Digital Image Processing Using Pixel Manipulation

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Abstract: Image Processing in its general form belongs to alternation and analysis of pictorial information. The term "image" refers to two dimensional light intensity function. The image may be corrupted by the external noises and undesirable brightness. The elimination of noise or disturbance from the Image can be done by using filters. In this thesis we have applied Low pass filters and High pass filters to the image to eliminate noise from the image. These noisy images or some images are inputs for this project. Each filter has been applied on the noisy images and the output has been compared with the original image in terms of visualization. The image's edges are enhanced so that the images are clearly visible and have better look. It also performs some operations such as Shrinking, Zooming, Morphing, Flipping , Rotation etc , some Mathematical operations such as Addition, Subtraction etc, and Some Boolean operations such as AND,OR, NAND,NOR,EX-OR,EX-NOR etc. The project aims to restoration of noisy images in long distances communication like satellites, big Networks etc.

Keywords: Noise Elimination, Low pass filter, High pass filter, Image Processing, Medical Image Process.

I. INTRODUCTION

Next to speech, visual information play a major role in human communication and orientation. It is estimated that 75% of all information received by man is visual, a fact which is illustrated by the ancient Chinese proverb, "A picture speaks a thousand words". It is not surprising therefore, that with the advent of electronic data processing the desire arose for the acquisition, processing and analysis of pictures or images by digital computers.

As a result of numerous applications not least as a consequence of cheap computer technology image processing now influences almost all areas of our daily life : Automated acquisition, processing and production of documents; industrial process automation(vision – guided control of machine tools, conveyor belts and robots and automated quality control); the acquisition and automated analysis for medical pictures(X-ray photography, ultrasonic measurements, and cell and chromosome image analysis); biology(observation of the growth processes of cell cultures); geo-physics(analysis of aerial photographs, study of temperature zones of earth); meteorology(surface temperature, humidity and air pressure measurements); astronomy; physics; criminal investigation(analysis of fingerprints and face profiles);

If the pictures are to be processed in a digital computer the signals, which are still defined in continuous coordinates, must be quantized with respect to their spatial coordinates and intensifies; this means that they must be transformed into a numerical matrix representation. Two dimensional image processing using pixel manipulation converts a large number of topics and areas, and a selection of topics was necessary due to time limitation at the time of starting this project. So a very vast topic : "Image Processing using Pixel Manipulation" is selected for implementation. Image processing refers to the manipulation of images, including resizing, cropping, rotation flipping, adjusting the color or brightness, edge detection, converting to a gray scale image, constructing a histogram and such. For example, this processing may remove noise, improve the contrast of the image, remove blurring caused by movement of the camera during image acquisition, it may correct for geometrical distortions caused by the lens.

Modern digital technology has made it possible to manipulate multi-dimensional signals with systems that range from simple digital circuits to advanced parallel computers. The following manipulation carried out in this project:

* Image Processing *image in -> image out*

We will focus on the fundamental concepts of *image processing*. Space does not permit us to make more than a few introductory remarks about *image analysis*. Further, this project is restricted to two-dimensional (2D) image processing although most of the concepts and techniques that are to be described can be extended easily to three or more dimensions.

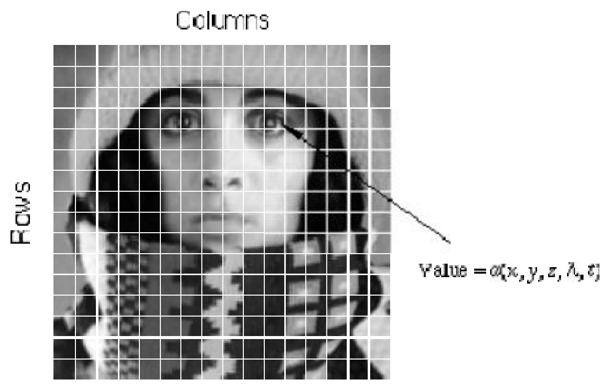
Basic definitions:

An image defined in the "real world" is considered to be a function of two real variables, for example, $a(x,y)$ with a as the amplitude (e.g. brightness) of the image at the *real* coordinate position (x,y). An image may be considered to contain sub-images sometimes referred to as *regions-of-interest*, *ROIs*, or simply *regions*. This concept reflects the fact that images frequently contain collections of objects each of which can be the basis for a region. In a sophisticated image processing system it should be possible to apply specific image processing operations to selected regions. Thus one part of an image (region) might be processed to suppress motion blur while another part might be processed to improve color rendition. The amplitudes of a given image will almost always be either real numbers or integer numbers. The latter is usually a result of a quantization process that converts a continuous range (say, between 0 and

100%) to a discrete number of levels. In certain image-forming processes, however, the signal may involve photon counting which implies that the amplitude would be inherently quantized. In other image forming procedures, such as magnetic resonance imaging, the direct physical measurement yields a complex number in the form of a real magnitude and a real phase. For the remainder of this book we will consider amplitudes as real or integer unless otherwise indicated.

Digital Image:

A digital image $a[m,n]$ described in a 2D discrete space is derived from an analog image $a(x,y)$ in a 2D continuous space through a *sampling* process that is frequently referred to as digitization. For now we will look at some basic definitions associated with the digital image. The effect of digitization is shown in Figure. The 2D continuous image $a(x,y)$ is divided into *N rows* and *M columns*. The intersection of a row and a column is termed a *pixel*. The value assigned to the integer coordinates $[m,n]$ with $\{m=0,1,2,...,M-1\}$ and $\{n=0,1,2,...,N-1\}$ is $a[m,n]$. In fact, in most cases $a(x,y)$--which we might consider to be the physical signal that impinges on the face of a 2D sensor--is actually a function of many variables including depth (z), color (λ), and time (t). Unless otherwise stated, we will consider the case of 2D, monochromatic, static images in this chapter.



Digitization of a continuous image. The pixel at coordinates

$[m=10, n=3]$ has the integer brightness value 110.

The image shown in Figure has been divided into $N = 16$ rows and $M = 16$ columns. The value assigned to every pixel is the average brightness in the pixel rounded to the nearest integer value. The process of representing the amplitude of the 2D signal at a given coordinate as an integer value with L different gray levels is usually referred to as amplitude quantization or simply *quantization*.

Frequencies in an image :

If an image has large values at *high* frequency components then the data is changing rapidly on a short distance scale. *e.g.* a page of text.. If the image has large *low* frequency components then the large scale features of the picture are more important. *e.g.* a single fairly simple object which occupies most of the image.

II. PROPOSED SYSTEM

Digital image processing refers to the processing of images by the use of a digital computer. Interest in digital processing technique dates back to the early 1920s when digitized pictures of world news were first transmitted by submarine cable between New York and London. Digital image processing has been used to determine the brightness of stars in a picture from a telescope, to determine the structure of virus in microscope image and to produce highly accurate maps of earth from satellite-gathered filters. It has been used to design textile patterns prior to weaving and to help restore paintings. It has applications in medicine, factory automation, computer vision (pattern recognition), astronomy, mineral analysis, fluid mechanics, radioactive analysis, particle physics and ocean modeling.

This project aims to compare noisy images with original image in terms of visualization, and perform some operations on the images. This project qualifies as "Image Analysis" as it analyses a portion of the image and then implements some filters in order to rectify the noise. Although we specify the path of the complete image when we read an image, we actually read only portion of the image into a multi-dimensional array applying filters on them in order to view image without any abnormalities.

Digital image processing encompassing a board range of hardware, software, and theoretical underpinnings. The First step in the process is image acquisition-that is, to acquire a digital image. To do so requires an imaging sensor and the capability to digitize the signal produced by the sensor. After the digital image has been obtained, the next setp deals with preprocessing that image. The key function of preprocessing is to improve the image in ways that increase the chances for success of the other processes.

We are also using different types of filters for enhancing the image. They include High pass filter, smoothening filter, etc. Edges and other abrupt changes in gray levels are associated with high frequency components, image sharpening can be achieved in the frequency domain by High pass filter. The smoothening filters are used for blurring and for noise reduction. Blurring used in preprocessing steps. These filters are sometimes known as averaging filters or referred to as low pass filters. The output of a smoothing, linear spatial filter is simply the average of the pixels contained in the neighborhood of the filter mask. The Laplacian is a 2D isotropic measure of the second spatial derivative of an image. The Laplacian of an image highlights the regions of rapid intensity change and is therefore often used for edge detection. The next step deals with segmentation. Segmentation defines that partitions an input image into its constituent parts or objects. The output of the segmentation stage usually is raw pixel data, consisting of either the boundary of a region or all the points in the region itself. The last stage involves assigning meaning to an ensemble of recognized objects.

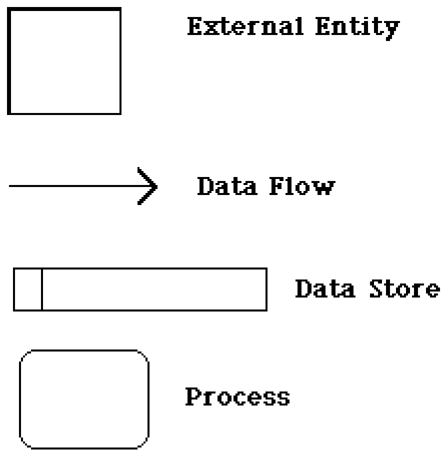
III. THE TECHNIQUE OF DATA FLOW DIAGRAMMING

- This section describes in detail the data flow diagramming technique. It is intended to serve as a handbook to guide the reader in developing data flow diagramming skills.
- **Definition:**
- Data Flow Diagramming is a means of representing a system at any level of detail with a graphic network of symbols showing data flows, data stores, data processes, and data sources/destinations.
- **Purpose/Objective:**
- The purpose of data flow diagrams is to provide a semantic bridge between users and systems developers. The diagrams are:
- Graphical, eliminating thousands of words;
- Logical representations, modeling WHAT a system does, rather than physical models showing HOW it does it;
- Hierarchical, showing systems at any level of detail; and
- Jargon less, allowing user understanding and reviewing.

The goal of data flow diagramming is to have a commonly understood model of a system. The diagrams are the basis of structured systems analysis. Data flow diagrams are supported by other techniques of structured systems analysis such as data structure diagrams, data dictionaries, and procedure-representing techniques such as decision tables, decision trees, and structured English.

Data flow diagrams have the objective of avoiding the cost of:

- user/developer misunderstanding of a system, resulting in a need to redo systems or in not using the system.
- having to start documentation from scratch when the physical system changes since the logical system, WHAT gets done, often remains the same when technology changes.
- systems inefficiencies because a system gets "computerized" before it gets "systematized".
- being unable to evaluate system project boundaries or degree of automation, resulting in a project of inappropriate scope.
- **Description:**
- Data Flow Diagrams are composed of the four basic symbols shown below.



The External Entity symbol represents sources of data to the system or destinations of data from the system. The Data Flow symbol represents movement of data. The Data Store symbol represents data that is not moving (delayed data at rest). The Process symbol represents an activity that transforms or manipulates the data (combines, reorders, converts, etc.).Any system can be represented at any level of detail by these four symbols.

- **External Entities:**

1. are named with appropriate name.
2. can be duplicated, one or more times, on the diagram to avoid line crossing.
3. determine the system boundary. They are external to the system being studied. They are often beyond the area of influence of the developer.
4. can represent another system or subsystem.
5. go on margins/edges of data flow diagram.

- **Data Flows:**

1. are represented with a line with an arrowhead on one end. A fork in a data flow means that the same data goes to two separate destinations. The same data coming from several locations can also be joined.
2. should only represent data, not control.
3. are ALWAYS named. Name is not to include the word "data".
4. are referenced by a combination of the identifiers of the constructs that the data flow connects. (14-A references a data flow from process 14 to external entity A)

- **Data Stores:**

1. are generic for physical files (index cards, desk drawers, magnetic disk, magnetic tape, shirt pocket, human memory, etc.)
2. are named with an appropriate name, not to include the word "file", and numbered with a number preceded with a capital letter D

3. can be duplicated, one or more times, to avoid line crossing.
4. can show two or more systems that share a data store. This is done by adding a solid stripe on the left boundary. (Figure 5.34) This can occur in the case of one system updating the data store, while the other system only accesses the data. For ex ample, the data store could be a freight rate book that one system builds and maintains, but is used by the represented system.
5. are detailed in the data dictionary or with data description diagrams.

- **Processes:**

1. show data transformation or change. Data coming into a process must be "worked on" or transformed in some way. Thus, all processes must have inputs and outputs. In some (rare) cases, data inputs or outputs will only be shown at more detailed levels of the diagrams. Each process in always "running" and ready to accept data.
2. are represented by a rounded corner rectangle
3. are named with one carefully chosen verb and an object of the verb. There is no subject. Name is not to include the word "process". Each process should represent one function or action. If there is an "and" in the name, you likely have more than one function (and process).
4. have physical location shown only for existing physical systems or a physical design is being represented.
5. are numbered within the diagram as convenient. Levels of detail are shown by decimal notation. For example, top level process would be Process 14, next level of detail Processes 14.1-14.4, and next level with Processes 14.3.1-14.3.6.
6. should generally move from top to bottom and left to right.

DFD Principles :

- The general principle in Data Flow Diagramming is that a system can be decomposed into subsystems, and subsystems can be decomposed into lower level subsystems, and so on.
- Each subsystem represents a process or activity in which data is processed. At the lowest level, processes can no longer be decomposed.
- Each 'process' (and from now on, by 'process' we mean subsystem and activity) in a DFD has the characteristics of a system.
- Just as a system must have input and output (if it is not dead), so a process must have input and output.

Data enters the system from the environment; data flows between processes within the system; and data is produced as output from the system

An **image** may be defined as a 2D function ‘f(x, y)’ where x & y are spatial (plane) co-ordinates and the amplitude of f at any pair of co-ordinates ‘(x, y)’ is called 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 of digital images by means of digital computer. The digital image is composed of a finite number of elements known as **pixels** or picture elements, each of which has a particular location and value.

Examples of the fields that use digital image processing:

The areas of application of digital image processing are so varied that some of organization is desirable in attempting to capture the breadth of this field. One of the simplest ways to develop a basic understanding of the extent of image processing applications is to categorize images according to their source (e.g., visual, x-ray).The principle energy source for images in use today is the electromagnetic energy spectrum.

1. Gamma-Ray Imaging

2. X- Ray Imaging

3. Imaging in the Ultraviolet and Infrared bands

4. Imaging in the microwave and radio band.

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