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IMAGE NOISE REMOVER USING SPATIAL FILTERS

A PROJECT

Submitted to the college of engineering of the university of diyala in partial fulfilment of the requirements for the degree of B.SC. In computer &software engineering.

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بسم الله الرحمن الرحيم

" يرفع الله الذين آمنوا منكم

والذين أوتوا العلم درجات والله

بما تعملون خبير "

صدق الله العظيم

سورة المجادلة الآية رقم 11

الإهداء

إلهي لايطيب الليل إلا بشكرك ولايطيب النهار إلى بطاعتك .. ولاتطيب اللحظات إلا بذكرك .. ولا تطيب الآخرة إلا بعفوك .. ولا تطيب الجنة إلا برؤيتك

الله ﷻ

إلى من بلغ الرسالة وأدى الأمانة .. ونصح الأمة .. إلى نبي الرحمة ونور العالمين

سيدنا محمد ﷺ

إلى ملاكي في الحياة .. إلى معنى الحب والحنان والتفاني .. إلى بسمة الحياة وسر الوجود .. إلى من كان دعائها سر نجاحي وحنانها بلسم جراحي إلى أغلى الحبايب

أمي الغالية

إلى من علوني التفاؤل والمضي إلى الأمام .. إلى من مهد الطريق امامي للوصول الى ذروة العلم .. إلى من به أكبر وعليها أعتمد

أستاذي العزيز

كلمة الشكر

في مثل هذه اللحظات يتوقف اليراع ليفكر قبل أن يخط الحروف ليجمعها في كلمات ..

تتبعثر الأحرف وعبثاً أن يحاول تجميعها في سطور

سطوراً كثيرة تمر في الخيال ولا يبقى لنا في نهاية المطاف إلا قليلاً من الذكريات وصور

تجمعنا برفاق كانوا إلى جانبنا

فواجب علينا شكرهم ووداعهم ونحن نخطو خطوتنا الأولى في غمار الحياة

ونخص بالجزيل الشكر والعرفان إلى كل من أشعل شمعة في دروب عملنا

وإلى من وقف على المنابر وأعطى من حصيلة فكره لينير دربنا

إلى الأساتذة الكرام في كلية الهندسة ونتوجه بالشكر الجزيل إلى

الاستاذ

ظافر طه شهاب

الذي تفضل بالإشراف على هذا البحث فجزاه الله عنا كل خير فله منا كل التقدير

والاحترام

Certification of the Examination Committee

We certify we have read this project entitled (Image compression by using slantlet transform) and as examining committee examined the student (Zinab Ali Ahmed, Sura Mohammed Kaleed ,Ayaat Mahdy) .In its content and that in our opening it meets the standard of the project for the degree of B .Sc .in computer and software engineering.

Signature:	**Signature:**
Name:	**Name:**
Title:	**Title:**
(Member)	(Member)
Data:	**Data:**

Signature:

Name:

Title:

(Chairman)

Data:

Approve for computer and software engineering department .

Signature:

Name: Dr. Ali J . Abboud

(Head of the department)

Title: lecturer

Supervision Certification

We certify that this project entitled (Image Compression by using slantlet transform) was prepared under my supervision at the computer and software engineering department /college of engineering by (Zinab Ali Ahmed ,Sura Mommed Kaleed , Ayaat Mahdy) as a partial fulfillment of the requirement for the degree of B.Sc. in computer and software engineering.

Signature:	**Signature:**
Name:	**Name:** Dr. Ali J . Abboud
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In view of available recommendations , I forward this project for debate by the examining committee.

Signature:

Name: Dr. Ali J . Abboud

(Head of the department)

Title: lecturer

Data:

Chapter 1

Theoretical part

Chapter one

Introduction

1 IMAGE AND PICTURES

As we mentioned in the preface, human beings are predominantly visual creatures: we rely heavily on our vision to make sense of the world around us. We not only look at things to identify and classify them, but we can scan for differences, and obtain an overall rough feeling for a scene with a quick glance. Humans have evolved very precise visual skills we can identify a face in an instant; we can differentiate colors we can process a large amount of visual information very quickly. However, the world is in constant motion: stare at something for long enough and it will change in some way. Even a large solid structure, like a building or a mountain, will change its appearance depending on the time of day (day or night); amount of sunlight (clear or cloudy), or various shadows falling upon it. We are concerned with single images: snapshots, if you like, of a visual scene. Although image processing can deal with changing scenes, we shall not discuss it in any detail in this text. For our purposes, an image is a single picture which represents something. It may be a picture of a person, of people or animals, or of an outdoor scene, or a microphotograph of an electronic component, or the result of medical imaging. Even if the picture is not immediately recognizable, it will not be just a random blur [3].

1.1 WHAT IS DIGITAL IMAGE PROCESSING?

An image may be defined as a two-dimensional function, f(x, y), where x and y are *spatial* (plane) coordinates, and the amplitude of fat any pair of coordinates (x, y) is called the *intensity* or *gray level* of the image at that point .When x, y, and the amplitude values of f are all finite, discrete quantities, we call the image a *digital image* .The field of *digital image processing* refers to processing digital images by means of a digital computer. Note that a digital image is composed of a finite number of elements, each of which has a particular location and value .These elements are referred to as *picture elements*, *image elements*, *pels* , and *pixels*. *Pixel* is the term most widely used to denote the elements of a digital image Vision is the most advanced of our senses, so it is not surprising that images play the single most important role in human perception. However, unlike humans, who are limited to the visual band of the electromagnetic (EM) spectrum, imaging machines cover almost the entire EM spectrum, ranging from gamma to radio waves .They can operate on images generated by sources that humans are not accustomed to associating with images. These include ultrasound, electron microscopy , and computer-generated images .Thus, digital image processing encompasses a wide and varied field of applications. There is no general agreement among authors regarding where image processing stops and other related areas, such as image analysis and computer vision, start. Sometimes a distinction is made by defining image processing as a discipline in which both the input and output of a process are images We believe this to be a limiting and somewhat artificial boundary. For example, under this definition, even the trivial task of computing the average intensity of an image (which yields a single number) would not be considered an image processing operation. On the other hand, there are fields such as computer vision whose ultimate goal is to use computers to emulate human vision, including learning and being able to make inferences and take actions based on visual inputs .This area itself is a branch of artificial intelligence (AI) whose objective is to emulate human intelligence .The field of AI is in its earliest stages of infancy in terms of development, with progress having been much slower than originally anticipated. The area of image analysis (also called image understanding) is in between image processing and computer vision. There are no clear-cut boundaries in the continuum from image processing at one end to computer vision at the other. However, one useful paradigm is to consider three types of computerized processes in this continuum: low-, mid-, and high-level processes. Low-level processes involve primitive operations such as image preprocessing to reduce noise, contrast enhancement, and image sharpening .A low-level process is characterized by the fact that both its inputs and outputs are images. Mid-level processing on images involves tasks such as segmentation (partitioning an image into regions or objects), description of those objects to reduce them to a form suitable for computer processing, and classification (recognition) of individual objects .A mid-level process is characterized by the fact that its inputs generally are images, but its outputs are attributes extracted from those images (e.g., edges, contours, and the identity of individual objects). Finally, higher-level processing involves "making sense" of an ensemble of recognized objects, as in image analysis, and, at the far end of the continuum, performing the cognitive functions normally associated with vision. Based on the preceding comments, we see that a logical place of overlap between image processing and image analysis is the area of recognition of individual regions or objects in an image. Thus, what we call in this book *digital image processing* encompasses processes whose inputs and outputs are images and, in addition, encompasses processes that extract attributes from images, up to and including the recognition of individual objects. As a simple illustration to clarify these concepts, consider the area of automated analysis of text. The processes of acquiring an image of the area containing the text, preprocessing that image, extracting (segmenting) the individual characters, describing the characters in a form suitable for computer processing, and recognizing those individual characters are in the scope of what we call digital image processing in this book. Making sense of the content of the page may be viewed as being in the domain of image analysis and even computer vision, depending on the level of complexity implied by the statement “making sense.” As will become evident shortly, digital image processing, as we have defined it, is used successfully in a broad range of areas of exceptional social and economic value .The concepts developed in the following chapters are the foundation for the methods used in those application areas [1].

1.2 DIGITAL IMAGE

A digital remotely sensed image is typically composed of picture elements (pixels) located at the intersection of each row i and column j in each K bands of imagery. Associated with each pixel is a number known as Digital Number(DN) or Brightness Value (BV), that depicts the average radiance of a relatively small area within a scene (Fig. 1). A smaller number indicates low average radiance from the area and the high number is an indicator of high radiant properties of the area. The size of this area effects the reproduction of details within the scene. As pixel size is reduced more scene detail is presented in digital representation [2].

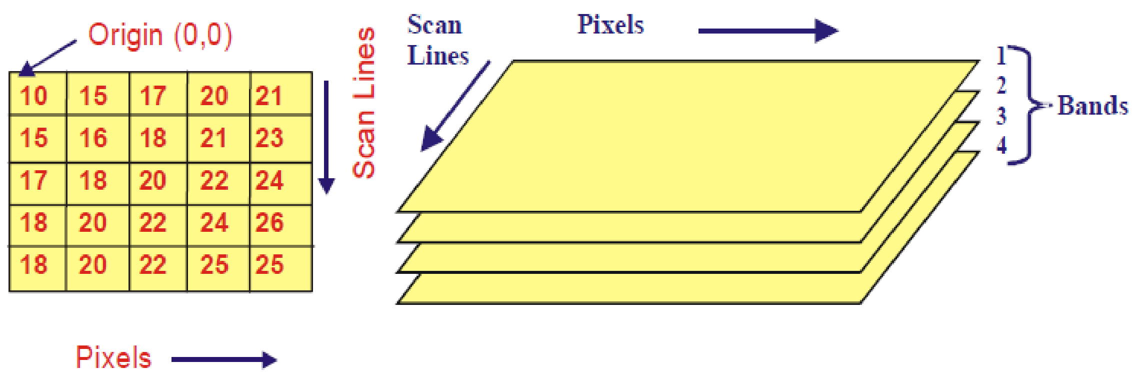
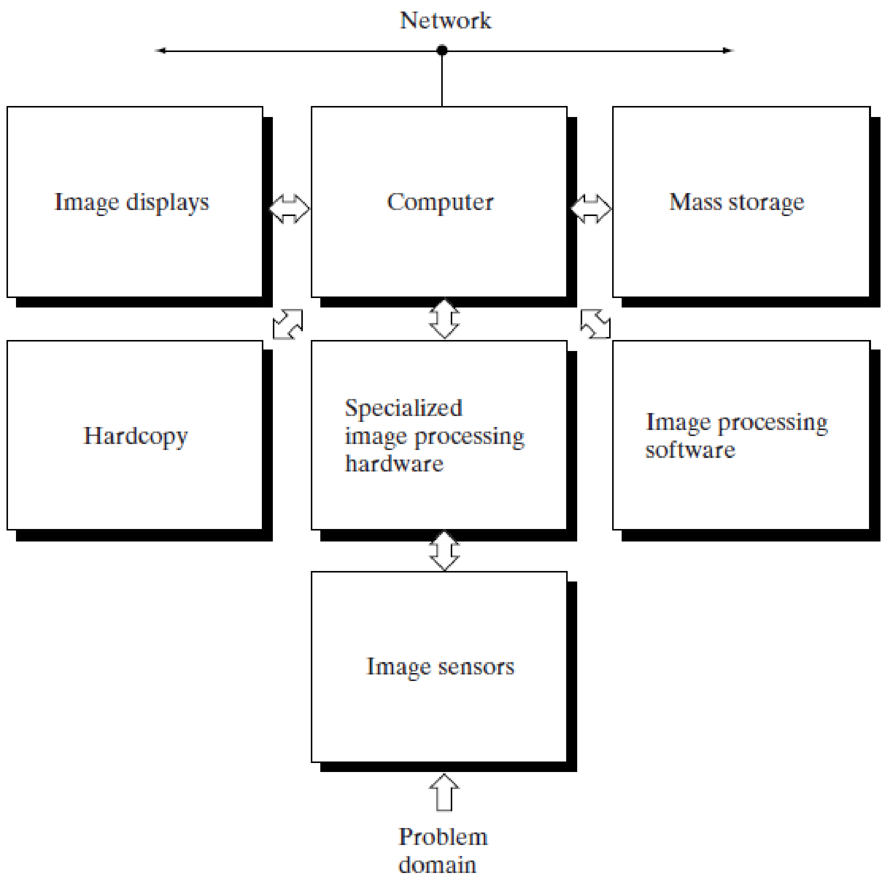


Figure 1 : Structure of a Digital Image and Multispectral Image

1.3 COMPONENT OF AN IMAGE PROCESSING SYSTEM

As recently as the mid-1980s, numerous models of image processing systems being sold throughout the world were rather substantial peripheral devices that attached to equally substantial host computers. Late in the 1980s and early in the 1990s, the market shifted to image processing hardware in the form of single boards designed to be compatible with industry standard buses and to fit into engineering workstation cabinets and personal computers. In addition to lowering costs, this market shift also served as a catalyst for a significant number of new companies whose specialty is the development of software written specifically for image processing. Although large-scale image processing systems still are being sold for massive imaging applications, such as processing of satellite images, the trend continues toward miniaturizing and blending of general-purpose small computers with specialized image processing hardware. Figure 1.1 shows the basic components comprising a typical *general-purpose* The function of each component is discussed in the following paragraphs, starting with image sensing. With reference to *sensing*, two elements are required to acquire digital images .m The first is a physical device that is sensitive to the energy radiated by the object we wish to image .The second, called a *digitizer*, is a device for converting the output of the physical sensing device into digital form. For instance, in a digital video camera, the sensors produce an electrical output proportional to light intensity .The digitizer converts these outputs to digital data *Specialized image processing hardware* usually consists of the digitizer just mentioned, plus hardware that performs other primitive operations, such as an arithmetic logic unit (ALU), which performs arithmetic and logical operations in parallel on entire images. One example of how an ALU is used is in averaging images as quickly as they are digitized, for the purpose of noise reduction. This type of hardware sometimes is called a *front-end subsystem*, and its most



fig(1.1)

Distinguishing characteristic is speed. In other words, this unit performs functions that require fast data throughputs (e.g., digitizing and averaging video images at 30 frames) that the typical main computer cannot handle. The *computer* in an image processing system is a general-purpose computer and can range from a PC to a supercomputer. In dedicated applications, sometimes specially designed computers are used to achieve a required level of performance, but our interest here is on general-purpose image processing systems. In these systems, almost any well-equipped PC-type machine is suitable for offline image processing tasks. *Software* for image processing consists of specialized modules that perform specific tasks .A well-designed package also includes the capability for the user to write code that, as a minimum, utilizes the specialized modules. More sophisticated software packages allow the integration of those modules and general- purpose software commands from at least one computer language. *Mass storage* capability is a must in image processing applications .An image of size 1024*1024 pixels, in which the intensity of each pixel is an 8-bit quantity, requires one megabyte of storage space if the image is not compressed. When dealing with thousands, or even millions, of images, providing adequate storage in an image processing system can be a challenge. Digital storage for image processing applications falls into three principal categories: (1) short term storage for use during processing, (2) on-line storage for relatively fast recall, and (3) archival storage, characterized by infrequent access. Storage is measured in bytes (eight bits), Kbytes (one thousand bytes), Mbytes (one million bytes), G bytes (meaning giga , or one billion, bytes), and T bytes (meaning tera , or one trillion, bytes). One method of providing short-term storage is computer memory .Another is by specialized boards, called *frame buffers*, that store one or more images and can be accessed rapidly, usually at video rates (e.g., at 30 complete images per second).The latter method allows virtually instantaneous image *zoom*, as well as *scroll* (vertical shifts) and *pan* (horizontal shifts). Frame buffers usually are housed in the specialized image processing hardware unit shown in Fig. 1.1. Online storage generally takes the form of magnetic disks or optical-media storage. The key factor characterizing on-line storage is frequent access to the stored data. Finally, archival storage is characterized by massive storage requirements but infrequent need for access. Magnetic tapes and optical disks housed in “jukeboxes” are the usual media for archival applications. *Image displays* in use today are mainly color (preferably flat screen) TV monitors. Monitors are driven by the outputs of image and graphics display cards that are an integral part of the computer system. Seldom are there requirements for image display applications that cannot be met by display cards available commercially as part of the computer system. In some cases, it is necessary to have stereo displays, and these are implemented in the form of headgear containing two small displays embedded in goggles worn by the user. *Hardcopy* devices for recording images include laser printers, film cameras, heat-sensitive devices, inkjet units, and digital units, such as optical and CD-ROM disks. Film provides the highest possible resolution, but paper is the obvious medium of choice for written material .For presentations, images are displayed on film transparencies or in a digital medium if image projection equipment is used .The latter approach is gaining acceptance as the standard for image presentations.

Networking is almost a default function in any computer system in use today. Because of the large amount of data inherent in image processing applications, the key consideration in image transmission is bandwidth. In dedicated networks, this typically is not a problem, but communications with remote sites via the Internet are not always as efficient. Fortunately, this situation is improving quickly as a result of optical fiber and other broadband technologies [1].

1.4 SOME APPLICATION

Image processing has an enormous range of applications; almost every area of science and technology can make use of image processing methods. Here is a short list just to give some indication of the range of image processing applications [3].

1. Medicine

- Inspection and interpretation of images obtained from X-rays, MRI or CAT scans,
- analysis of cell images, of chromosome karyotypes.

2. Agriculture

- Satellite/aerial views of land, for example to determine how much land is being used for

Different purposes, or to investigate the suitability of different regions for different crops.

- inspection of fruit and vegetables distinguishing good and fresh produce from old.

3. Industry

- Automatic inspection of items on a production line.
- inspection of paper samples.

4. Law enforcement

- Fingerprint analysis,
- sharpening or de-blurring of speed-camera image.

1.5 ASPECTS OF IMAGE PROCESSING

It is convenient to subdivide different image processing algorithms into broad subclasses. There are different algorithms for different tasks and problems, and often we would like to distinguish the nature of the task at hand [3].

Image enhancement. This refers to processing an image so that the result is more suitable for a particular application. Example include:

- sharpening or de-blurring an out of focus image,
- highlighting edges,
- improving image contrast, or brightening an image,
- removing noise.

Image restoration. This may be considered as reversing the damage done to an image by a known cause, for example:

- removing of blur caused by linear motion.

- removal of optical distortions.
- removing periodic interference.

Image segmentation. This involves subdividing an image into constituent parts, or isolating certain aspects of an image:

- finding lines, circles, or particular shapes in an image,
- in an aerial photograph, identifying cars, trees, buildings, or roads.

These classes are not disjoint; a given algorithm may be used for both image enhancement or for image restoration. However, we should be able to decide what it is that we are trying to do with our image: simply make it look better (enhancement), or removing damage (restoration).

1.6 AN IMAGE PROCESSING TASK

We will look in some detail at a particular real-world task, and see how the above classes may be used to describe the various stages in performing this task. The job is to obtain, by an automatic process, the postcodes from envelopes. Here is how this may be accomplished: Acquiring the image. First we need to produce a digital image from a paper envelope. This an be done using either a CCD camera, or a scanner. Preprocessing. This is the step taken before the _major_ image processing task. The problem here is to perform some basic tasks in order to render the resulting image more suitable for the job to follow. In this case it may involve enhancing the contrast, removing noise, or identifying regions likely to contain the postcode. Segmentation. Here is where we actually get the postcode; in other words we extract from the image that part of it which contains just the postcode. Representation and description. These terms refer to extracting the particular features which allow us to differentiate between objects. Here we will be looking for curves, holes and corners which allow us to distinguish the different digits which constitute a postcode. Recognition and interpretation. This means assigning labels to objects based on their descriptors (from the previous step), and assigning meanings to those labels. So we identify particular digits, and we interpret a string of four digits at the end of the address as the postcode [1].

1.7 TYPE OF DIGITAL IMAGE

For photographic purposes, there are two important types of digital images—color and black and white. Color images are made up of colored pixels while black and white images are made of pixels in different shades of gray [17].

1.7.1 Black and White Images

A black and white image is made up of pixels each of which holds a single number corresponding to the gray level of the image at a particular location. These gray levels span the full range from black to white in a series of very fine steps, normally 256 different grays. Since the eye can barely distinguish about 200 different gray levels, this is enough to give the illusion of a step less tonal scale as illustrated below:

Assuming 256 gray levels, each black and white pixel can be stored in a single byte (8 bits) of memory [17].

1.7.2 Greyscale.

Each pixel is a shade of grey, normally from 0(black) to255 (white). This range means that each pixel can be represented by eight bits, or exactly one byte. This is a very natural range for image _le handling. Other greyscale ranges are used, but generally they are a power of 2. Such images arise in medicine (X-rays), images of printed works, and indeed 256 different grey levels is sufficient for the recognition of most natural objects [3].

230	229	232	234	235	232	148
237	236	236	234	233	234	152
255	255	255	251	230	236	161
99	90	67	37	94	247	130
222	152	255	129	129	246	132
154	199	255	150	189	241	147
216	132	162	163	170	239	122

1.7.3 Color Images

A color image is made up of pixels each of which holds three numbers corresponding to the red, green, and blue levels of the image at a particular location. Red, green, and blue (sometimes referred to as RGB) are the primary colors for mixing light—these so-called additive primary colors are different from the subtractive primary colors used for mixing paints (cyan, magenta, and yellow). Any color can be created by mixing the correct amounts of red, green, and blue light. Assuming 256 levels for each primary, each color pixel can be stored in three bytes (24 bits) of memory. This corresponds to roughly 16.7 million different possible colors. Note that for images of the same size, a black and white version will use three times less memory than a color version [17][3].

49	55	56	57	52	53
58	60	60	58	55	57
58	58	54	53	55	56
83	78	72	69	68	69
88	91	91	84	83	82
69	76	83	78	76	75
61	69	73	78	76	76

Red

64	76	82	79	78	78
93	93	91	91	86	86
88	82	88	90	88	89
125	119	113	108	111	110
137	136	132	128	126	120
105	108	114	114	118	113
96	103	112	108	111	107

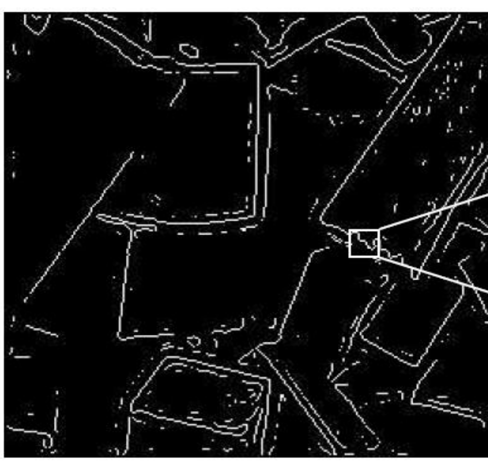
Green

66	80	77	80	87	77
81	93	96	99	86	85
83	83	91	94	92	88
135	128	126	112	107	106
141	129	129	117	115	101
95	99	109	108	112	109
84	93	107	101	105	102

Blue

1.7.4 Binary or Bi level Images

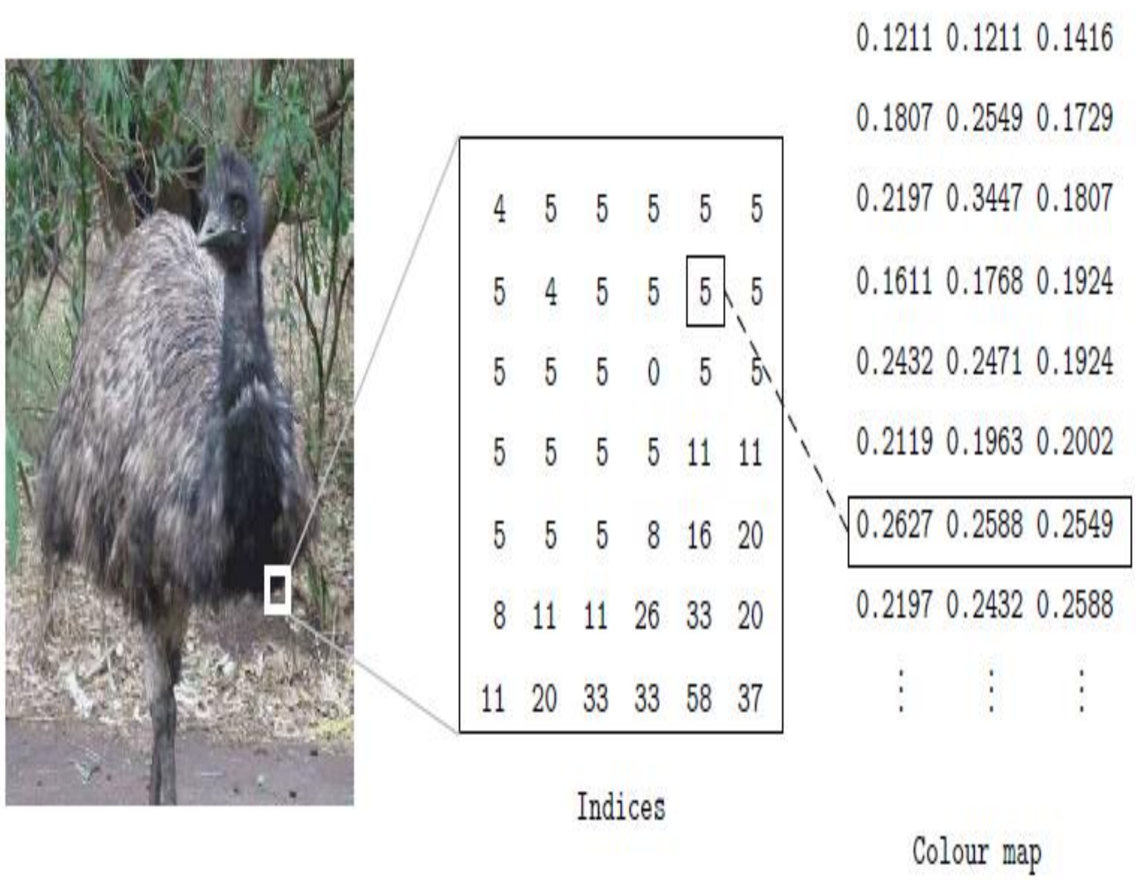
Binary images use only a single bit to represent each pixel. Since a bit can only exist in two states—on or off, every pixel in a binary image must be one of two colors, usually black or white. This inability to represent intermediate shades of gray is what limits their usefulness in dealing with photographic images[17][3].



1	1	0	0	0	0
0	0	1	0	0	0
0	0	1	0	0	0
0	0	0	1	0	0
0	0	0	1	1	0
0	0	0	0	0	1

1.7.5 Indexed Color Images

Some color images are created using a limited palette of colors, typically 256 different colors. These images are referred to as indexed color images because the data for each pixel consists of a palette index indicating which of the colors in the palette applies to that pixel. There are several problems with using indexed color to represent photographic images. First, if the image contains more different colors than are in the palette, techniques such as dithering must be applied to represent the missing colors and this degrades the image. Second, combining two indexed color images that use different palettes or even retouching part of a single indexed color image creates problems because of the limited number of available colors[17][3].



1.8 IMAGE ACQUISITION

We will briefly discuss means for getting a picture into a computer.

CCD camera. Such a camera has, in place of the usual film, an array of photosets these are silicon electronic devices whose voltage output is proportional to the intensity of light falling on them. For a camera attached to a computer, information from the photosets is then output to a suitable storage medium. Generally this is done on hardware, as being much faster and more efficient than software, using a frame-grabbing card. This allows a large number of images to be captured in a very short time in the order of one ten-thousandth of a second each. The images can then be copied onto a permanent storage device at some later time. Digital still cameras use a range of devices, from copy discs and CD's, to various specialized cards and memory sticks. The information can then be downloaded from these devices to a computer hard disk.

Flat bed scanner. This works on a principle similar to the CCD camera. Instead of the entire image being captured at once on a large array, a single row of photo sites is moved across the image, capturing it row-by-row as it moves. Since this is a much slower process than taking a picture with a camera, it is quite reasonable to allow all capture and storage to be processed by suitable software [3].

1.9 FILE SIZE

TIFF is, in principle, a very flexible format that can be lossless or lossy . The details of the image storage algorithm are included as part of the file. In practice, TIFF is used almost exclusively as a lossless image storage format that uses no compression at all. Most graphics programs that use TIFF do not compression. Consequently, file sizes are quite big. (Sometimes a lossless compression algorithm called LZW is used, but it is not universally supported.) **[11]**

PNG is also a lossless storage format. However, in contrast with common TIFF usage, it looks for patterns in the image that it can use to compress file size. The compression is exactly reversible, so the image is recovered exactly.

GIF creates a table of up to 256 colors from a pool of 16 million. If the image has fewer than 256 colors, GIF can render the image exactly. When the image contains many colors, software that creates the GIF uses any of several algorithms to approximate the colors in the image with the limited palette of 256 colors available. Better algorithms search the image to find an optimum set of 256 colors. Sometimes GIF uses the nearest color to represent each pixel, and sometimes it uses "error diffusion" to adjust the color of nearby pixels to correct for the error in each pixel. GIF achieves compression in two ways. First, it reduces the number of colors of color-rich images, thereby reducing the number of bits needed per pixel, as just described. Second, it replaces commonly occurring patterns (especially large areas of uniform color) with a short abbreviation: instead of storing "white, white, white, white, white," it stores "5 white." Thus, GIF is "lossless" only for images with 256 colors or less. For a rich, true color image, GIF may "lose" 99.998% of the colors[11].

JPG is optimized for photographs and similar continuous tone images that contain many, many colors. It can achieve astounding compression ratios even while maintaining very high image quality. GIF compression is unkind to such images. JPG works by analyzing images and discarding kinds of information that the eye is least likely to notice. It stores information as 24 bit color. Important: the degree of compression of JPG is adjustable. At moderate compression levels of photographic images, it is very difficult for the eye to discern any difference from the original, even at extreme magnification. Compression factors of more than 20 are often quite acceptable. Better graphics programs, such as Paint Shop Pro and Photoshop, allow you to view the image quality and file size as a function of compression level, so that you can conveniently choose the balance between quality and file size[11].

RAW is an image output option available on some digital cameras. Though lossless, it is a factor of three of four smaller than TIFF files of the same image. The disadvantage is that there is a different RAW format for each manufacturer, and so you may have to use the manufacturer's software to view the images. (Some graphics applications can read some manufacturer's RAW formats.)[11]

BMP is an uncompressed proprietary format invented by Microsoft. There is really no reason to ever use this format[11].

PSD, PSP, etc. , are proprietary formats used by graphics programs. Photoshop's files have the PSD extension, while Paint Shop Pro files use PSP. These are the preferred working formats as you edit images in the software, because only the proprietary formats retain all the editing power of the programs. These packages use layers, for example, to build complex images, and layer information may be lost in the nonproprietary formats such as TIFF and JPG. However, be sure to save your end result as a standard TIFF or JPG, or you may not be able to view it in a few years when your software has changed. Currently, GIF and JPG are the formats used for nearly all web images. PNG is supported by most of the latest generation browsers. TIFF is not widely supported by web browsers, and should be avoided for web use. PNG does everything GIF does, and better, so expect to see PNG replace GIF in the future. PNG will *not* replace JPG, since JPG is capable of much greater compression of photographic images, even when set for quite [11].

Chapter two

IMAGE RESTORATION

2 INTRODUCTION

Image restoration methods are used to improve the appearance of an image by application of a restoration process that uses a mathematical model for image degradation [3]. Examples of the types of degradation include blunting caused by motion or atmospheric disturbance, geometric distortion caused by Imperfect lenses, superimposed interference pattern caused by mechanical system, and noise from electronic sources, It is assumed hat the degradation model is known or can be estimated, The idea is to model the degradation process and then apply the inverse process to restore the original image, in general, image restoration is more of an art than a science; the restoration process relies on the experience of the individual to model the degradation process successfully In this chapter we will consider the various types of degradation that can be modeled and discuss the various techniques available to restore the image, The types of degradation models include both spatial and frequency domain consideration . In practice the degradation process model is often not known and must be experimentally determined or estimated. (A number of techniques are available to estimate this degradation analytically. They are beyond the scope of the discussion and can be explored with the references.) Any available information regarding the images and the systems used to acquire and process them is helpful. This information, combined with the developer's experience, can be applied to solve the specific application. A general block diagram for the image restoration process is provided in Figure 2.1. Here we see that degraded image(s) and knowledge of the image creation process are provided as input to the development of the degradation model, Knowledge of the image creation process is application specific; for example, it is helpful to know how a specific lens distorts an image or how mechanical vibration from a satellite affects an image. This information may be provided by knowledge about the image acquisition process

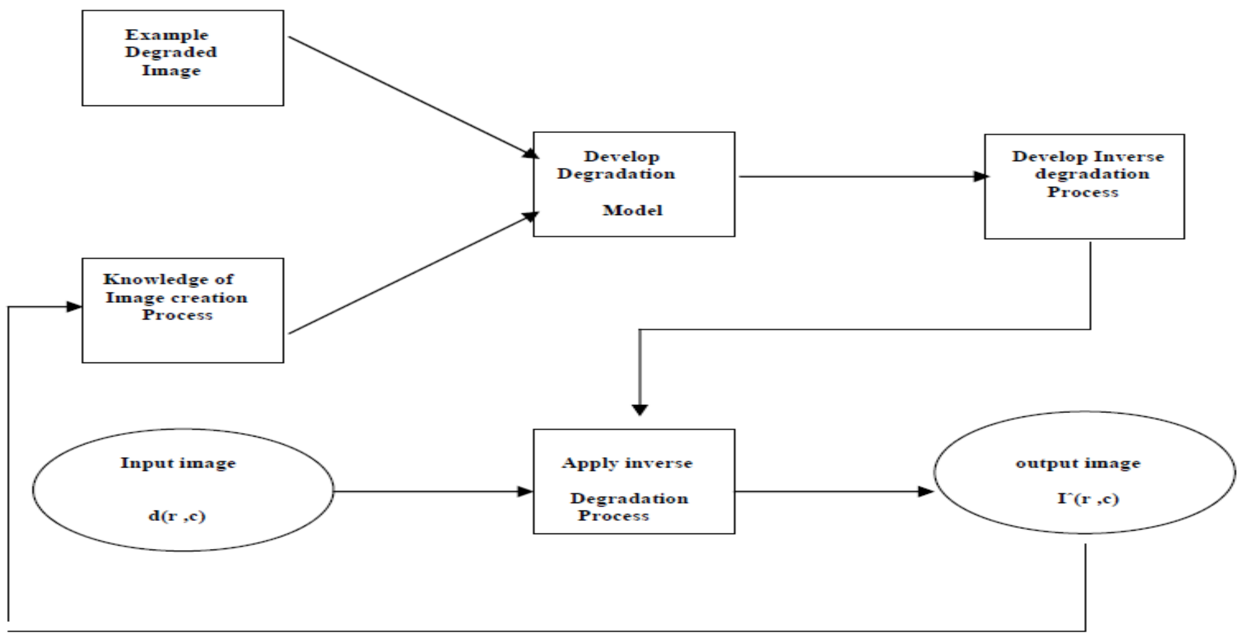


fig 2.1

Itself, or it may extracted from the degraded images by applying Image analysis techniques. After the degradation process has been Developed , the formulation of the inverse process follows. This inverse degradation process is then applied to the degraded image **d(r, c),** which results in the output image Iˆ(r, c), This output image Iˆ**(r , c)** is the restored image that represents an estimate of the original image I(r, c), After the estimated image has been created, any knowledge gained by observation and analysis of this image is used as additional input for the development of the degradation model. This process continues until satisfactory results are achieved. With this perspective, we can define image restoration as the process of finding an approximation to the degraded on process and finding the appropriate inverse process to estimate the original image [3].

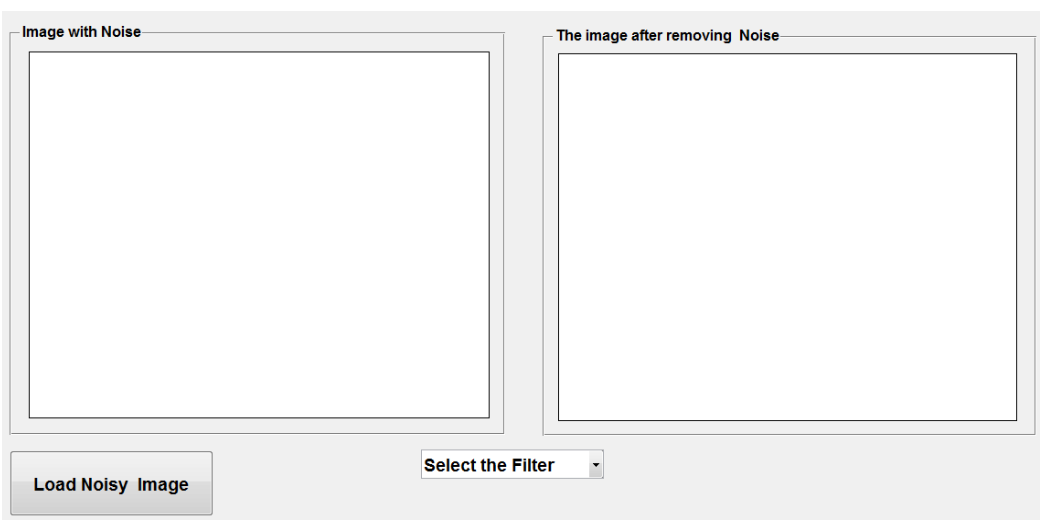
2.1 NOICE

What is noise? Noise is any undesired information that contaminates an image. Noise appears in images from a variety of sources. The digital image acquisition process, which converts an optical image into a continuous electrical signal that is then sampled, is the primary process by **which** noise appears in digital images. At every step in the process there are fluctuation caused by natural phenomena that add a random value to the exact brightness value for a given pixel. In typical images the noise can be modeled with either a Gaussian ("normal"). Uniform, or salt-and-pepper ("impulse") distribution. In the salt-and-pepper noise model there are only two possible values a and **b**, and the probability of each is typically less than 0.1- with numbers greater than this, the noise will dominate the image. For an 8-bit Image, the typical value for pepper noise is 0 and for Salt-noise, 255. The salt-and-pepper type noise is typically caused malfunctioning pixel elements in the camera sensors, faulty memory locations, or timing errors in the digitization process [3].

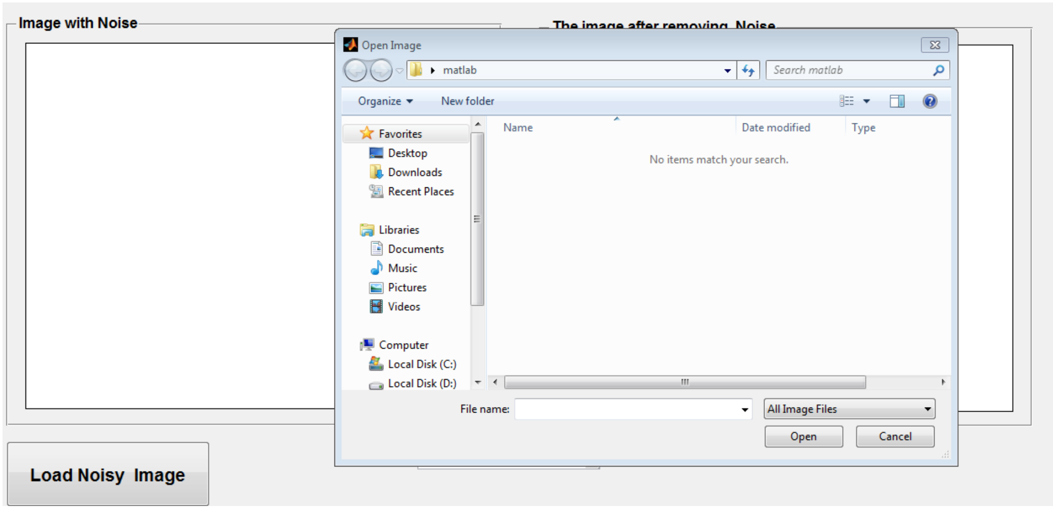
Chapter three

Practical Part

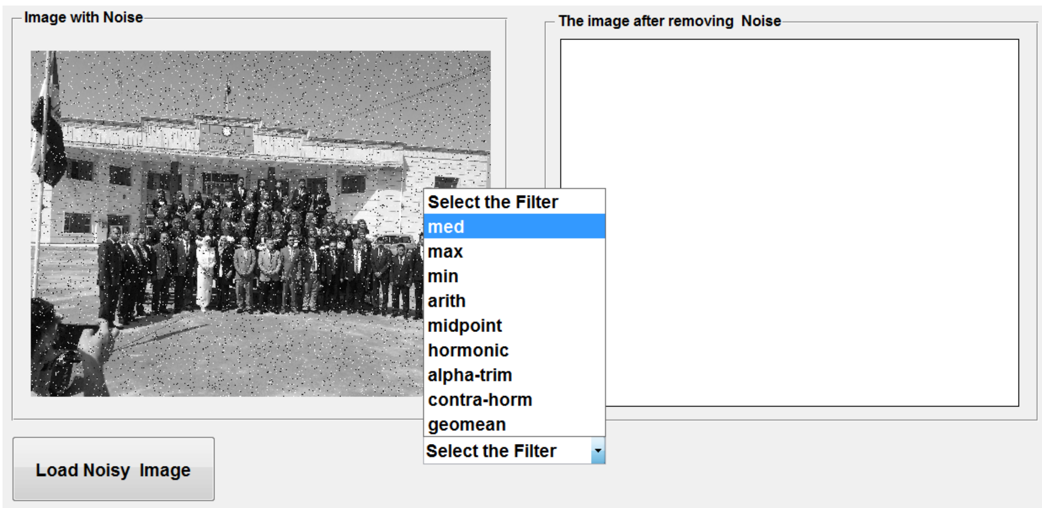
The program interface



Choose Picture



Choose the filter



3.1 MEAN FLITER

3.1.1 Arithmetic mean filter: reduce noise as a result of blurring The mean filters function by finding some form of an average within the ***N*** **x** ***N*** window, using the sliding window concept to process the entire image. The most basic of these filters is the ***arithmetic mean filter***, which finds the arithmetic average of the pixel values in the

$$\hat{f}(x,y) = \frac{1}{mn} \sum_{(s,t)\in S_{xy}} g(s,t)$$

S_{xy}: the $m \times n$ area for computing $\hat{f}(x,y)$

3.1.2 Geometric mean filter: reduce noise as a result of blurring

$$\hat{f}(x,y) = \left[\prod_{(s,t)\in S_{xy}} g(s,t) \right]^{\frac{1}{mn}}$$

3.1.3 Harmonic mean filter: for pepper and Gaussian noise

$$\hat{f}(x,y)=\frac{mn}{\sum_{(s,t)\in S_{xy}}\frac{1}{g(s,t)}}$$

3.2 ORDER FILTERS

3.2.1 Median filter: for bipolar or unipolar impulse noise Taking the median value instead of the average or weighted average of pixels in the window sort all the pixels in an increasing order, take the middle one The window shape does not need to be a square Special shapes can preserve line structures

$$\hat{f}(x,y) = \underset{(s,t)\in S_{xy}}{\text{median}}\{g(s,t)\}$$

3.2.2 Max and min filters: for salt or pepper noise The maximum and minimum filters are two order filters that ,can be used for elimination of salt-and-pepper(impulse) noise. The ***maximum filter*** selects the largest value within an ordered window of pixel values, whereas the ***minimum filter*** selects the smallest value. The minimum filter works when the noise is primarily of the salt-type (high values), and the maximum filters works best for pepper-type noise (low values).

$$\hat{f}(x,y) = \max_{(s,t)\in S_{xy}}\{g(s,t)\}, \quad \hat{f}(x,y) = \min_{(s,t)\in S_{xy}}\{g(s,t)\}$$

The final two order filters are the midpoint and alpha-trimmed mean filters, they are actually both order and mean filters because they rely on ordering the pixel values but they are then calculated by an averaging process, the ***midpoint filter*** is the average of the maximum and minimum within the window.

3.2.3 Midpoint filter: combine order statistics and averaging filtering; work well for randomly distributed noise The midpoint filter is most useful for Gaussian and uniform noise,

$$\hat{f}(x,y) = \frac{1}{2}\left[\max_{(s,t)\in S_{xy}}\{g(s,t)\} + \min_{(s,t)\in S_{xy}}\{g(s,t)\}\right]$$

3.2.4 Alpha-trimmed mean filter

The ***alpha-trimmed mean*** is the average of the pixel values within the window, but with some of the endpoint-ranked values excluded.

$$\hat{f}(x,y)=\frac{1}{mn-d}\sum_{(s,t)\in S_{xy}} g_r(s,t)$$

Conclusion

This project contained code to apply filters on images, and showed a few different filters and their result. These are only the very basics of image filtering, with bigger filters and a lot of tweaking you can get much better filters. In this project, we process the image after added noise ,with filters (used spatial filters) and then compare between new image (after filtering) and original image but we notice there are some differences between the images for each filter ,through working on the project we faced some troubles ,one of them is the equation of the noise and add it to the images ,so that we added the noise randomly. The other trouble is getting the resources and benefit from it.

Future Works

There are many ideas, we want to apply in this project such as using sharping filters and smoothing filters and dealing with other types of noises and we can write this project by using more friendly GUI of matlab .

جمهورية العراق

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في جامعة ديالى – كلية الهندسة كجزء من متطلبات نيل درجة البكالوريوس في هندسة الحاسوب و البرمجيات

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