

Ministry of higher Education  
and Scientific Research  
University of Diyala  
College of Science  
Department of Computer  
Science



**Text color enhancement in document**

The project is submitted to the Computer Department at Diyala University as part of the requirements for obtaining a Bachelor's degree in Computer Science

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—►1441

م 2020

**بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ**

يَرْفَعُ اللَّهُ الَّذِينَ آمَنُوا مِنْكُمْ وَالَّذِينَ أُوتُوا الْعِلْمَ دَرَجَاتٍ وَاللَّهُ (بِمَا تَعْمَلُونَ خَبِيرٌ)

## (سورة المجادلة ) (١١)

## الاهداء

إلى النور الذي ينير لي درب النجاح .... أبي  
إلى من علمتني الصمود مهما تبدلت الظروف ..... أمي  
إلى .... أستاذتي  
إلى .... زملائي  
إلى ..... الشموع التي تحترق لتضيء لآخرين  
إلى..... كل من علمني حرفاً  
أهدي هذا البحث المتواضع راجياً من المولى عز وجل أن يجد القبول  
والنجاح

## **كلمة شكر**

لابد لنا ونحن في خطواتنا الاخيرة في حياتنا الجامعية من وقفة نعود أعوام قضيناها في رحاب كلية كلية مع اساتذتنا الكرام الذين قدموا لنا الكثير باذلين بذلك جهودا كبيرة في بناء جيل الغد لتبني الامة من جديد ...

وقبل ان نمضي نقدم اسمى ايات الشكر والامتنان والتقدير والمحبة الى الذين حملوا اقدس رسالتة في الحياة

الى الذين مهدوا لنا طريق العلم والمعرفة ..

الى جميع اساتذتنا الكرام ....

كما اتمنى اتوجه بالشكر الجزيل الى من علمتنا التفاؤل والمضي الى الامام الى من رعانا وحافظت علينا الى من وقفت الى جانبنا عندما ضللنا الطريق مشرف البحث ...

**الدكتور عبد الباسط كاظم**

واخيرا اريد اشكر جميع زملائي ومن اجتمعنا معهم بأجمل سنين من حياتي

## **Abstract**

In this research, a new program for digital image processing (enhancement image) was written using the C Sharp and the different thing in this program from the other available ready-made programs such as filter photo or ACDSee is that the program performs the process of improving the images at once and without user intervention by the user once Click the appropriate key. These are not available in the aforementioned programs, as they require the presence of an expert or professional in the use of brushes, colors, cutting ... etc., and therefore they take a longer time.

Since there are several programs available to improve images, the current research has focused on a problem that already exists and deserves attention and we often come across it, which is the problem of official books and distorted documents, which is the subject of interest in this research. We often notice deformation of some official books or documents due to the fall of something from tea or Pepsi Cola and other drinks or even oil stains or any deformation due to food. Deformation may be caused by messing around with children. These errors are caused by negligence. However, deformation may occur due to a mechanical or technical defect in the printers. We often notice the lack of clarity of the documents printed in the printer laser for lack of ink, or we may get light printing in areas and dark in others. The current research undertakes to address such distortions using the threshold method, and the threshold method has also been used to perform other operations such as changing the background of images or removing or changing some unwanted colors.

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## Chapter one

### 1.1 Introduction

It is no secret to anyone of the importance of image processing in our daily life, as many of us deal daily with devices that process or generate images, so the smartphone devices have the ability to generate images as well as the ability to process those images by a small amount compared to the personal computer and exceed the image processing until it reaches medical applications that may begin with medical images and tumor detection, and does not end with three-dimensional images that are used to simulate surgical giants such as complex heart analyzes, as well as using image processing for security checks in sensitive sites such as airports and military uses in identifying and pursuing targets.

Digital image processing is one of the most important fields of computer science, and it is also one of the exciting scientific fields of our time that is sometimes referred to as the term computer imaging.

The interest in digital photo processing comes from two main areas:

- 1- Improving visual information to facilitate its interpretation and understanding of human beings, and here will be the focus of our research.
- 2- Processing the image data for the purposes of (storing on various media), sending the image from a place

To another with the lowest possible bandwidth, the automatic realization of the image and its contents without human assistance, ..... etc.).

## 1.2 The genesis of digital image processing

Some of the origins of digital processing date back to the early twenties when the digital picture was sent to news of global events for the first time by cable running between New York and London. But digital image processing applications did not become widespread until the mid-sixties when the third generation computers began offering the speed and storage capabilities necessary for the practical implementation of the image processing algorithms. Since that time, this field has witnessed active growth because it has become a subject of research and study related to several fields. The results of these efforts demonstrated the techniques of the importance of image processing techniques in a variety of issues, ranging from recovering and improving images from satellite sensors to processing fingerprints for commercial transactions.

The range of image processing applications has expanded to include various life activities. So it includes, but is not limited to, medicine, space, visual radio, defense, space research, communications ..... etc. Familiarity with the principles of image processing is not only desirable, but a necessity in many cases, because industrial products that rely on image processing invade the whole world.

Visual information that is transmitted as digital image has become a primary method of communication today (i.e. the information age).

Computer imaging can be defined as the process of acquiring (obtaining) and manipulating visual information with a computer.

Digital image processing can be classified into two main categories: computer vision and image processing.

In the field of computer vision applications, the processed and produced images are intended for computer use (processing of image data to be perceived by the computer) and the focus is on the process of extracting extraction information from images appropriately for computer processing. This information often carries little resemblance to the visual properties that are used by Humans explain the content of images. Typical applications in the field of computer vision include automatic alphabet recognition, robots, automated fingerprint processing, machine processing of aerial photographs and in the military field, etc.

The other category is to improve the information formed in the form of pictures for interpretation by humans. The goal of the techniques in this field is

to help people interpret images. And applications in this field require an understanding of how the human visual system works.

The human visual system (HVS) possesses different capabilities and capabilities for the computer, which is considered as a vision system.

Therefore, the subject of computerized digital image processing needs to be aware of the function of these two different systems.

### 1.3 digital photos

Digital image (2) is a digital representation (binary values zero and one) for a physical object that can be seen in the human eye, which is inserted (by digital camera or scanner) into the computer for the purpose of storing, modifying, or storing. It is a two-dimensional image, as in Figure R (1):



Figure. (1)

X represents the horizontal dimension of the width representation.

Y represents the vertical dimension of the height representation.

The image has two types of composition, a type called Vector images, which is not affected by zooming in or out, and it maintains clarity in all cases. As for the second type called bitmap image or raster image, and usually when mentioning digital image digital image, this type is what is intended and is the focus of our study.

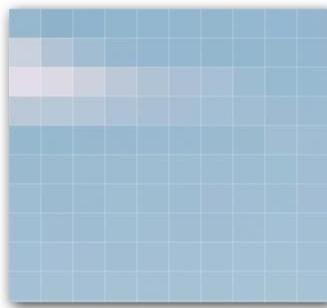
When inserting the Continuous Image into the computer (converting it to a digital image), it has a process called Sampling, which is a small sampling of the real image and its description to represent the real image.

Each square specimen is called a pixel (Pixel = Picture element) and is considered the smallest part of the digital image.

When the image is enlarged, it becomes clear to us that each pixel carries only one color (depending on the type of image, binary, gray or colored), as shown

in Figure 2.

Figure (2)

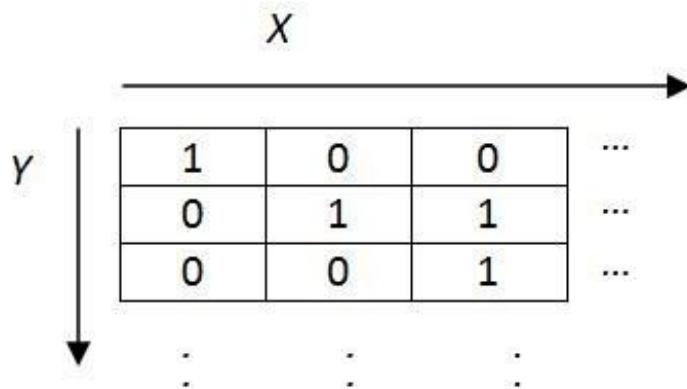


### 1.3.1 Types of digital photos

1- Binary Image: It is the image that contains only white and black colors and each pixel has either zero or one (2).

The image is made up of a number of very small squares known as pixels  
In Binary image, the number of available color values for each pixel is and equals 2, which means that if a pixel has a value of 0, its color is black, and if it holds a value of 1, its color will be white. [2]

Figure No. (3) represents a binary array representing the values for each pixel in the image.



Figure(3)

That is, a binary image is 350 pixels wide and 200 pixels high, and each pixel occupies in memory one bit 1-bit its size is  $350 * 200 * 1$  and equals 70000 bits.

\* For converting from bits to bytes we divide by 8, to convert from bytes to kilobytes divide by 1024, and to convert from kilobytes to megabytes we divide by 1024.

2-Its intensity or numbers are represented by numbers from 0 to 255 where the number 0 represents the bright white color and when the image of grayscale image is gray: it is the image that contains black and white with gray tones 255 the color of this pixel is dark black and when this image is represented on the computer it represents By equal columns and equal rows of pixels, each pixel has 8 bits that determine the intensity from 0 to 255. [2]

Gray-scale image, the number of color values for each pixel is equal to 256, which is the number of grades from white to black starting from the value 0 to 255 - meaning that each pixel is reserved 8 bits (one byte) in memory for storage as in the figure ( 4 ).



figure ( 4 )

Figure No. 5 shows an array representing the gray-scale image. We notice that every possible pixel takes a color value from 0 to 255.

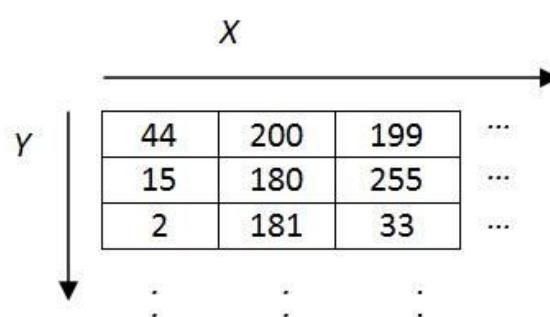


Figure.( 5 )

Note,

the values in the previous figure are written in the decimal number system for convenience, and can be converted to the binary system as the computer deals

with it (example: the number 200 equals 11001000 in the binary system). [2]  
To calculate the size of a gray (8-bit) image with a width of 350 pixels and a height of 200 pixels, we calculate the number of pixels in the image and multiply it by the number of bits of the image  
 $350 * 200 * 8 = 560000$  bits

3-Colored Image: They are digital images that support colors by allocating three cells per pixel to determine the intensity of the three primary colors (red, green, and blue) and each cell contains 8 houses for writing, for example, the intensity of green may be 00100000 meaning that there are 24 houses per pixel, but Some of the images may only have 8 bits and contain 256 colors, as shown in figures (6), (7) and (8).



figures (6)



figures (7)



figures (8)

Colored image, the number of possible color values for each pixel is 16,777,216 colors !!

We have three main colors, which are red, blue, and green. This system is denoted by (RGB) as shown in Figure No. (9)



figures (9)

Each pixel in the color images holds three values, which are a mixture of red, green and blue to represent a new color.

Each color has values from 0 to 255, meaning that the red color has 256 different values (from light to dark) and green and blue have the same thing. When you combine all the possibilities from the three colors, we get 16,777,216 different colors.

In color images, the image is represented in the form of a three-dimensional matrix (two-dimensional and gray-dimensional images), as in Figure No. 10:

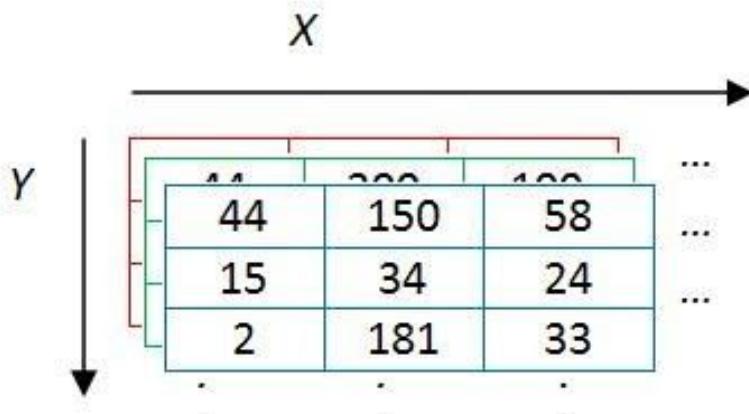


Figure. (10)

Note, the values in the previous figure are written in the decimal system for convenience.

Each pixel is reserved for 24 bits in memory, 8 for red, 8 for green and 8 for blue.

Means to calculate the size of a color image with a width of 350 and a height of 250, we multiply the height in width by the number of bits per pixel. [2]

Image size equals  $350 * 250 * 24 = 2100000$  bits and equals 262500 bytes.

#### 4- Multiscale images

Multiple-spectrum images contain information that is outside the normal human perception range. This type includes infrared, ultraviolet, x-ray, acoustic and radar data. And these are not pictures in the true sense, not a form of their information that cannot be perceived by man. Nevertheless, this information can be represented in a visual form by converting different spectral bands into RGB vehicles. If there are more than three packets of information in the multiple-spectrum images, they reduce the dimensions using a specific transformation process. The sources for these images are satellite broadcasting systems, deepwater sensing systems, radars, infrared image systems, and medical imaging systems.

There are several formats for saving on the computer, including JPEG, GIF, PNG, BMP, and many others. These formats provide different compression

methods for images that may contradict the previous calculations, in addition to providing additional capabilities for the images.

Among the applications of digital image processing:

\*Medical Applications

Where image processing has been widely used in the medical field, in particular to diagnose diseases, especially cancerous tumors and brain problems that need to be identified and treated.

\* Astronomy applications

Astrophysical images are usually captured using electronic detectors such as CCD (Dual Charge) where the captured images are processed to detect various telescopes.

\*Biology applications

These applications include the use of camera-based hardware systems or color scanners for image input. Software packages developed for biology include.

\*Meteorology applications

These applications include research into weather and climate phenomena. Includes meteorological-related image-processing applications geared to gain a detailed understanding of severe weather events.

\*Agricultural applications

In agriculture, remote sensing (RS) technology has been widely used in various applications. [2] Remote sensing was the science of determining the properties of the Earth's surface and estimating geo-geophysical properties using electromagnetic radiation.

\*Entertainment applications

In a way digital image processing is used especially in entertainment programs such as personal photo capture and processing programs, for example, Photoshop.

\*Military Applications

In the current digital age, digital image processing systems are an excellent tool for operational commanders. Use of GIS applications in the defense force, etc.

## **Chapter two**

### **digital image enhancement**

#### **2.1 image enhancement**

It is a processing process that takes place on the digital image data, in which the data is improved and replaced with new data in which the image becomes clearer, which facilitates the process of interpreting the contents of the image and identifying the objectives that cover it more accurately. This process includes techniques aimed at increasing the visual differences between the features in the image. These techniques include radiative image enhancement with contrast extension techniques, spatial image optimization using filtering techniques, and image spectral improvement using digital image data conversion techniques.

Image optimization techniques are used to make the image properties clearly defined for presentation and analysis. The main goal of optimization techniques is to process a specific image, so that the result is more appropriate than the original image for a specific application.

The digital image is denoted by a two-dimensional matrix  $f(x, y)$ , and often consists of small square pieces called image elements (points) (Pixels), the locations of these elements in the matrix correspond to the locations of the original image points represented by space coordinates  $(x, y)$  while values These elements are proportional to the light intensity value at these points, and the digital image can be mathematically represented by the following formula (Lee, 1990):

$$f(x,y)=r(x,y). i(x,y)$$

whereas

$f(x, y)$  represents the on-site digital image element  $(x, y)$

$r(x, y)$  represents the reflectivity from the location  $(x, y)$ ,  $1 \leq r(x, y) \leq 0$ .

$i(x, y)$  represents the intensity of the incident light

The monochromatic image is represented by one function ((one dimension) 1 bits / pixel), which contains information of brightness only, and it is defined as a function of the intensity of the light that reaches the sensor (optical system). The images refer to unicolor and include information of brightness or

brightness, that is, they do not contain gradations, and the value of each element in the image determines the gray gradient that ranges between (0-255) or (1-0) in the standard case, and each of its elements It is represented by (8bits / pixel), and often it is represented by (12bits / pixel) or (16 bits / pixel) such as medical imaging, as well as color images represented by (24bits / pixel) are called pictures with true colors and the number of colors in them is equal to (2<sup>24</sup>) = 16,777,216 colors. The point color in this image consists of a mixture of the three main RGB colors, and each color is represented by 1byte or 8bits byte, and one point is represented by three bytes. The primary colors are red, green and blue, using (8bit / pixel) in each color package, and accordingly the color image is represented by (24bit / pixel) (Compbell, 1996).

The use of colors to display and improve the digital image is an important concept in the treatment of the digital image with multiple spectrum ranges so that the image analyzer can derive more information from it when looking at it for interpretation and classification, that the human eye is limited in the ability to distinguish grayscale but has a high ability to distinguish colors , That all systems used to display digital images use the system of adding complex colors using the three primary colors (red, green, and blue).

One of the techniques of improving the image to facilitate its reading and interpretation is to make certain numerical numbers represent specific colors, and thus the contrast increases for certain values of the numerical numbers with respect to the image units around it. The entire image can be converted from black and white into a color image, and the color image in natural colors in which the colors represent the digital numbers in the spectrum field that gives these colors their reality (so that the blue bodies appear in blue, green bodies in green and red bodies in red in the picture) the figure shows Next is a picture in the natural colors of a satellite, and the objects that reflect the red spectrum from the visible spectrum in red are shown in the picture as the person sees them in reality, and the same applies to the bodies that reflect the green and blue spectrum, which appear respectively in the image in green and blue, and as a result the image becomes A closer representation of the reality of the Earth's surface as a person sees it in reality !!!

As for the technique of false (false) colors depends on setting colors for numerical numbers that differ from what they represent in reality from a spectral reflection from the surface of the earth as seen by man, one of the advantages of this technique is that it helps in focusing on certain earth phenomena during the process of interpreting the image, by highlighting these phenomena in The picture is more visible in colors, for example, the satellite image in the following figure has been improved so that the red color

represents the infrared reflected from the vegetation, so the most vivid reddish plants appear so it is easy to classify them with the naked eye.

As we mentioned earlier, improving the image to facilitate its interpretation can be done by increasing the gray hue, which is what we expressed by extending the contrast, or by converting the gray hue to the color representation, whether the colors are natural or unnatural, and a detailed description of this process follows.

In this digital processing, the gray hue of the image (white and black) is converted to a hue of colors consisting of the primary colors (red, blue, green) and is called the color model. The color model is a method for defining colors in relation to a three-dimensional coordinate system or a space that contains all the colors that can be formed within the model, that any color can be determined using the color model represented by one point inside the space defined by this color. There are a number of color representation systems or color models used.

Each model is directed to either a specific system (such as the red-green-blue color model) or to an application in digital image processing (such as the model: color - saturation - HSI brightness).

There are many algorithms to optimize images according to the desired purpose. An important purpose is to clear the image from noise, which is caused by several reasons, such as the camera sensor or during the transfer and storage of the image. The image is also improved by reducing or removing blur from the image. An important issue before image processing is to correct and redistribute colors and lighting, and this is done in several ways as needed, such as distributing color tones evenly or increasing or reducing contrast and brightness.



## 2.2 How is the process of improving the digital image?

That the gray gradient of the digital image represented by the numerical numbers starts from the number 0 represents the black color in the visual image, and the gradient continues with increasing rays and thus increasing the digital number until we reach the maximum rays represented by the number 255 expressing the bright white color in the visual image. In practical terms, the numerical numbers that represent the image units are confined to a certain range within this gradient. The more numerical numbers are confined to a narrow range of this gradient, the more visible the features will appear in the resulting visual image, with very close colors, making it difficult to distinguish them from each other. If these numerical numbers are confined to a portion of the gradient close to zero, the picture is generally dark, and if confined to the

large numbers close to the number 255, the features of the image appear white in general, and the contrast between them becomes weak. The following table shows data for a part of a digital image consisting of 38,000 image units represented by numerical numbers ranging from 25 to 100 only

## 2.3 Image optimization techniques

It is the techniques that are used to determine the strictures or boundaries in the image to highlight the characteristics, characteristics and analysis of the image

These techniques are used in multiple applications using the so-called feedback from inputs to outputs to give optimization models tested by nature after development.

One of the applications of reverse feed or methods to improve the image. The method of adjusting and improving using the gray level is also called adjusting the gray level through operations that apply to the point using functions and changing these points using the matching equation, which is somewhat linear and non-linear equations and adjusted by linear models and conform to the original model of the level Gray, i.e. its value with other assigned values

These applications include so-called contrast enhancement and so-called feature enhancements.

Depending on the initial operations that apply to the gray levels, or that the previous two processes (contrast - properties) reduce or be enlarged to the gray levels, here are the simplest types that take linear equations and apply this process so that we compress the gray level or pressure the gray level if the range is greater than one We consider it an expansion

## 2.4 Arithmetic / Logic Operations

Also through it, the contrast of an image is improved, and it includes the implementation of the four arithmetic operations (addition, subtraction, multiplication, division) by the pixels of the digital image. This process can be divided into two parts:

1. Numerical operations: It is the implementation of the four operations (addition, subtraction, multiplication, division) for each (pixel) with a fixed numerical value. The input to this method is a digital image with a fixed value and its output is an image. For example, to add the value  $a$  to the image  $f$ , it is calculated as follows:

$$\text{Result\_image}(x, y) = (f)(x, y) = f(x, y) + a$$

These operations are useful for carrying out some improvement resulting from image shifting or standardization. The following figure shows an example of improving the brightness of an image using operations.



Before treatment



After treatment

### 2- Image-Image Operations

The input to this method is a digital image with another digital image and its output is an image. For example, suppose there are two images  $f, g$ , then each image process of an image (addition, subtraction, multiplication, division) is performed between each two pixels in the same location, meaning that the addition, for example, in Figure No. (11) is calculated as follows:

$$\text{Result\_image}(x, y) = (f+g)(x, y) = f(x, y) + g(x, y)$$



Figure (11)

As for logical operations, they include performing operations (and, Nand, or, Nor, not) on the pixels of the digital image, as follows:

### 1- Logical AND / NAND

The logical operations AND and NAND have the following fact tables:

A	B	Q
0	0	0
0	1	0
1	0	0
1	1	1

**AND**

A	B	Q
0	0	1
0	1	1
1	0	1
1	1	0

**NAND**

As we have seen, the AND output values are the opposite of the NAND output values.

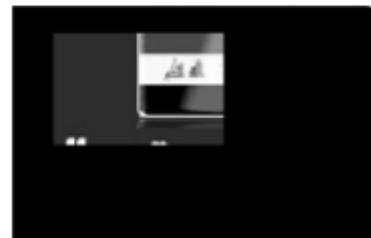
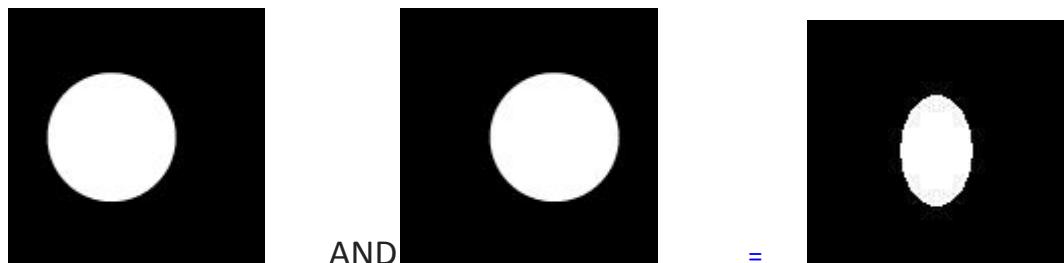
The AND operation (similarly to the NAND process) has an input that is two images and produces a representative output with a picture with a value of each pixel resulting from the value of each pixel from the first image And (or NAND) the value of the corresponding pixel from the second image. Or as calculations ... can It takes a single income image with a fixed fixed logical value.

- It is important that all of the input pixel values are stored with the same number of bits, otherwise unexpected problems may occur.
- When the values of the pixels of the input images are not simple (takes more than 1 bit) it is normal (but not always) that the AND operation is done between all the corresponding bits individually. For example, to work the AND between the pixel value is 47 and another value is 255, the result of the process is pixels with a value 47 as follows:

$$0010111 \text{ AND } 11111111 = 00101111$$

The most obvious application of the AND operation is to calculate the intersection of two pictures. This is illustrated by an example

Let us have the following two images



## 2-Logical OR / NOR

Truth tables for them:

A	B	Q
0	0	0
0	1	1
1	0	1
1	1	1

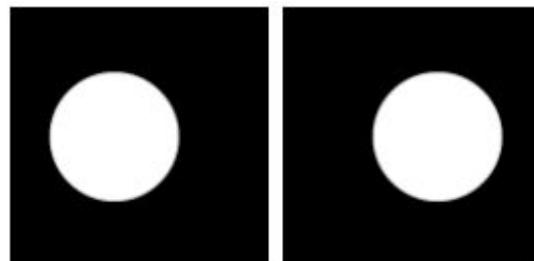
**OR**

A	B	Q
0	0	1
0	1	0
1	0	0
1	1	0

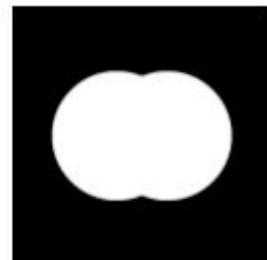
**NOR**

All logical operations are performed in a similar manner mentioned in the AND process.

Example: The OR operation is applied to the following two images:



تعطى الصورة النتيجة التالية :



### 3-Invert / Logical NOT

Her truth schedule is

A	Q
0	1
1	0

**NOT**

The logical negation process takes as an input that has a Binary Image or GrayLevel and produces an inverted or inverted image. That is, the dark areas in the form of income will become luminous and the bright areas .will turn dark

This is done by applying the relationship

$$Q(i, j) = 255 - P(i, j)$$

For example:

We have the following picture:



After applying the negation process, it will be as follows



### Improve your photos using a histogram

The histogram equation is a method for image processing to adjust contrast using the image graph, as shown in Figure 12.

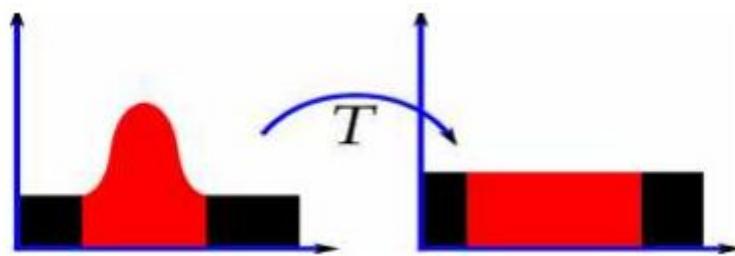
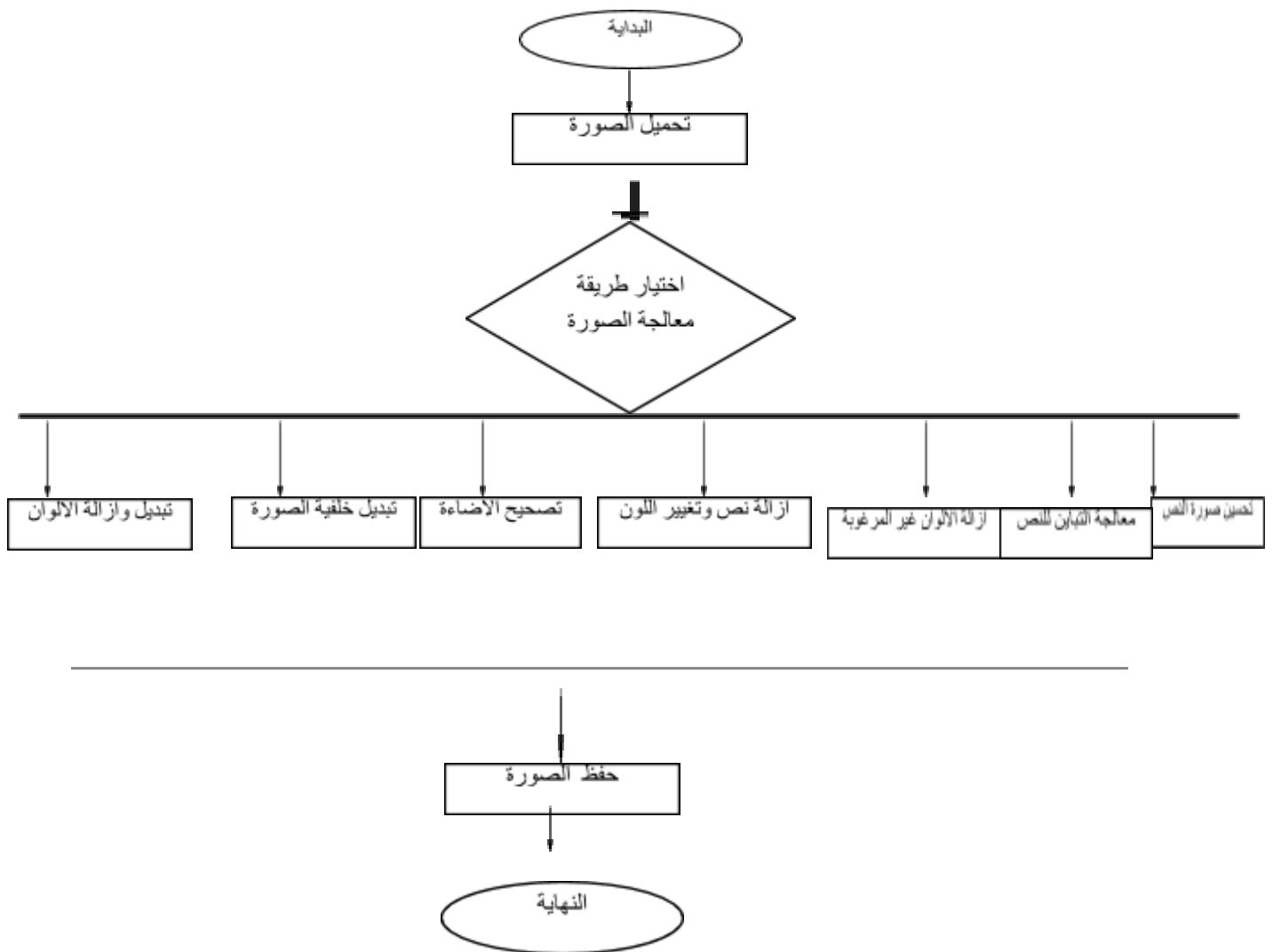


Figure (12)

Image optimization is the process of adjusting digital images so that the results are more suitable for presentation or for further image analysis. The image can be improved with the histogram equation. Histogram formula is a technique for adjusting the intensity of an image to enhance contrast. This method usually increases the general contrast of many images, especially when the usable data in the image is represented by close contrast values. With this adjustment, the intensity can be better distributed on the graph. This allows areas with less local contrast to obtain higher contrast. Achieve histogram parity accomplishes this by effectively posting the most frequent density values. This finds applications in science and engineering.

## Chapter three



## مخطط الجزء العملي

## **Introduction**

The subject of digital image processing is one of the topics that received wide attention and great progress as it diversified and expanded its applications, it is now considered one of the most important and most important computer applications for its use in various fields, it was not limited to the treatment of ordinary (personal photographing or other) images, but went beyond that to image processing Various fields of science, such as: medical image processing, film and image production, remote sensing in addition to monitoring applications. Perhaps the most important in the medical field, the detection or prediction of cancerous diseases in cells, where it became possible to diagnose the affected cells through a computer or to detect a type of disease from a radiogram. Of all this came the attention to digital image processing. Despite the importance and modernity of these areas, I chose another area that may seem traditional in its subject, but it is important in its application, as it cares about a problem that exists in our daily life and is important and it is a problem of documents or official books distorted as a result of neglect, such as the fall of something from a drink or food or because of a related technical defect Printing or photocopying, as processing it with ready-made programs requires a great effort from people who are experienced in this field.

## **Processing image digital**

The importance of digital image processing lies in several areas: (3.2)

- 1- Improving pictorial information to facilitate its interpretation and understanding of human beings.
- 2- Processing image data for storing on different media quickly and with less volume.
- 3- Send the image from one place to another with the lowest possible bandwidth
- 4- Automatic realization of the image and its contents without human assistance.
- 5- Image processing to make it suitable for some applications.

## **Image Digital**

It consists of a limited number of elements, each with a specific location and value. These elements are called elements picture, elements image, or. pixels It is known that the image plays an important role in the acquisition of information by humans. However, human perception of the image is limited to those images that are in the visible range of the electromagnetic spectrum. Otherwise, we find that the cameras can cover the entire electromagnetic spectrum, from gamma rays to radio waves. Examples include ultrasound images, computer generated images, electron microscopy, etc. (10)

Mathematically, any image can be defined as a function with two dimensional function two  $(x, y)$  where  $x, y$  are the point coordinates and  $(d)$  is the "gray level" or the intensity at that point. And digital images are obtained from digital imaging devices or by scanner where the values of  $x, y$ , and  $d$  are all belong to a set of specific quantities discrete values and then they are easily processed by the digital computer, and this field is called "digital image processing" and it is possible to divide operations Which is performed on digital images using the computer to three levels (6,7):

1- Low-level operations concerned with image processing at the pixel level, which includes removing distortion, improving contrast, increasing image sharpness or denoising and detecting edges. These operations can be described as those processes that have an image input and output image.

2- Medium level operations that use the information extracted from the low level. Which includes dividing the image into areas or elements and then describing these elements to reduce them to a valid representation for computer processing. It also includes the processes of identifying specific elements of the image. Medium-level operations can be described as operations whose input is an image and the output is properties and attributes extracted from this image, for example the frameworks of the elements and the identity of those elements.

3- High-level operations which extract useful information from the previous two levels, which are processing applications such as line recognition, for example. The process of understanding or "sense making" a group of the

elements that have been identified. At the top of the operations of this level comes the processes of learning and acquiring knowledge associated with the vision of the computer.

## **Enhancement Image Digital:**

The process of improving the images is the process pre where we may need to make an improvement to the digital image for the purpose of preparing it for another upcoming process such as the compression process and the improvement process may be the processing post when it is performed on the images that result from operations such as the result of improving the images after the decompression process to remove Noise or smoothing. There are several ways to improve images (6):

### **1- histogram: histogram:**

One of the steps to improve images or color correction is to use the histogram, where the image is first previewed and determined what it is required to accomplish. The histogram represents the number of times a specific color value is repeated in the image. . As follows: (8.1)

$$\text{Hist.of pixel (n)} = (\text{numb. Of pixels of value } n) / \text{total numb. of pixels}$$

The histogram is used in the following cases:

- 1- For a better image scan
- 2- Determine the amount of increase or decrease of brightness or brightness
- 3- Determine the contrast in the contract image
- 4- Detect and correct problems in color channels separately

5- The histogram tells us if there is enough information to improve the image

The most famous ways to improve lighting are done using a histogram, and it is considered one of the important Processing-Pre operations in various image processing applications, including, but not limited to: static image processing: where lighting may be when taking a bad image, features do not appear well (9) .

Figure (13) shows the histogram for each color channel (B, G, R) as well as the amount of luminance calculated from the average information in the three color channels.

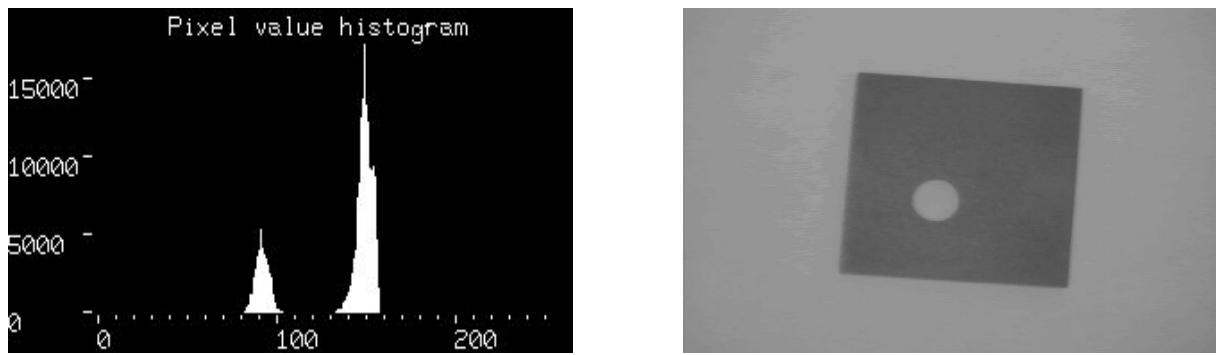


Figure (13)

## 2- Arithmetic operations

It includes the implementation of the four arithmetic operations (addition, subtraction, multiplication, division) by the points of the digital image. This process can be divided into two parts (4):

1 .Numerical operations: It is the implementation of the four operations (addition, subtraction, multiplication, division) for each value of a screen point (pixel) with a fixed numerical value. Inputs for this method are digital image with fixed value and output is image. For example, to add the value a to image f, it is calculated as follows:

$$\text{Result\_image } (x, y) = (f) (x, y) = f(x, y) + a$$

These operations are useful for carrying out some optimization caused by image displacement or measurement. Figure 14shows an example of improving the brightness of an image using numerical operations.



Figure 14

## 3- Image Operations Image-Image:

The input of this method is a digital image with another digital image and its output is an image. For example, suppose that there are two images g, f, having the same resolution. Then each image operation of an image (addition, subtraction, multiplication, division) is executed between each two pixels in the same location, i.e. that the combination, for example, is calculated as follows:

$$\text{Result\_image } (x, y) = (f + g) (x, y) = f (x, y) + g (x, y)$$

One of the important applications in the use of peace processes is the so-called Blending Alpha, which is to insert an image into another with transparent control and calculated as follows:

$$\text{Alpha } (f, g) = a * f (x, y) + (1-a) * g (x, y)$$

By changing the value of constant  $a$ , we get more interference. Figure 15 shows an example of using peaceful methods to add two images using the value of  $a = 5.0$ .



Figure 15

### 3- Threshold

Threshold is the simplest way to divide the image by segmentation image. Every pixel screen point in grayscale images, for example, grayscale will be considered as an actual point when its value is greater than the value of the default threshold (for example, to search for an object, object, or any part of the image that is more bright or bright From the background). The point of the screen that meets the conditions is the thing that we are looking for. Conversely, the point is the background, that is, when the value of the point (pixel) is smaller than the default value of the threshold. In theory, the value (1) of the object or object points and the value (0) of the background of the image are determined. Multiple values (several thresholds) can be used for several areas of the image, and this is called adaptive threshold (3,6).

The main factor lies in how to choose the value of the threshold, there are several different ways to choose the threshold, the simplest and easiest of these methods is the choice of average calculation or median value mean and the fundamental reason behind this is that if the shape points in the image were more lit than the rest of the image background It is also more luminous than average or mean. In images that do not contain image noiseless noise with uniform background and object, the mean will work well and in general it is not the ideal method (9).

The most advanced method is to find the histogram for pixel intensities, from which the valley point is used as a threshold. However, it cannot clearly define the valley point of many of the images. In the ideal case, we are looking for a simple way to choose a threshold that does not require much prior knowledge of the image and works well for images with noisy images.

The good method is method iterative, and it is as follows:

- 1- The value of the initial threshold is tested randomly or in any other way.
- 2 - As previously shown, the image is divided into the background and object points in the image (two groups) are formed:

Group1 =  $\{f(m, n): f(m, n) > T\}$  (object pixel)

Group2 =  $\{f(m, n): f(m, n) \leq T\}$  (background pixels)

Note: ( $f(m, n)$  is the value of the pixel point in column  $m$  and row  $n$ )

- 3- The arithmetic mean for each group is as follows:

Mean1 = average value of Group1

Mean2 = average value of Group2

- 4- The value of the new threshold is calculated from the rate of  $m_1$  and  $m_2$

$$T = (m_1 + m_2) / 2$$

- 5 - Refer to step (2) and repeat the process using the new threshold value obtained from step (4), until the value of the new threshold corresponds to the value before it or in other words convergence the two values converge.

## Practical

The threshold method was used with mathematical operations to perform an image optimization process. The images were first previewed to determine what is needed and thus the necessary operations were determined for that. Image data were reviewed to determine the threshold value or the range of values needed to implement what is required with the greatest possible accuracy. The process becomes more complicated when dealing with text images or with color images, and in general there is a high correlation high between pixels (especially in normal images, whether regular images or color images), and it means that there is a relationship between adjacent points in the image and therefore it is possible Knowing the value of the next point from

the point that precedes it, for example, where it is often an approximation of it in the value or the amount of intensity, except for the edge areas. This causes complicated questions to determine the value of the threshold or determine the appropriate calculations accurately. We may need more than one threshold or more than a math or a mixture thereof, for one purpose.

## Results and Discussion

In the program for this research, several tests were performed to treat images such as changing or removing image or background colors, treating poor distribution of brightness, and removing distortions due to an error or defect.

### 1- Changing and removing colors:

Figure (16) shows an example of changing and removing colors, image a represents the original image, and images d, c, b are the results after processing.



Figure (16)

### Switch background image:

Figure 17 shows an example of switching the background of the image, image a represents the original image, and the images d, c, b are the resulting images after processing.



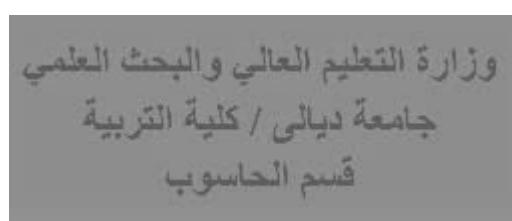
Figure 17

The image processing operations in the previous examples may seem traditional that can be provided by the image processing programs available, but I would like to mention that the current program does not require user intervention or any professionalism, all that the program requires is the download of the image to be processed.

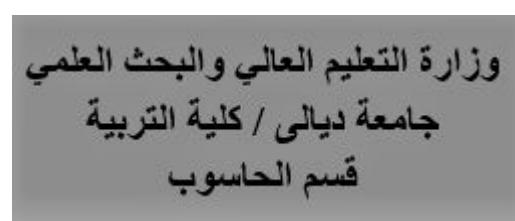
### 3- Lighting Correction:

One of the problems that deserves attention in the treatment of digital images is the problem of irregular lighting or brightness in the image, and Figure (a-18) and (b-18) illustrates an example of irregular lighting in all parts of the image, while Figure (c-18) is a picture High brightness.

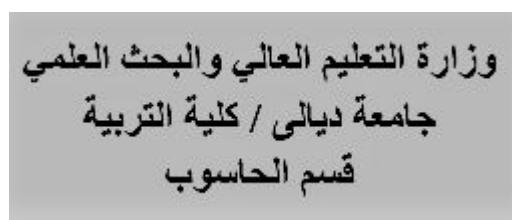
It is clear that such images cannot improve the lighting in them using mathematical operations only. Threshold threshold has been used for this purpose successfully. Figure (d-18) shows the previous pictures after treatment.



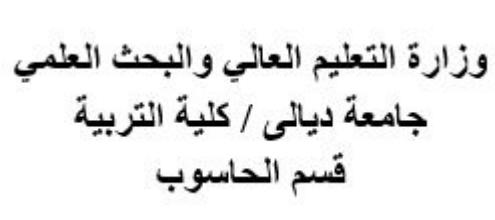
a-Before treatment



b-Before treatment



c-Before treatment



d-after treatment

figure (18)

#### 4- Remove text and change color:

Figure (19) shows an image of a text that has been processed to switch the color of the text or hide it. Figure A shows two-color text. The upper part is red and the bottom part is blue. After removing the red color, the shape D represents the full text after making it in one color which is blue.



Figure (19)

#### 5- Removing unwanted colors:

Figure (20) shows an example of removing unwanted colors that distort the text as a result. I have prepared this image for the purpose of research, as Figure (a) represents text for which you have made some effects on it by one of the available programs which is spraying the yellow color on the image of text in blue, and the shape ( b ) Represents the image of the text after processing.



Figure (20)

#### 6- Treating contrast in parts of the text:

Figure (21) illustrates an example of addressing the variation in some words in the text. This image was also prepared for the purpose of research, as (a) represents a change in the color of some words to appear less black than the rest of the text, and Figure (b) represents the text after processing.

- اول ابناء ادم عليه السلام هو قابيل.
- اول شخص ركب الخيل هو نبی الله اسماعيل عليه السلام.
- اول شخص اطلق سهاما في سبيل الله عز وجل هو سعد بن ابي وقاص.

a-Before treatment

b-after treatment

Figure (21)

## 7- Improving the image of the text:

Figure (22) shows an example of improving the image of text that may be distorted due to the fall of some drinks on it. This image was also prepared in Figure A for the purpose of research as some tea was poured onto the paper and left to show its effect, then the paper was previewed to guess the appropriate threshold value to address such deformations. Figure b shows the image of the text after processing.

```
#include <stdio.h>
#include <queue>
using namespace std;

int nodes, edges, src, last;
int graph[100][100], color[100], dist[100];
const int WHITE = 0;
const int GRAY = 1;
const int BLACK = 2;

int main() {
    // printf("Nodes, edges, source? ");
    scanf("%d %d", &nodes, &edges);
    for (int i = 0; i < edges; i++) {
        // printf("Edge %d: ", i);
        int x, y;
        scanf("%d %d", &x, &y);
        graph[x][y] = 1;
    }
}
```

```
#include <stdio.h>
#include <queue>
using namespace std;

int nodes, edges, src, last;
int graph[100][100], color[100], dist[100];
const int WHITE = 0;
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        // printf("Edge %d: ", i);
        int x, y;
        scanf("%d %d", &x, &y);
        graph[x][y] = 1;
    }
}
```

a-Before treatment

b-after treatment

Figure (22)

## **Conclusion**

The application of the threshold method with some mathematical operations to improve the digital images proved successful compared to the ready programs for that, several improvement operations were carried out without the intervention of the recipient, which is what image processing programs require, and text images were successfully and quickly processed in the achievement that we get when using us For those programs.

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