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Original Research Paper

Increasing the accuracy of diagnosing biological tissues using digital image processing

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Abstract: In diagnosing diseases, researchers and specialists usually rely on direct viewing with a microscope at a tissue sample to identify good tissue from the patient. Therefore, this paper was concerned with improving the accuracy and illustrate of biological tissue images by relying on a computer program, which is MATLAB, to perform image processing operations for images obtained from the microscope camera to illustrate it in a good way, so that specialists can make the best diagnosis using these results. Since there are many images of tissues that differ in terms of lighting, this paper relied on several illustration processes in two programs. The first focused on using histograms, it was based on a comparison between the original image and the image that was processed by spreading the histogram lighting once, and again with an image that was processed several times to get the best result, in addition to comparison with binary images and grayscale images. The second focused on detecting the edges of the image and using the complementary image. Several types of edge detection were used, the first using the detection function, the second using the Sobel filter, and the third using the Canny filter, through the results of the histogram and visual observation, it was found that the method of distributing histogram lighting is the best in obtaining distinctive results, after that complement of the image.

Keywords: image processing, medical image, biology image, MATLAB, biological tissue.

1.Introduction

Tissues and their uses in medicine have a great impact in diagnosing diseases. They have been used to reduce pain, especially when used to determine the type of disease and other tissue-related matters. Many techniques have been used in diagnosing tissues, including imaging, which has played a major role in the benefit in diagnosing these diseases. Tissue[1]. Since the details that we observe on the tissues under the microscope have a great impact on diagnosing diseases or identifying apparent strange conditions, therefore the tissue is considered the first joint in identifying diseases, and therefore the use of the microscope and the camera attached to the microscope, and consequently the digital images that are linked to the computer, have an impact in identifying many diseases [2,3]. After sacrificing the animal on which the experiment is being conducted, a sample can be taken from the biological tissue of this animal, after dissecting it and taking the appropriate sample by specialists. After that, it is stained to highlight the features that are to be studied, and then it is placed on a slide and placed under a microscope in order to examine it and observe the desired results[4,5]. By noting figure (1), that shows a number of biological tissues taken from the laboratory using a microscope and a camera, whatever their type[2].

It is also used when techniques are linked to the computer that helps in diagnosis through images taken from medical samples, including tissues, examples of which are the convolutional network (CNN), as well as the use of image processing[6].

The use of digital images in various fields has become a necessity. In addition to being easy to use and providing various services to the user, the digital image is a matrix of numbers consisting of rows and columns and containing cells inside them called pixels. These matrices facilitate the calculations to which images are subjected and thus provides the necessary information that the user needs[7]. But we notice in Figure (2), that it is a matrix with an image, which represents each square, which is a pixel that enters as an element of this matrix[8,9,10].

A digital image can be represented by the following equation:

$(x,y)=i(x,y)*r(x,y)$……………………………(1)

$0<(x,y)$, $0<i(x,y)<\infty$,$0<r(x,y)<1$

Were :

(x,y):the representation of 2-D image

i(x,y) : the illumination (the amount of light falling from the light source)

r(x,y):the reflectance (the amount of reflected light) [7].

Figure (3) represents some of the medical images used, which have become essential in modern science and are used to serve medical purposes[11,12].

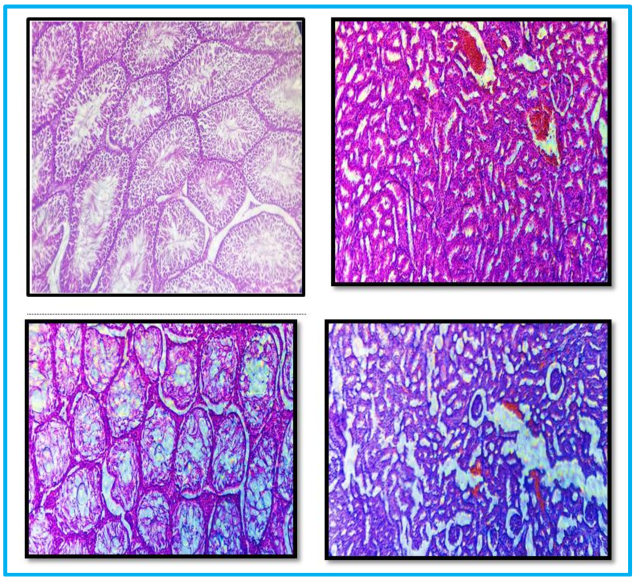


Figure (1): some type of biological tissue[2]

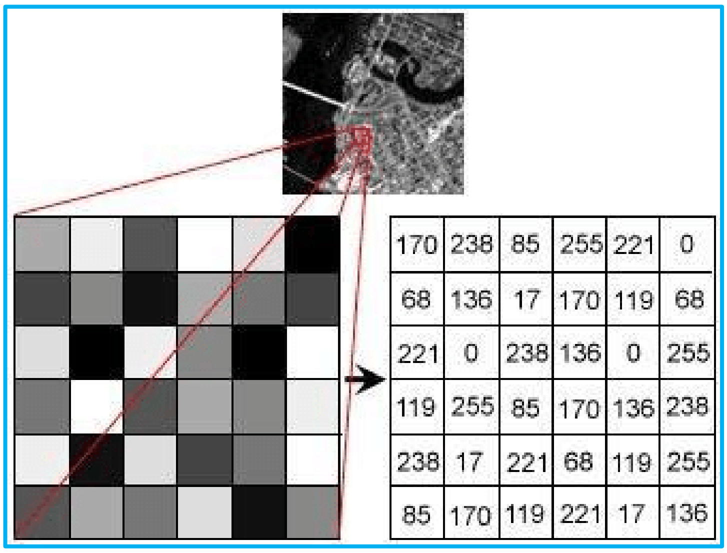


Figure (2): digital image [7]

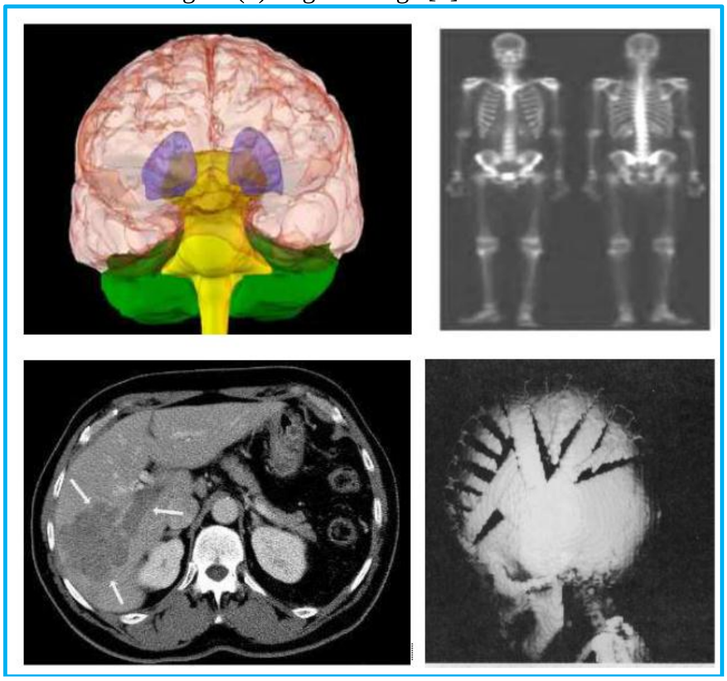


Figure (3): some of medical image [12]

Also, the development of the computer and consequently the computer programs that help specialists and researchers in their work and in all fields. Here in this field can notice that some computer programs such as the MATLAB program and the Dpis program, in addition to the C_{++} program, are among the most widespread programs in this field in terms of providing services to the medical field, and medical imaging[13,14].

The diagnosis of biological diseases depends on viewing the tissue using a microscope, but the development of science has led to the use of modern techniques, including digital images of tissues and taking them from the microscope directly to the computer (whatever type), and then observing or diagnosing through it and using image processing technology, this has led to ease of diagnosis with the help of this type of science.

But the images of tissues taken from the camera attached to the microscope may not be very clear for viewing, or this type of microscope may not be of high resolution, or this type of tissue may require a very, very high-resolution microscope, which is not available, or the problem related to the tissue is not It appears well in the captured photo. Therefore, this paper was concerned with improving the accuracy of the obtained digital image, in several ways, to meet the different needs that are used in diagnosing tissues, whether for the person searching for the disease or for the biologist or student of high studies who needs to discuss the details of these tissues scientifically.

Methods:

There are many types of biological tissues, it is require clarification or illustration of some details in their diagnosis. Considering the different types, several illustration methods have been chosen to benefit from the types of illustration that can be benefited from. The working method includes three steps:

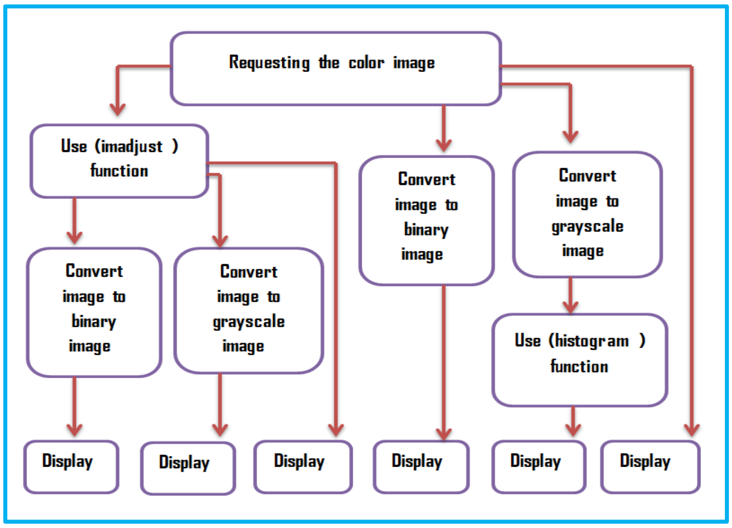
1. Preparing tissues in the laboratory: In this step, work is done using an optical microscope, in addition to the process of preparing biological tissues from living organisms such as a rat, and then these samples are examined using a microscope, as well as using a camera such as a mobile camera in order to take pictures of the samples being examined. First, the animal is sacrificed. After that, tissue sections are taken, and these tissue sections are prepared using known methods to obtain slides containing tissue sections, where stains such as (Hematoxylin and Eosin) are added to the tissue section in order to be able to distinguish these tissues when using a microscope. which are then examined using a microscope. In the final step, a camera, namely the mobile phone camera, was installed on the microscope in order to take pictures, which are then taken to the computer[2].

2. Taking images using a microscope: To take biological images from the microscope use the camera or mobile phone camera, or there are microscopes to which a camera is directly connected, to convert the image from the microscope lens, which is biological tissue, to the digital image and it is transferred to the computer to be dealt with it. Then used special computer programs for image processing[2].

3. Use computer programming to illustrate the obtained image:

In this paper, the MATLAB program is used to process the obtained images, starting with the process of requesting the obtained image and then processing it as follows:

A. Illustrate the image by using the histogram: Several steps are followed, where the color image is requested, then converted into a binary image, after that it is converted into a grayscale image, after which the function (imadjust) is used, and several times are taken to obtain the best result, after which the resulting images are displayed. Figure (4) represents the scheme of the steps that MATLAB follows from requesting the image to reaching into the image that was processed. Figure (5) represents the MATLAB windows on which the program was written. In the figures (8,9,10,11), can see some images that were processed using this program.

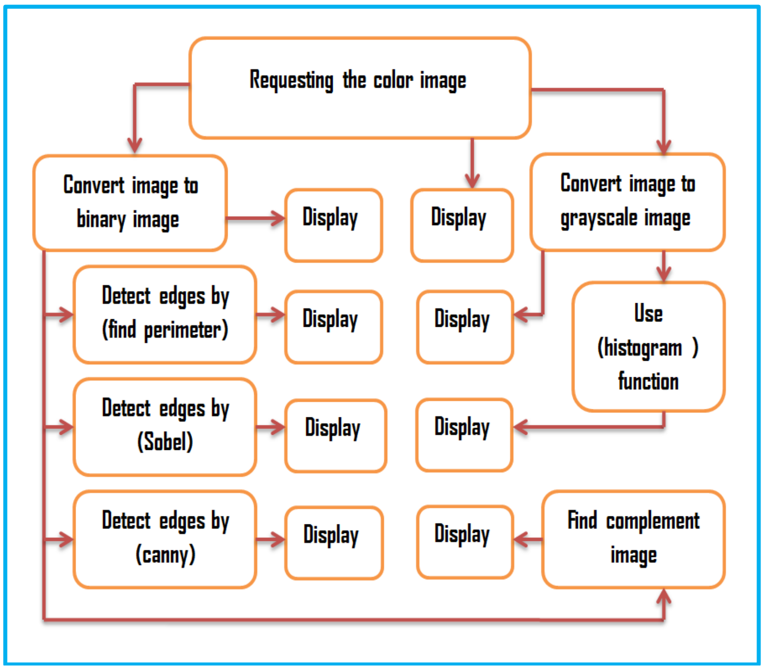


Figure(4): Scheme for MATLAB steps to illustrate the image

```
clc , clear all
I=imread('D:\im.jpg'); imshow(I)
I1=im2bw(I,0.6); figure,imshow(I1)
II1=rgb2gray(I); figure,imhist(II1);
J1=imadjust(I,[.3 .3 .3 ; .7 .7 .7],[]);figure, imshow(J1)
I2=im2bw(J1,0.9); figure,imshow(I2);
J2=imadjust(I,[.5 .4 .5 ; .8 .7 .8],[]);
figure, imshow(J2)
J3=imadjust(I,[.4 .4 .4 ; .8 .8 .8],[]);
I3=im2bw(J3,0.6); figure,imshow(I3)
II2=rgb2gray(J1); figure, imshow(II2),figure,imhist(II2);
J4=imadjust(J3,[.4 .4 .4 ; .8 .8 .8],[]);
I4=im2bw(J4,0.6);
J5=imadjust(J4,[.3 .3 .3 ; .8 .8 .8],[]);figure, imshow(J5)
I5=im2bw(J5,0.6); figure,imshow(I5)
II5=rgb2gray(J5); figure, imshow(II5)
figure,imhist(II5);
```

Figure(5): Programming steps in MATLAB to illustrate the image

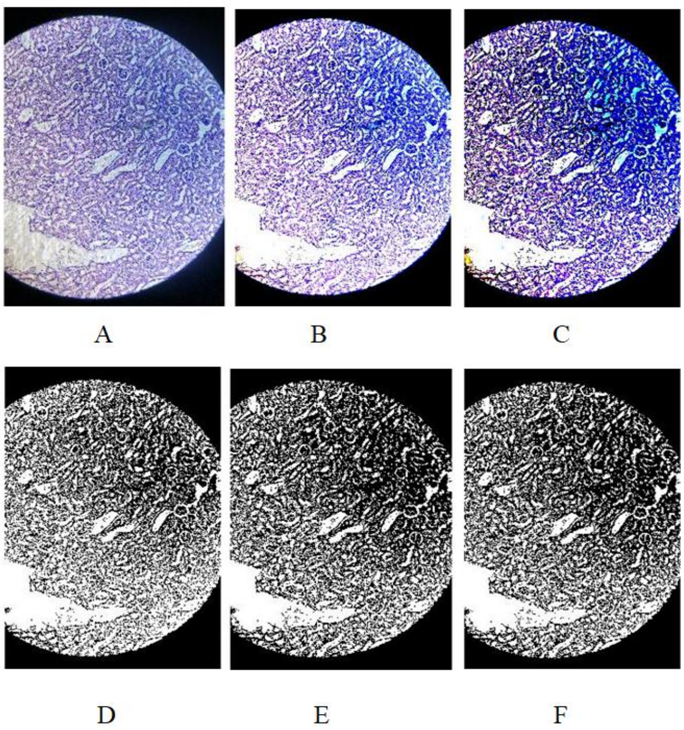
B. Finding edges and complement the image: This is done starting from requesting the image that should be processed, which is then converted into a binary image. After that, extracts the edge of the image, and then extracts the complement image to obtain several images from which it is possible to obtain the information desired to clarify the image. Figure (6) represents the scheme of the steps the MATLAB follows from requesting the image to reaching into the image that was processed. Figure (7) represents the MATLAB windows on which the program was written. In the figures (12,13,14,15), can see some images that were processed using this program.



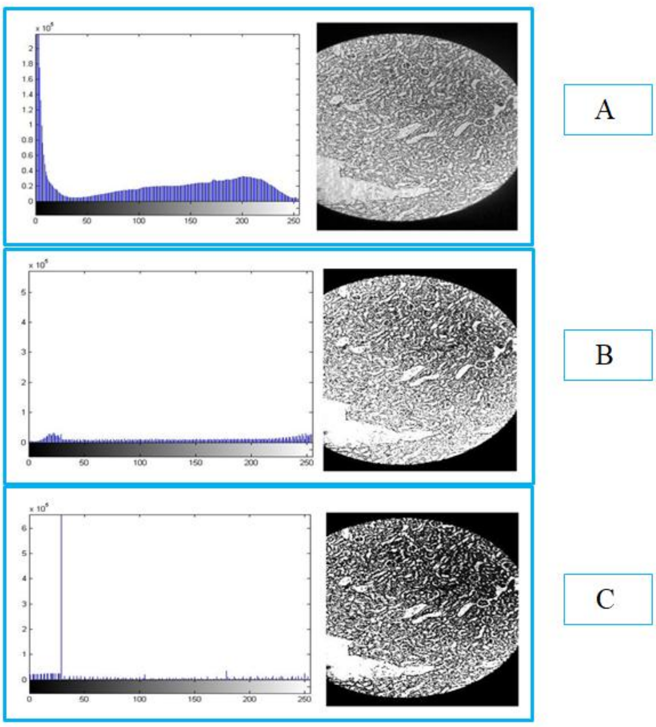
Figure(6): Scheme for MATLAB steps to find edges and complement the image

```
clc, clear all
x=imread('D:\im.jpg');
imshow(x)
I=im2bw(x,0.5);
figure, imshow(I)
my=rgb2gray(x);
figure,imshow(my)
figure,imhist(my)
bw2=bwperim(I,8);
figure, imshow(bw2),
y=imcomplement(I);
figure,imshow(y)
BW1 = edge(I,'sobel');
BW2 = edge(I,'canny');
figure,imshow(BW1)
figure,imshow(BW2)
```

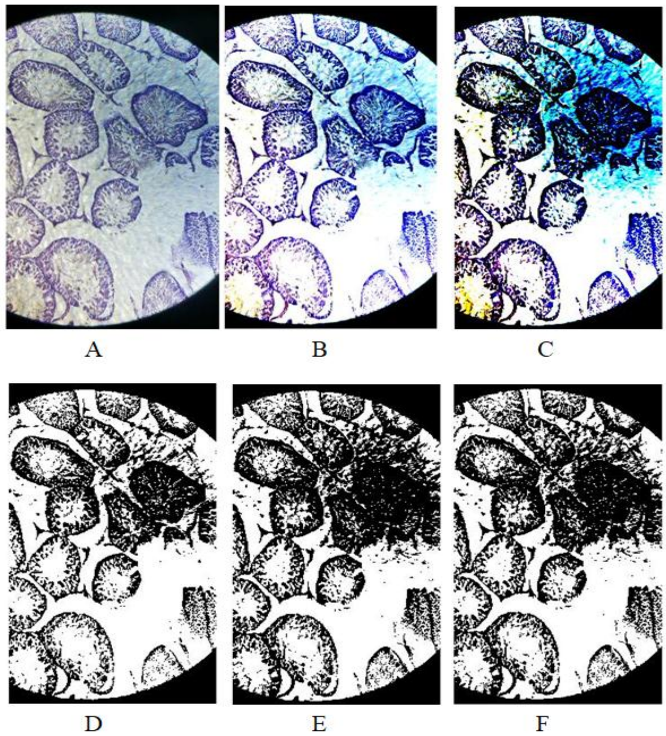
Figure(7): Programming steps in MATLAB to find edges and complement the image



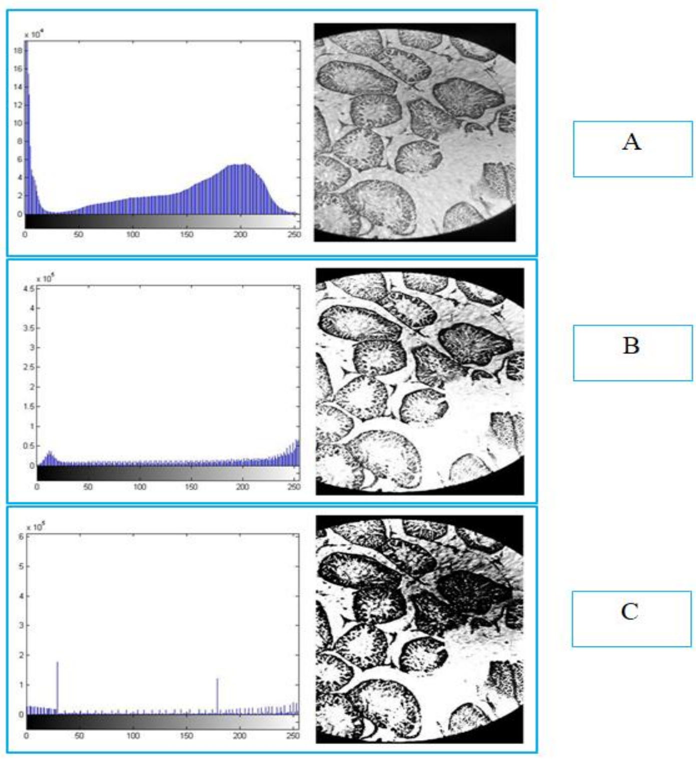
Figure(8): Tissue samples (1), where (A) is the original image, (B) is the first illustration, (C) is the final illustration after several illustrations, (D) is the binary image for (A) figure, (E) is the binary image for (B) figure, (F) is the binary image for (C) figure.



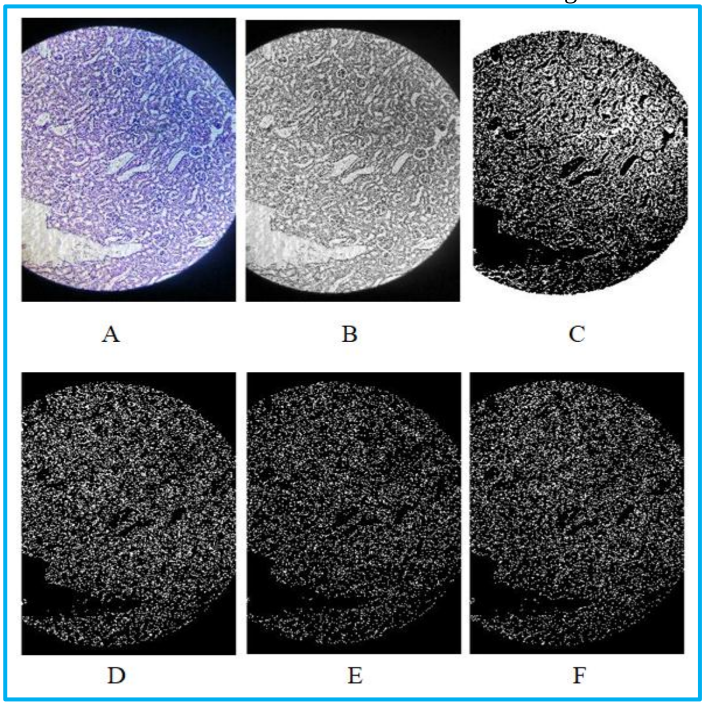
Figure(9): The grayscale images of figure (8), where (A) for original image with its hologram, (B) for first illustration and its hologram, and (C) for final illustration after several illustrations with its hologram.



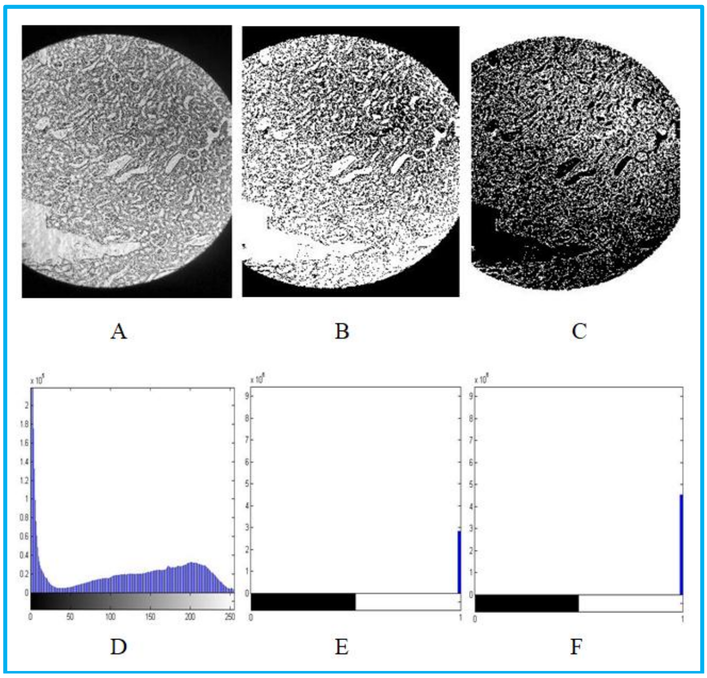
Figure(10): Tissue samples(2), where (A) is the original image, (B) is the first illustration, (C) is the final illustration after several illustrations, (D) is the binary image for (A)figure, (E) is the binary image for (B)figure, (F) is the binary image for (C)figure.



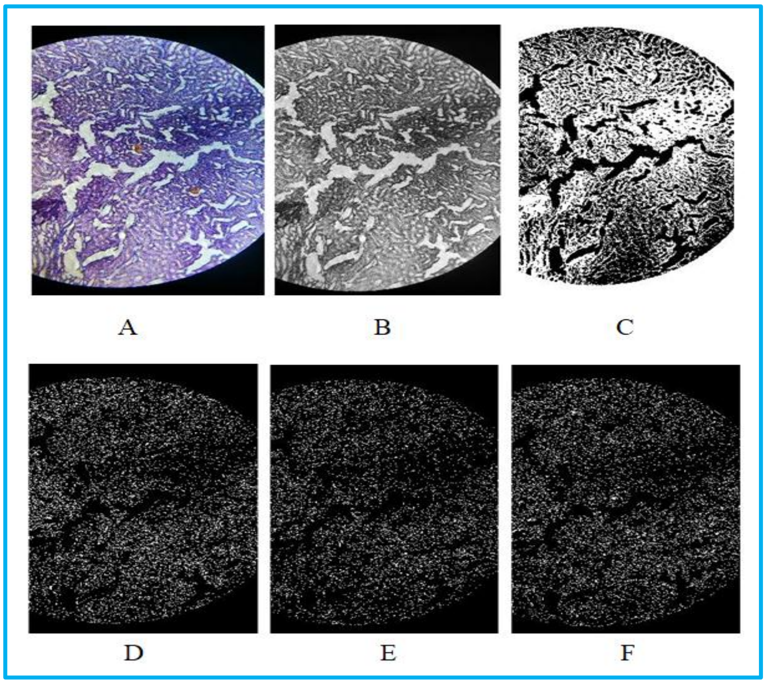
Figure(11): The grayscale images of figure (10), where (A) for original image with its hologram, (B) for first illustration and its hologram, and (C) for final illustration after several illustrations with its hologram.



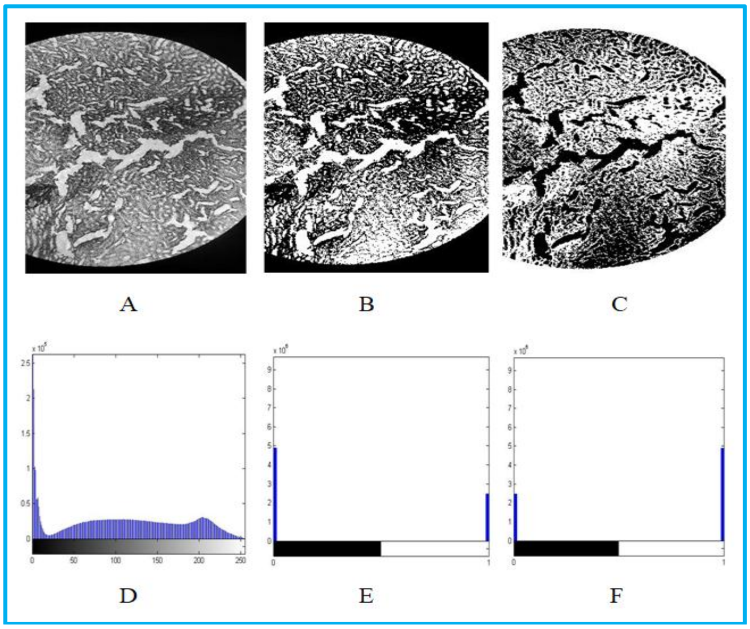
Figure(12): Tissue samples (3), where (A) original image, (B) grayscale image, (C) complement image, (D) find the edges by (find perameter) filter,(E) find the edges by (sobel) filter, and (F) find the edges by (canny) filter.



Figure(13): Same tissue samples (3), where (A) grayscale image, (B) binary image, (C) complement image, (D) hologram to figure (A), (E) hologram to figure (B), (F) hologram to figure (C).



Figure(14): Tissue samples (4), where (A) original image, (B) grayscale image, (C) complement image, (D) find the edges by (find perameter) filter,(E) find the edges by (sobel) filter, and (F) find the edges by (canny) filter.



Figure(15): Same tissue samples (4), where (A) grayscale image, (B) binary image, (C) complement image, (D) hologram to figure (A), (E) hologram to figure (B), (F) hologram to figure (C).

Results and conclusions:

From observing the figures, figure (8) is for tissue sample (1), Part (A) represents the original image that was processed for illustration, Part (B) is for the first illustration of the image, and Part (C) is for the final illustration, which included several times of illustration operations to reach to the final result. As for parts (D, E, and F), they are the binary images for every image above it. Figure (9) is the continuation of figure (8), where it represents grayscale images with hologram shapes for each of the (A) original image, (B) is the first illustration of the image, and (C) is the final illustration of the image. In the same way for figure (10), which is for tissue sample (2), it was done as in the previous figure. The continuation is in figure (11), as in figure (9).

The figure (12), is for sample (3) of tissue, and it represents part (A) the original image, part (B) the grayscale part for it, and part (C), which is complementary to the original image. Part (D) represents edge detection by (find perameter) filter, part (E) the Sobel filter, and Part (F) represents edge detection using the Canny filter. Figure (13) represents the complement of the sample (3), it is composed of part (A), which is the grayscale of the image, part (B) is the binary image, and part (C) is the complement of the original image, while the (D, E, F) parts represent the histogram for each one of them. In the same way, for sample (4), Figure (14) was made, and its continuation is Figure (15).

From observing Figures (8,10), we notice that Part (C) is clearer than the rest of the parts, and this appears clear to the viewer. Through the histogram in Figure (9, 11), we notice an extension of the lighting expansion to the (B) and (C) parts, which are more distributed and therefore the illustrations. We can benefit from Figures (12, 14) in knowing that illustration using the complement of the image, may help with the binary image to reveal some details through illustration of the image. From observing the histogram images of Figures (13 , 15), we will find that the histogram in part (E) is the reciprocal of the histogram of part (F), which indicates that the complement image is a complement even in the histogram.

As a result, the program was successful in the process of illustrating images of biological tissues in a way that serves beneficiaries and researchers in this field, as the images shown were clearly visible.

Ethics

This study was conducted under approval by the medical ethics committee at the University of Kufa (2017). Verbal and written consent was provided by parents and agreement for publication was obtained from both participants and researchers.

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