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Digital Computing Image Processing Network Technology

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Abstract—Based on digital, interactive, multimedia computer network teaching platform,which has become an important application of contemporary education means. Digital image processing technology curriculum for teaching the practical requirements of the network was designed and developed based on J2EE architecture, digital image processing technology course online teaching platform, the overall structure and function of each subsystem. Digital image processing is the use of computer algorithms to perform image pro-cessing on digital images. As a subcategory or field of digital signal processing, digital image processing has many advantages over analog image processing. It allows a much wider range of algorithms to be applied to the input data and can avoid problems such as the build-up of noise and signal distortion during processing. Since images are defined over two dimensions (perhaps more) digital image processing may be modeled in the form of multi dimensional systems. In 1960 Digital image processing techniques is first use in new paper Industry Many of the techniques of digital image processing, or digital picture processing as it often was called, were developed in the 1960s at the Jet Propulsion Labora-tory, Massachusetts Institute of Technology, Bell Laboratories, University of Maryland,and a few other research facilities, with application to satellite imagery, wire-photo standards conversion, medical imaging, videophone, character recogni-tion, and photograph enhancement. The cost of processing was fairly high, however, with the computing equipment of that era. That changed in the 1970s,when digital image processing proliferated as cheaper computers and dedicated hardware became available.Images then could be processed in real time, for some dedicated problems such as television standards conversion. As general-purpose computers became faster, they started to take over the role of dedicated hardware for all but the most specialized and computer-intensive operations.

Index Terms— Digital image processing, Digital Picture Processing, Techniques of Digital Signal Processing, Digital Camera Images.

1 INTRODUCTION

Interest in digital image processing methods stems from two principal application areas: improvement of pictorial information for human interpretation; and processing of image data for storage, transmission, and representation for autonomous machine perception. This chapter has several objectives: (1) to define the scope of the field that we call image processing; (2) to give a historical perspective of the origins of this field; (3) to give you an idea of the state of the art in image processing by examining some of the principal areas in which it is applied; (4) to discuss briefly the principal approaches used in digital image processing; (5) to give an overview of the components contained in a typical, general-purpose image processing system; and (6) to provide direction to the books and other literature where image processing work normally is reported.

Digital image processing technology for medical applications was inducted into the Space Foundation Space Technology. Introduction to Digital Image Processing and Manipulation using Photoshop and GIMP is important in many applications including editing and processing photographs, creating special effects for movies, drawing animated characters starting with photographs, analyzing and enhancing images captured by the mars rover or the Hubble telescope, and detecting suspects from surveillance cameras. This course is an introduction to basic digital image processing theory, and to the tools that make advanced image manipulation possible for day-to-day users. Tools like Photoshop and GIMP are used to introduce image processing concepts.

We will also discuss how to perform simple image processing programming with JAVA and Mat lab. When we speak of digital image processing, we mean the set of techniques used to modify a digital image in order to improve it (in terms of quality), or to reduce its size (in terms of bits compression encoding) or to get information out of it. Processing digital images is a new sector of knowledge, which has quickly developed thanks to the emergence of new information technologies. It relies mainly on the mathematics linked to information, signal processing, electronic systems and the advance in microprocessor computation capacities, particularly those that have been exclusively developed for signal processing and which offer high computation speed and capacity. To start with, a description of these four domains will allow us to better understand what image processing really is. Following this, we will look at how to obtain the digital images (by digitization of analog images) that we wish to process.

2 Image Processing:

Computer Vision is the branch of Computer Science whose goal is to model the real world or to recognize objects from digital images.

2.1 What Is Digital Image Processing

Image processing is any form of processing for which the input is an image, such as photographs or frames of video. The output of image processing can be either an image or a set of characteristics or parameters related to the image.

It also means analyzing and manipulating images with a computer.

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Image processing generally involves three steps:

i. **Import** an image with an optical scanner or directly through digital photography.
ii. **Manipulate** or analyze the image in some way. This stage can include image enhancement and data compression, or the image may be analyzed to find patterns that aren't visible by the human eye. For example, meteorologists use image processing to analyze satellite photographs.
iii. **Output** the result. The result might be the image altered in some way or it might be a report based on analysis of the image.

2.2 Fundamental steps in Digital Image Processing

Image acquisition is the first step in digital image processing. The image acquisition may be a very simple process where an image given may be already be in digital form. It can also be an image that may have to be converted to a digital form. This step may also include preprocessing wherein a image is converted to digital form.

Digital image formation in any digital image processing application consists of an optical system, sensor and the digitizer. Optical signal is transformed to electrical signal by using sensing device. Analog signal is transformed to digital by using video digitizer. Thus, optical image is transformed to digital. This system introduces deformation or degradation to digital image.

Digital image restoration reduces deformations and degradations introduced during digital image formation. These techniques try to reconstruct or recover the digital image.

Digital image enhancement improves the quality of digital image. This involves contrast enhancement, digital image sharpening and noise reduction. Pseudocoloring and halftoning may also be a part of this.

Digital images are corrupted by noise either during image acquisition or during image transmission. This may be a photoelectronic or film grain noise. Digital image noise can be removed by using noise filtering techniquest. Noise may also be generated artificially to improve performance in various algorithms.

2.3 Components of Digital Image Processing system

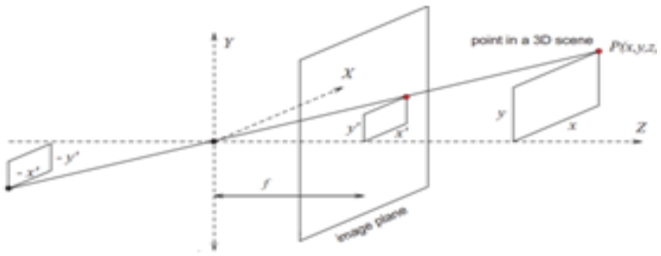
The basic components of digital image processing system include image sensors, digitizers, specialized processing hardwares, computer, processing software, storage device and image displays.

Image sensors are used to detect the image that has to be processed. This should be sensitive to the the energy radiated by the object so that it can be detected. Digitizers are used to convert the output of the device into digital form. These digitizers are a part of the specialized image processing hardwares. This is in addition to other hardwares that are required to perform primitive operations. The computer can be a PC or a supercomputer or custom computers. Software includes specialized modules to perform specific tasks and may also allow integration of software commands from multiple computer languages. Storage devices are a must for image processing. Providing adequate storage in image processing can be a challenge. The storage can be either short term, on line or archival. Short term storage can be achieved using buffers in computer memory. Image displays are used to display the images to the user. Monitors are typically used as image displayers.

2.4 Image effects:

In graphics and image-editing programs, image effects are predefined algorithms that enable you to add special effects to your images. The actual effects will depend on the software you use. You can usually choose different effects that will change the edges of your image, noise level, gradient and other aspects of your image. With most programs you can simply select the name of the image effect and the program will produce the image with the effect, then you can save the changed image. You can also choose undo if you don't like it and select another one to try.

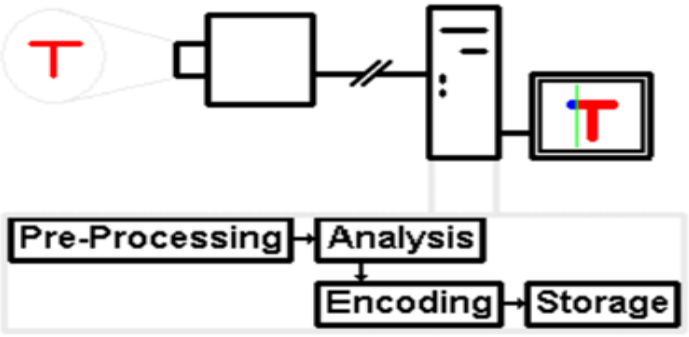
Also, you may find your program offers an effects browser, which will open your image as a thumbnail in a browser window that allows you to quickly preview how each effect will look before performing the action. Image effects are used as a way to change your image to add an artistic look, make textured patterns, or produce an enhanced real-world view. Some graphics programs will offer a few predefined effects, others designed with effects in mind may offer hundreds of image effects to choose.



An image may be defined as a two-dimensional function, where x and y are spatial (plane) coordinates, and the amplitude of f at any pair of coordinates (x, y) is called the intensity or gray level of the image at that point. When x, y, and the intensity 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 called picture elements, image elements, pels, and pixels. Pixel is the term used most widely to denote the elements of a digital image.

We consider these definitions in more formal terms. 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 ultra-sound, electron microscopy, and computer-generated images. Thus, digital image processing encompasses a wide and varied field of applications. There are no clear-cut boundaries in the continuum from image pro-

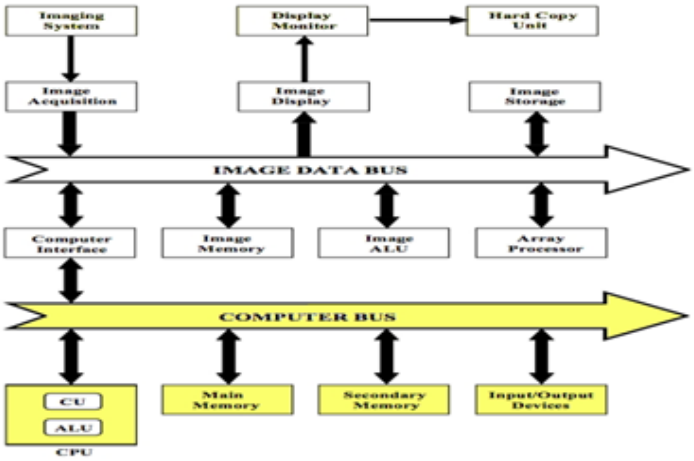
cessing at one end to computer vision at the other.



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).

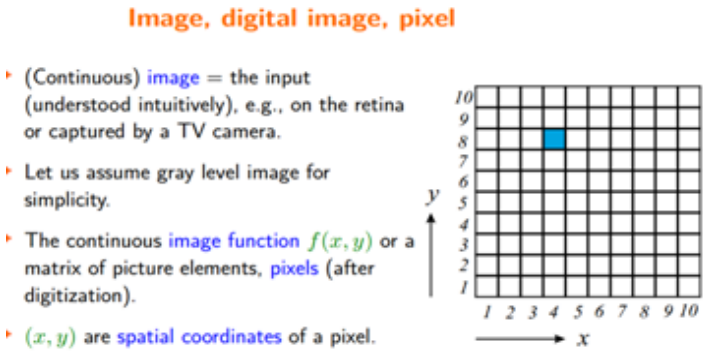
2.5 The Origins of Digital Image Processing

One of the first applications of digital images was in the newspaper industry, when pictures were first sent by submarine cable between London and New York. Introduction of the Bartlane cable picture transmission system in the early 1920s reduced the time required to transport a picture across the Atlantic from more than a week to less than three hours. Specialized printing equip-ment coded pictures for cable transmission and then recon-structed. Some of the initial problems in improving the visual quality of these early digital pictures were related to the selection of printing procedures and the distribution of intensity levels used for digital image processing.



Briefly, these advances may be summarized as follows:
(1) the invention of the transistor at Bell Laboratories in 1948;
(2) the development in the 1950s and 1960s of the high-level programming languages COBOL (Common Business-Oriented Language) and FORTRAN (Formula Translator);
(3) the invention of the integrated circuit (IC) at Texas Instruments in 1958;
(4) the development of operating systems in the early 1960s;
(5) the development of the microprocessor (a single chip consisting of the central processing unit, memory, and input and output controls) by Intel in the early 1970s;
(6) introduction by IBM of the personal computer in 1981; and
(7) progressive miniaturiza-tion of components, starting with large scale integration (LI) in the late 1970s, then very large scale integration (VLSI) in the 1980s, to the present use of ultra large scale.integration (ULSI).

Concurrent with these advances were developments in the areas of mass storage and display systems, both of which are fundamental requirements for digital image processing. Image Processing is processing of the image so as to reveal the inner details of the image for further investigation. With the advent of digital computers, Digital Image Processing has started revolutionizing the world with its diverse applications. The field of Image Processing continues, as it has since the early 1970's, on a path of dynamic growth in terms of popular and scientific interest and number of commercial applications. Considering the advances in the last 30 years resulting in routine application of image processing to problems in medicine, entertainment, law enforcement, and many others, Image processing has revolutionized in various fields. Examples include mapping internal organs in medicine using various scanning technologies (image reconstruction from projections), auto-



matic fingerprint recognition (pattern recognition and image coding) and HDTV (video coding). The discipline of Digital Image Processing covers a vast area of scientific and engineering knowledge.

Modern digital technology has made it possible to manipulate multi-dimensional signals with systems that range from simple digital circuits to advanced parallel computers. It's built on a foundation of one and two dimensional signal processing theory and overlaps with such disciplines as Artificial Intelligence (Scene understanding), information theory (image coding), statistical pattern recognition (image classification), communication theory (image coding and transmission), and microelectronics (image sensors, image processing hardware).

2.6 Digital camera images

Digital cameras generally include dedicated digital image processing chips to convert the raw data from the image sensor into a colour-corrected image in a standard image file format. Images from digital cameras often receive further processing to improve their quality, a distinct advantage that digital cameras have over film cameras. The digital image processing typically is executed by special software programs that can manipulate the images in many ways. Many digital cameras also enable viewing of histograms of images, as an aid for the photographer to understand the rendered brightness range of each shot more readily.

A camera stores images digitally rather than recording them on film. Once a picture has been taken, it can be downloaded to a computer system, and then manipulated with a graphics program and printed. Unlike film photographs, which have an almost infinite resolution, digital photos are limited by the amount of memory in the camera, the optical resolution of the digitizing mechanism, and, finally, by the resolution of the final output device. Even the best digital cameras connected to the best printers cannot produce film-quality photos. However, if the final output device is a laser printer, it doesn't really matter whether you take a real photo and then scan it, or take a digital photo. In both cases, the image must eventually be reduced to the resolution of the printer.

3 Tasks

Digital image processing allows the use of much more complex algorithms, and hence, can offer both more sophisticated performance at simple tasks, and the imple-mentation of methods which would be impossible by analog means.

In particular, digital image processing is the only practical technology for:

- Classification
- Feature extraction
- Pattern recognition
- Projection
- Multi-scale signal analysis

Some techniques which are used in digital image processing include:

- Pixelation
- Linear filtering
- Principal components analysis
- Independent component analysis
- Hidden Markov models
- Anisotropic diffusion
- Partial differential equations
- Self-organizing maps
- Neural networks
- Wavelets

4 Digital Image Processing Alogorithms

Digital image processing is the use of computer algorithms to create, process, communicate, and display digital images. Digital image processing algorithms can be classified into different classes' namely low level vision, intermediate level vision and high level vision. Low level vision algorithms are essentially digital image processing algorithms: there input and output are digital images. Intermediate level vision algorithms have digital images as input and low level symbolic representations of image features as output. High level vision algorithms use symbolic representations for both input and output. High level vision is closely related to artificial intelligence and to pattern recognition. It tries to simulate the high levels of human visual perception.

Digital image processing algorithms can be used to:

- Convert signals from an image sensor into digital images
- Improve clarity, remove noise, and other artifacts
- Extract the size, scale, or number of objects in a scene
- Prepare images for display or printing
- Compress images for communication across a network

MATLAB is a high performance language for technical computing. The image processing toolbox is a collection of MATLAB functions that extend the capability for solution of digital image processing problems. You can perform digital image processing in MATLAB with Image Processing Toolbox, which provide digital image processing algorithms, tools, and a comprehensive environment for data analysis, visualization, and algorithm development.

There have been various algorithms proposed for digital image processing. Quantum algorithms are one of these. Several quantum digital image processing algorithms have been proposed based on the Eldar-Oppenheim framework including image halftoning, edge detection and visual cryptography. In these algorithms, the pixel of input image is transformed into superposition of multiple quantum states. Then, the quantum measurement outcome is obtained and transformed into the desired output value.

A recursive algorithm for digital Image Processing using Local Statistics constitutes a recursive implementaiton of an approach proposed and implemented nonrecursively by J.S. Lee (Naval Research Laboratory Report 8192, March 1978). Calculations show that the proposed recursion introduces considerable improvement in efficiency.

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