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Using MATLAB to calculate objects of the digital images for biological tissues

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Abstract
MATLAB is a good program for dealing with complex variables and simplifying them. This comes mainly or especially with images. The MATLAB program, has an accurate analysis of image data. Therefore, the MATLAB program was used to process medical images of tissues to obtain information of objects, to calculate the number of objects present in the tissue image. The research focused on finding the area of all objects in the image, and then comparing it with the arithmetic average of the large and small objects, to obtain an equation from which can directly extract the number of objects through direct image processing. Three groups of images were used in the research. The first group is experimental images manufactured through the Microsoft Word program in order to ensure the accuracy of the program. The second group is images from Google in order to increase the accuracy of verifying the validity of the program. The third group is the normal tissues for tissues (Rats), the fourth group is the abnormal tissues for tissues (Rats). The last two groups are the ones whose tissues were designed by the program to be examined by knowing the number of the object to determine whether the tissue is normal, abnormal, finished or invalid. It was also found that the best equation to give the number of objects required is the equation in which the area of all objects is divided by the ratio between the average area of the objects and the smallest object.
Keywords: *MATLAB program, image processing, tissue diagnosis, medical images.*

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I. INTRODUCTION

Images of tissues are used in laboratories for the purpose of diagnosing several diseases through changes in the shape, structure, or number of cells of the tissue[1]. A tissue is a group of cells similar in form and function, and all organisms (humans, plants, animals) share the presence of tissues in the structure of the organs of their bodies[2].

From figure (1), the normal tissue section of the testicle of the animal (rat), consists of cells. As this picture shows, after using a stain (Hematoxylin and Eosin), the nucleus of each cell was stained in the color of the stain, while the spaces between the cells, which are filled with cytoplasm, remained without stain, with delamination, some edges in the arrangement of tissue clumps. From this shape, we notice that it is a healthy tissue free of defects, but there is a slight overlap between the cells[3].

In the figure (2), it is a tissue section of testicle of an animal (rat), and it also consists of cells that have been stained with the stain (Hematoxylin and Eosin), but the tissue has a problem (defect), which causes a lack of cells in the tissue and its cells are clearly separated[4].

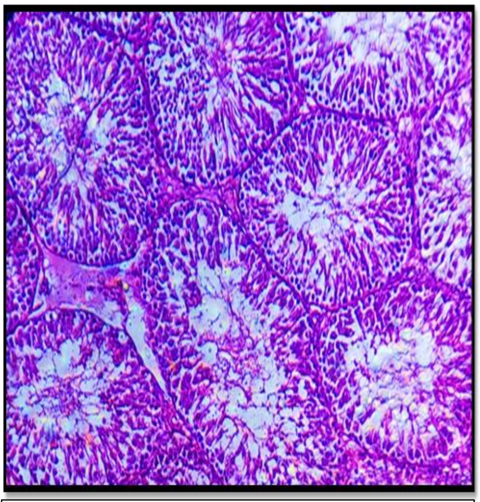

Figure (1): the normal tissue section of the testicle of the animal (rat)

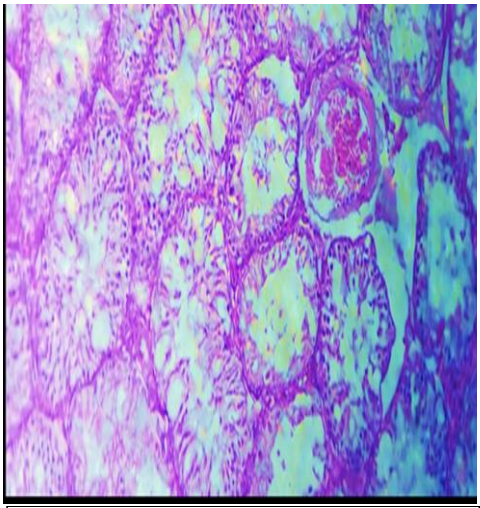

Figure (1): the abnormal tissue section of the testicle of the animal

It is beneficial to use images in many fields in terms of clarifying microscopic matters or obtaining important information about parts of the image. Image processing is one of the modern things that people have benefited from in various research works[5,6].

As the digital image consists of rows and columns to form a digital matrix consisting of cells (pixels), resulting from every intersection between a row and a column, this cell contains a digital value indicating specific information. Figure (3) represents a digital image composed of cells (pixels), and each cell has a specific value that represents the data in that cell[1,7].

10	20	10	20	20	20	10	10	70	50
10	100	200	70	70	70	70	40	70	50
10	70	70	200	200	200	200	40	70	50
10	200	200	200	50	50	50	40	70	30
10	70	60	60	60	60	60	50	70	30
10	70	60	200	200	100	100	50	40	50
20	70	60	60	60	100	100	30	40	50
40	40	40	40	40	40	40	30	40	50

Figure (3): digital image

The MATLAB program is one of the most prominent programs for dealing with and processing digital images, as the researcher can use the MATLAB program to obtain important information about the image, as well as the ability to control parts of the image, such as enlarging, reducing, dividing, compressing, illustrating, and other different uses, that serve scientific research[8].

Figure (4) represents an interface to the MATLAB program used in this research. Figure (5) represents an image that was processed with MATLAB and steps in terms of reducing the image and cutting out part of it. The MATLAB program relies on mathematical relationships between variables in order to achieve the desired effect[9].

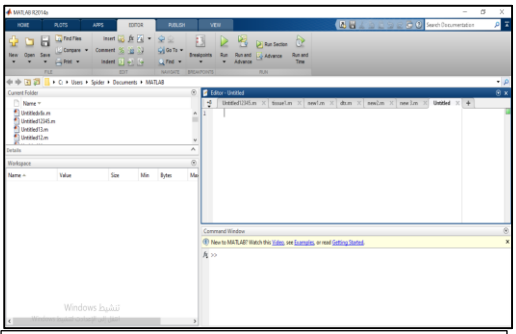

Figure (4): interface to the MATLAB program

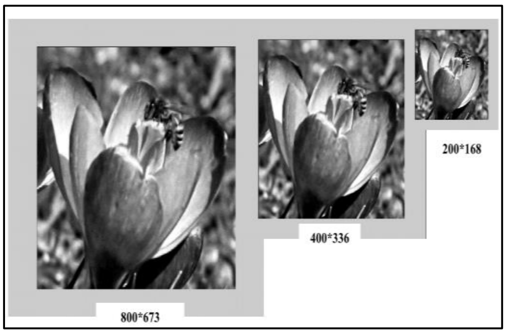

Figure (5): image that was processed with MATLAB

A digital image can be represented by the following equation:

$f(x,y) = i(x,y) * r(x,y)$……………………………(1)

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

Were :

$f(x,y)$: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)

Digital images consist of several types, such as color images, grayscale images, and binary images, in the processing images, sometimes needs to convert from type of digital image to another, such as converting from a color image to a binary image. In that case, there must be a specific threshold intensity in order to the conversion, where the cell number that is greater than the threshold intensity has the number one and below it has the number zero to represent a binary digital image. The symbol τ the value of the threshold, and obtain the following equation[10]:

$0 < \tau < 1$ ……………………………….(2)

$\tau = 0.1$ to the 1.

The arithmetic average is a mathematical function, (Statistical mathematical value) through which one can obtain an approximate result. The arithmetic mean represents the central value of a group of different values, as in the following equation[11].

$x = \frac{1}{n}(\sum_{i=1}^{n} x_i) = \frac{x1+x2+\cdots+xn}{n}$ ……………………………(3)

x : the arithmetic average, n : no. of values

Scientists have used the MATLAB program in many researches. In 2018, David N. Sousa and Hugo A. Ferreira, used the MATLAB to diagnose healthy cells from diseased cells in tissue by uses the way of the diffusion processes[12].

In another research, X-ray images were used by B. Nugraha, with his league, in 2019 in order to identify the diffusion of oxygen in the cells of plant tissues. Uses the information provided by digital images (X-ray images) to identify the pores inside tree cells through multiple tissue sections and using a computer[13].

In 2022, Breti John, carried out the process of studying pathological tissues using direct diagnosis through a microscope after taking a biopsy from the pathological sample[14].

In 2023, Dhamya Kadhim Sarhan and Ali Hassan Abood, carried out the process of diagnosing diseases in the tissues of rat animals using direct diagnosis. To know the effect of one of the obesity medications (Orlistat) on the testicular tissue cells of the male rats[3].

This research aims to identify abnormal tissues by identifying the number the cells of the tissue, as well as identifying the number of cells in the normal tissue by the number of nuclei.

II. METHODS

In this research used following materials :

- The MATLAB program.
- Samples of testicular tissue for traction of the rats.
- A stain (Hematoxylin and Eosin), to highlight the nuclei of cells.
- Microscope with camera.
- Images created for testing from programs such as word and images directly from the Google.

Figure (6), show the steps of the methods of the research

The first part: here need to create clear images for the test, by Microsoft office (Word), and direct images from Google.

The second part: here is made histological sections by dissecting the testes of the rats. After that, added stain (Hematoxylin and Eosin), in order to distinguish between the parts of the histological section, especially the nuclei of the sperm. After that, the tissue was examined under the microscope and photographed with a camera in order to obtain digital images, which were then inserted. These images are sent to the program process it.

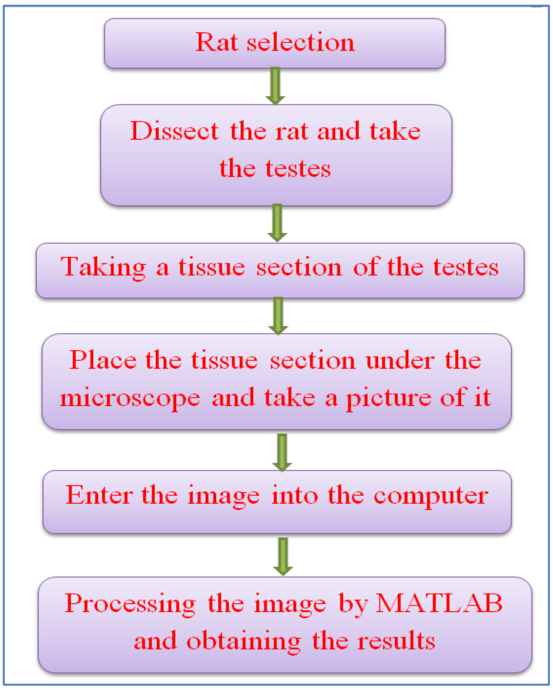

Figure (6): chart the steps of the methods of the research

The third part: included programming the MATLAB to obtain a program through which we can know the preparation of the sperm or objects. Figure (7), show the steps of programing. Figure (8) shows the program.

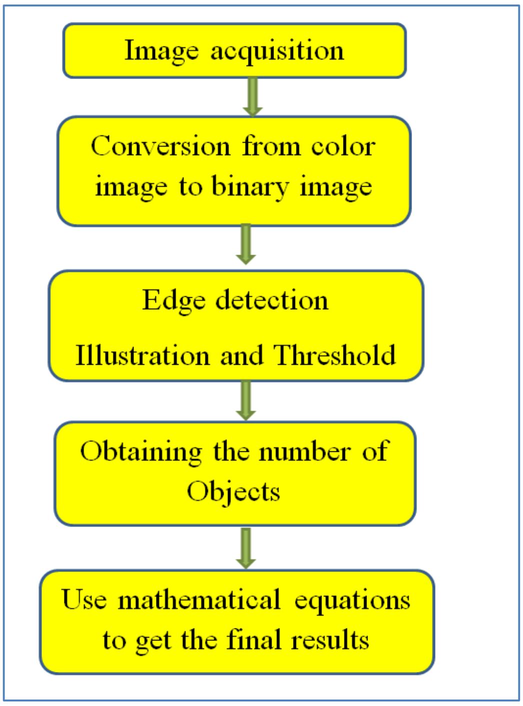

Figure (7): chart the steps of the programing

```
clear all , clc
x=imread('D:\5\111.jpg'); imshow(x);
bbx=im2bw(x,0.44);  %figure,imshow(bbx);
bx=imcomplement(bbx);     %figure,imshow(bx)
x2=imcrop(bx,[400 300 900 600]);  %figure,imshow(x2);
%x2=bx;
bw=imresize(x2,6);              figure,imshow(bw);
[labeled,numObjects]=bwlabel(bw,4);
info=regionprops(labeled,'all');
Areas=cat(2,info.Area)
t=sum(Areas)
tt=min(Areas), tt2=max(Areas)
t1=(tt+tt2)/2; t2=(tt+tt2)/3 ; t3=t/numObjects; t4=(t3+tt)/2
ttt1=t/t1 , ttt2=t/t2 , ttt3=t/t4
```

Figure (8) : the program

III. RESULTS AND DISCUSSION

In the following figures, it is noted that two images were placed in one shot. The first image, which is on the left, is the shape of the tissue or object to be examined. The image on the right is the workspace window in the MATLAB program to identify the obtained measurements.

In this research, the number of cell nuclei was calculated based on the number of objects, the calculation was based on the area of all objects, with the amount of the minimal and maximum area of objects, which was calculated through the two variables (ttt1) and (ttt3).

In the first way (ttt1), the total area of the objects was divided on the average objects area (where the average objects was extracted from the value of the maximal object area and the minimal object area). The second way (ttt3), using the total area of the objects was divided on the average value of the objects area (where the average objects were extracted from the average between the average area of every object and the minimal value of the area of object).

1) First group figures (test figures): consisting of a figures (9,10,11,12), the images were created using the Word program, the purpose of using these images is to verify the values that obtained from the program and which variables are closest to the truth.

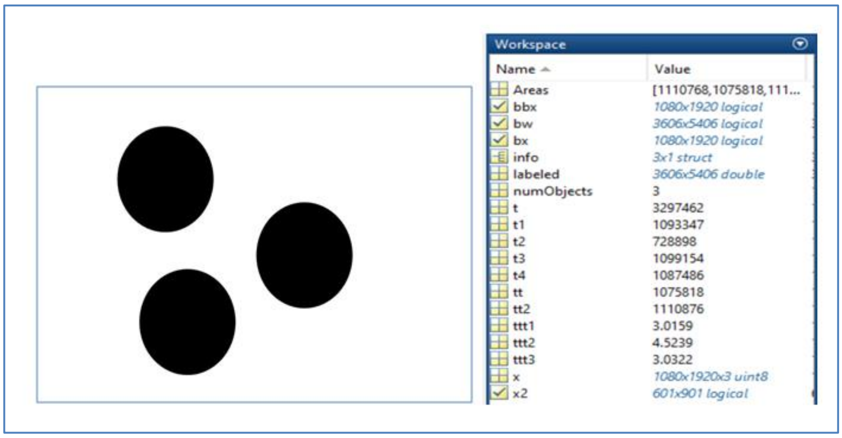

Figure (9): image make by word program (3 circles, 3 objects)

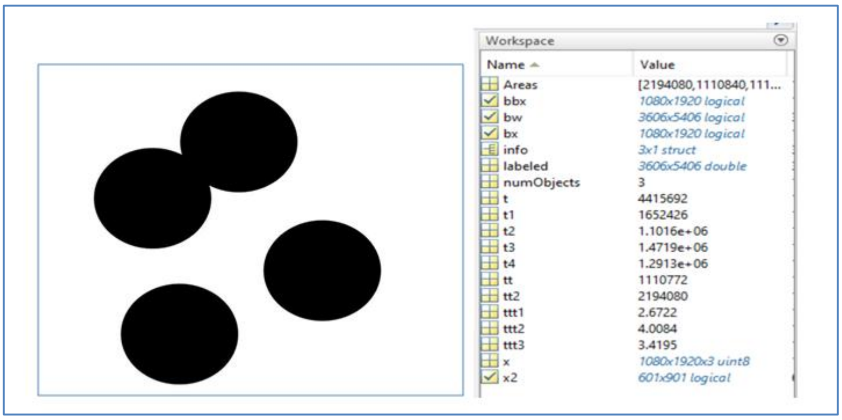

Figure (10): image make by word program (4 circles, 3 objects)

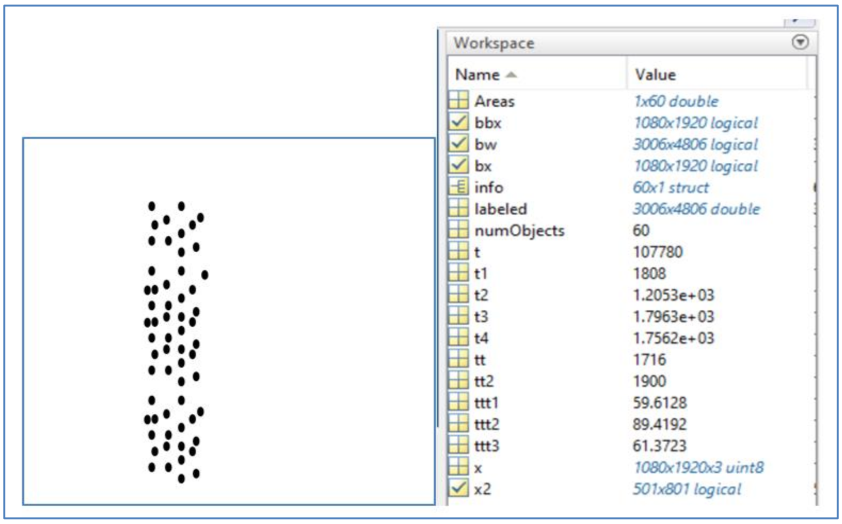

Figure (11): image make by word program (60 circles, 60 objects)

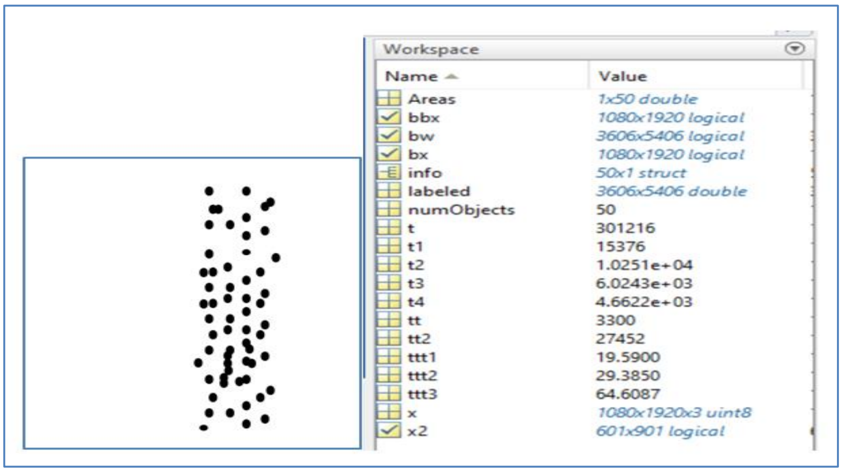

Figure (12): image make by word program (60 circles, 50 objects)

2) Second group figures (test images): consisting of a figures (13,14), the images take by Google image, this group is similar to the first group in terms of purpose.

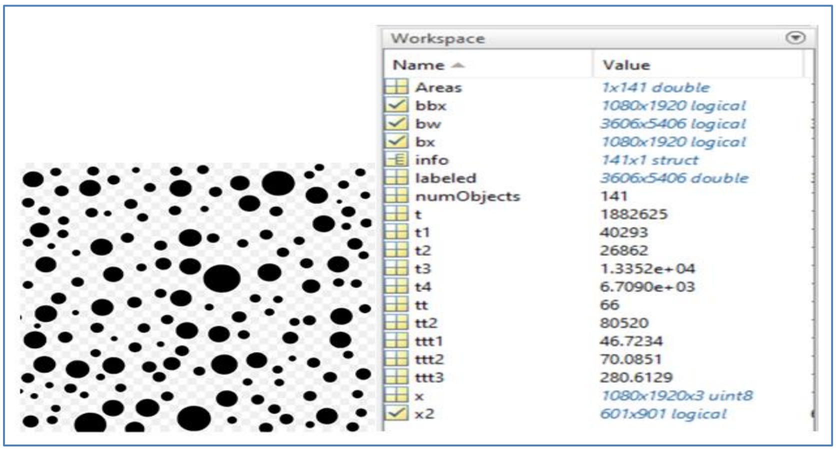

Figure (13): image take from Google (141 circles, 141 objects)

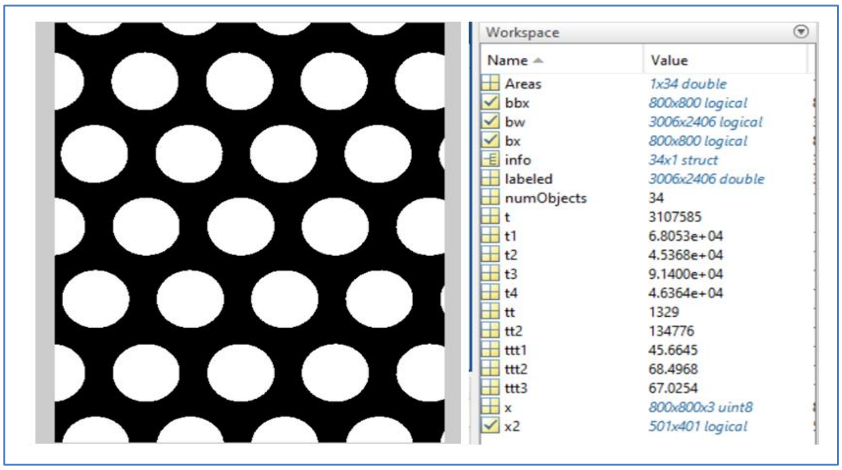

Figure (14): image take from Google (34 circles, 34 objects)

3) Third group figures (normal tissues): figure (15) is for the testicles, figure (16) is for the liver, and figure (17) is for the kidney, they represent normal tissue. These tissues were obtained from rats in the laboratory.

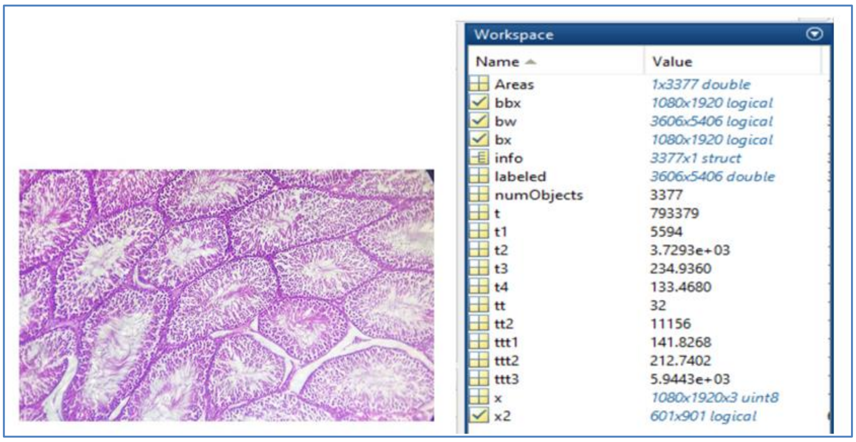

Figure (15) : normal tissues for testicles for Rat

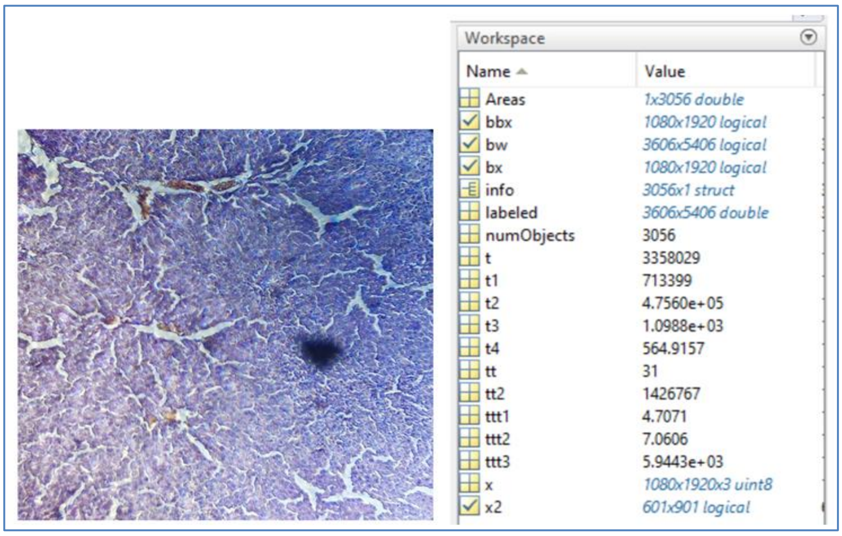

Figure (16) : normal tissues for liver for Rat

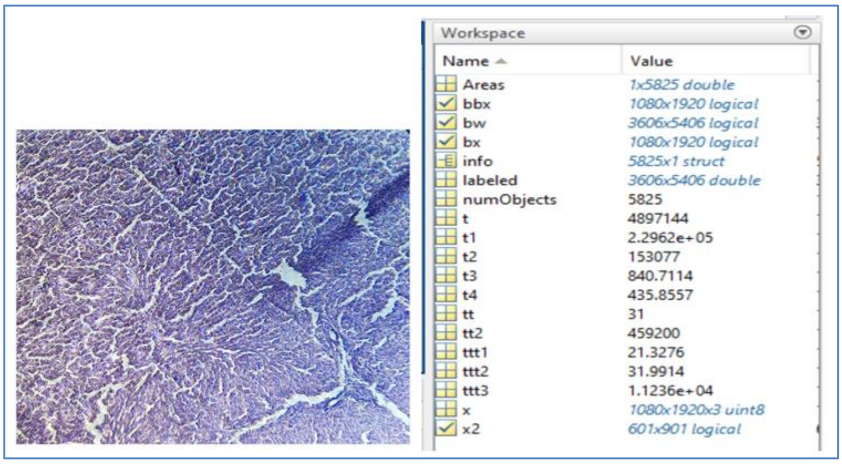

Figure (17) : normal tissues for kidney for Rat

4) Fourth group figures (abnormal tissues): the figures for abnormal tissues for testicles in different reasons, obtained from laboratory. Figures (18) and (19) represent from abnormal tissues for the testicles of a Rat.

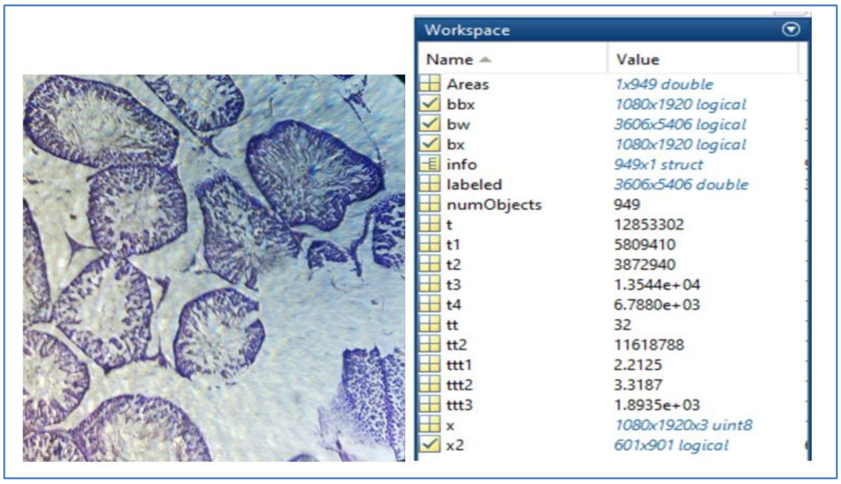

Figure (18) abnormal tissues for testicles for Rat, case one

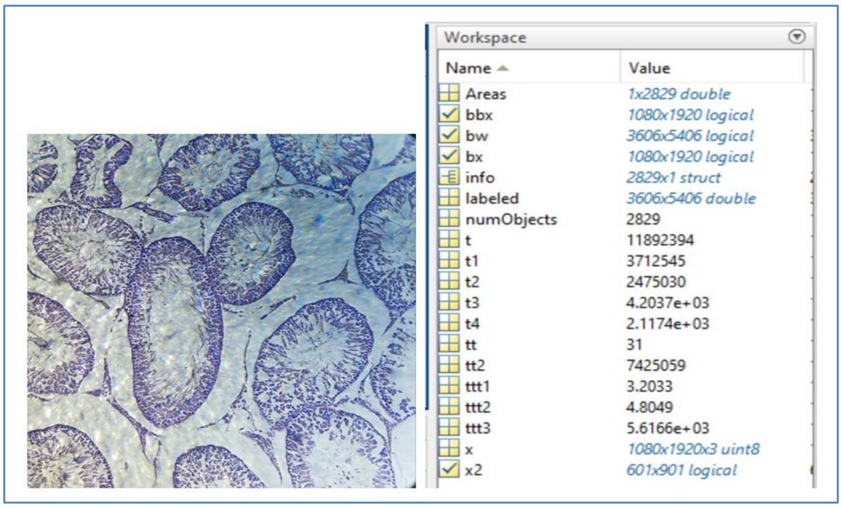

Figure (19) abnormal tissues for testicles for Rat, case two

IV. CONCLUSIONS

By observing the results, can be found that the equation for the variable (ttt3) is closer to reality in terms of the validity or accuracy of the final information, it is more accurate than the equation for the variable (ttt1). The reason is due to the difference between the objects area. Figures (13) and (14) deviate from this rule due to the large difference between the areas of large objects and small ones. This difference does not usually occur in tissues. Figures (11) and (12), were able to illustrate in a large way the accuracy of this program, note that the results were very good in terms of whether the object was separate or combined, that is, composed of several objects.

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