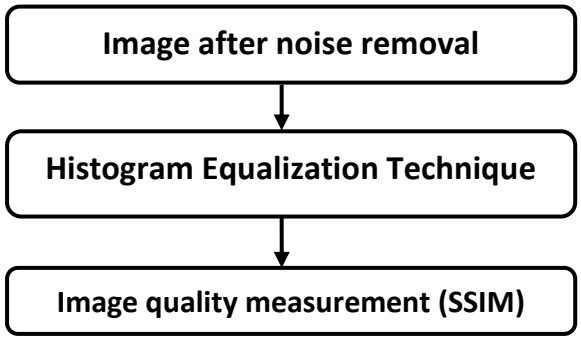
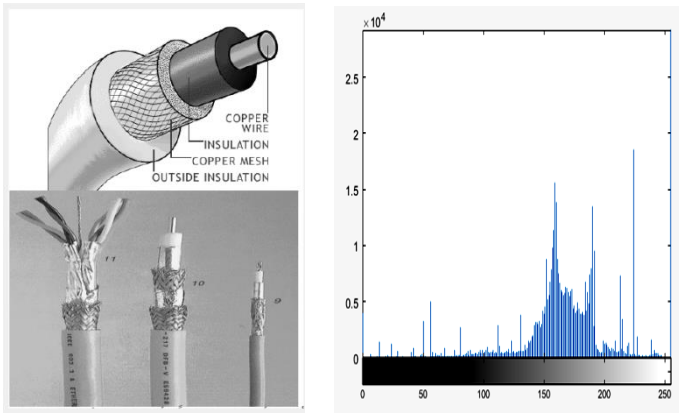


Figure6: Step3 Histogram Equalization Technique.



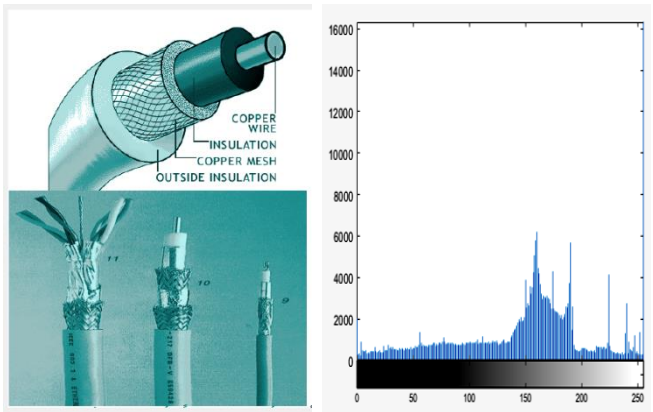


Figure7: Results of Histogram Equalization Technique.

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3) The third stage: Image quality measurement (SSIM) Structural Similarity Index Measure

At this stage, structural similarity is measured Structural Similarity Index Measure (SSIM). It is a full reference image quality assessment index, which measures image similarity from three aspects: brightness, contrast and texture.

$$l(X,Y)=\frac{2\mu_X\mu_Y+C_1}{\mu_X^2+\mu_Y^2+C_1} \qquad c(X,Y)=\frac{2\sigma_X\sigma_Y+C_2}{\sigma_X^2+\sigma_Y^2+C_2} \qquad s(X,Y)=\frac{\sigma_{XY}+C_3}{\sigma_X\sigma_Y+C_3}$$

where ux and uy represent the mean values of images X and Y respectively, σX and σY represent variances of images X and Y, and YXY represents variances of images X and Y, which are

$$\mu_X=\frac{1}{H\times W}\sum_{i=1}^{H}\sum_{j=1}^{W}X(i,j) \qquad \sigma_X^2=\frac{1}{H\times W-1}\sum_{i=1}^{H}\sum_{j=1}^{W}(X(i,j)-\mu_X)^2$$

$$\sigma_{XY}=\frac{1}{H\times W-1}\sum_{i=1}^{H}\sum_{j=1}^{W}((X(i,j)-\mu_x)(Y(i,j)-\mu_y))$$

C1, C2, C3 are constants, to avoid the situation where the denominator is 0, usually take C1 = (K1 * L) ^ 2, C2 = (K2 * L) ^ 2, C3 = C2 / 2, generally K1 = 0.01 , K2 = 0.03, L = 255, then

$$SSIM(X,Y)=l(X,Y)\bullet c(X,Y)\bullet s(X,Y)$$

SSIM value range is [0,1], that value is between zero and one .The closer that value is to the correct one, the less distortion the image is, and the improvement process becomes good, and the image still retains its intrinsic properties after the improvement, and vice versa whenever it approaches zero.

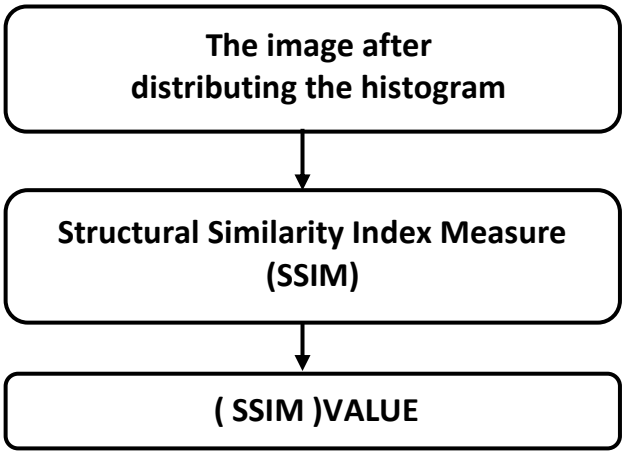

Figure8: Image quality measurement (SSIM) Structural

4) The fourth stage: compare the SSIM value between the original image and the improved image.

At this stage, the SSIM value is compared and a decision is made before the image is output to the screen or no .In the event that the value of (SSIM) is greater than or equal to 0.85%.This means that the improved image and the original image are similar to a large extent in their essential characteristics. and there is no need for the improved image, Accordingly, the following is printed:

First:

- value output (SSIM),Message output: “Image enhancement is not necessary "and Output the original image .

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Second:

In the event that the value of (SSIM) is less than 0.85%.This means that the improved image and the original image are not completely identical in their intrinsic properties, and the improved image must be preserved (taking into account that the closer that value is to the correct one, the improvement process becomes good, and the image still retains its intrinsic properties after optimization and vice versa, the closer it approaches zero); Accordingly The following is printed value output (SSIM), Output a message “Enhancing input image "Output the original image .

- Enhanced output (resulting from optimization operations) inside figure(9).

```
if enhance_decision_value >=0.85
    disp('Image enhancement is not necessary')
else
    disp('Enhancing input image')
    enhanced=histeq(img);
    figure;
    imshow(enhanced)
end
```

Figure9: compare the SSIM value between the original image and the improved image

5) The Fifth stage: calculating the PSNR value for the original image and the improved image.

Calculate the (PSNR) value of the original image and the enhanced image and come up with a resolution to evaluate the quality of the enhanced image. At this stage, the mse is measured, and then the PSNR value of the original image and the improved image resulting from the system is measured, in order to evaluate the results of the system.

whereas :

MSE is the mean square error between the original image and the processed image.

The value MAXI is the maximum value of the image color and is expressed as 255, and is determined by the relationship:

$$MSE = \frac{1}{mn}\sum_{i=0}^{m-1}\sum_{j=0}^{n-1}||I(i,j) - K(i,j)||^2$$

PSNR: is a technical term for the ratio between the maximum value of the measured signal and the amount of noise affecting the signals. Because some signals have a very wide and dynamic range, PSNR is usually measured in decibels (dB) and the higher the value the less distortion, PSNR is generally used to determine the quality of the processed image for example added compression or noise, it is mathematically formulated as:

$$PSNR = 10 \cdot \log_{10}\left(\frac{MAX_I^2}{MSE}\right)$$

8. EXPERIMENTS AND RESULTS

After applying the proposed system to a set of digital educational images for the course of Computer Networks, for fourth year students, department of computer teacher preparation, faculty of specific education, damietta university, according to the previously mentioned stages of the system, the SSIM value and the PSNR value were obtained for the original images and the improved images, and the results were in favor of the proposed system. As in the following tables:

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Table 1: Shows results for the original and improved images with the proposed system

Image. No	PSNR		SSIM Value
	Original Image	Improved Image	
Img_1	5.6577	5.94414	0.532
Img_2	5.77887	6.1993	0.53
Img_3	5.30147	5.84472	0.31
Img_4	5.80723	6.03674	0.638
Img_5	4.7575	5.19205	0.553
Img_6	6.15509	6.12067	0.847
Img_7	6.9262	6.50698	0.811
Img_8	6.04049	6.20286	0.734
Img_9	6.32399	6.38451	0.829
Img_10	6.27568	6.35936	0.831

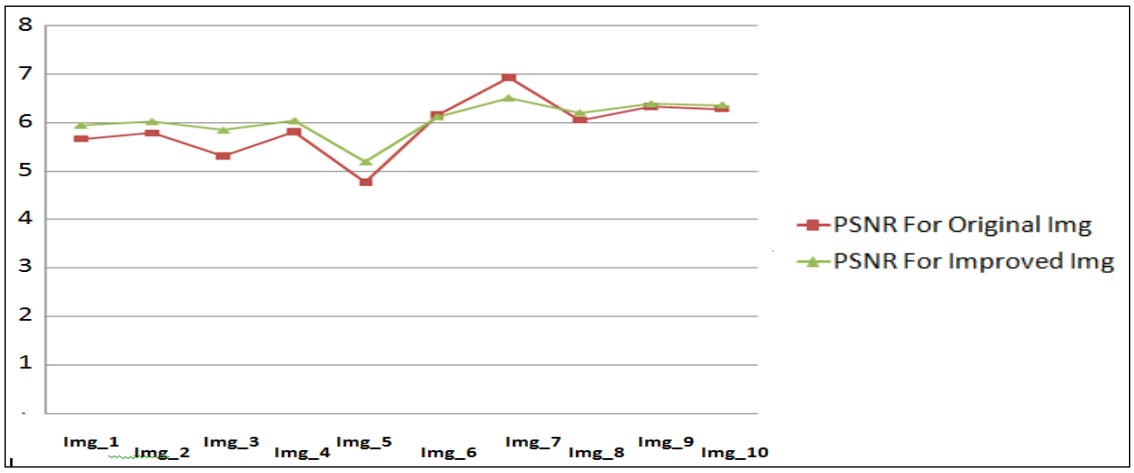

Figure10: PSNR for original image and improved image (Table(1))

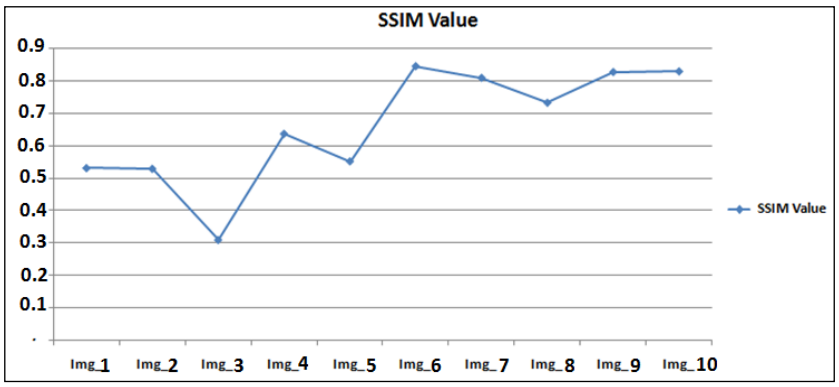

Figure11: SSIM for original image and improved image (Table(1))

Table 2: Shows results for the original and improved images with the proposed system

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Image. No	PSNR		SSIM Value
	Original Image	Improved Image	
Img_11	6.9262	6.50698	0.811
Img_12	4.88303	5.48554	0.337
Img_13	5.43163	5.87391	0.539
Img_14	4.57174	4.76553	0.751
Img_15	5.59019	6.01058	0.632
Img_16	5.38575	5.39743	0.737
Img_17	4.75216	5.06282	0.652
Img_18	5.12242	5.41627	0.532
Img_19	4.86341	5.12679	0.618
Img_20	4.67688	4.91144	0.761

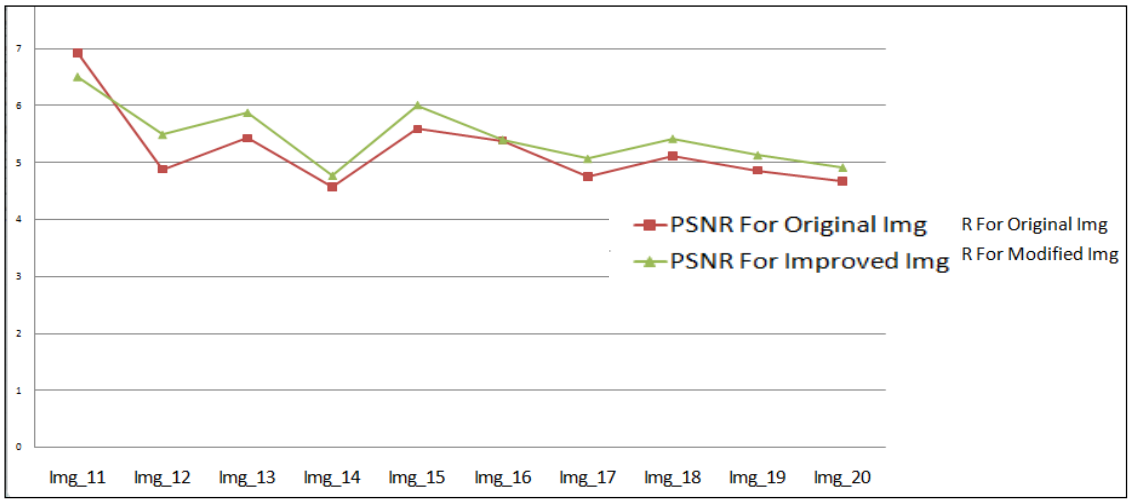

Figure12: PSNR for original image and improved image (Table(2))

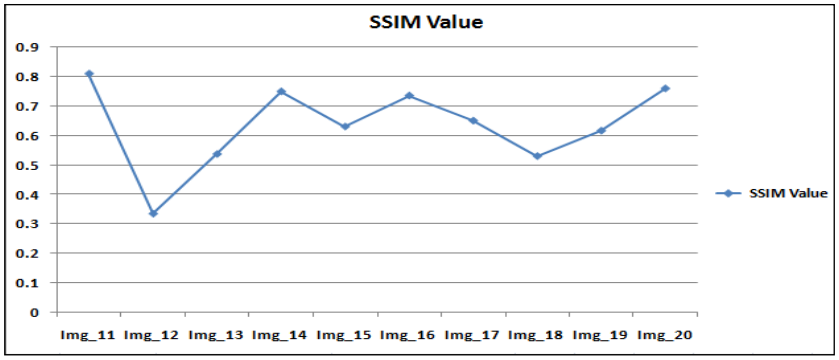

Figure13: SSIM for original image and improved image (Table(2))

Through the previous tables and graph and a comparison of PSNR values between the original and improved images, it is clear that the values of the improved images are higher than the original

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images, and the results are in favor of the proposed system, which shows the extent of its efficiency and quality to improve the contrast of digital educational images, we recommend applying the proposed system within the e-course production centers.

9. Conclusion

The results of this study showed the effectiveness of the system in improving the quality of digital images used in the production of electronic courses, and improving the contrast and lighting ratio by using the iterative curve modification histogram techniques in the Matlab program. Effectively e-courses.

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