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IMAGE PROCESSING

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Abstract

In this paper, the basics of capturing an image, image processing to modify and enhance the image are discussed. There are many applications for Image Processing like surveillance, navigation, and robotics. Robotics is a very interesting field and promises future development so it is chosen as an example to explain the various aspects involved in Image Processing.

The various techniques of Image Processing are explained briefly and the advantages and disadvantages are listed. There are countless different routines that can be used for variety of purposes. Most of these routines are created for specific operations and applications. However, certain fundamental techniques such as convolution masks can be applied to many classes of routines. The authors have concentrated on these techniques, which enable us to adapt, develop, and use other routines and techniques for other applications. The advances in technology have created tremendous opportunities for visual system and image processing. There is no doubt that the trend will continue into the future.

I. 1. INTRODUCTION

1.1Image Processing:

Image processing pertains to the alteration and analysis of pictorial information. Common case of image processing is the adjustment of brightness and contrast controls on a television set by doing this we enhance the image until its subjective appearing to us is most appealing. The biological system (eye, brain) receives, enhances, and dissects analyzes and stores mages at enormous rates of speed.

Basically there are two-methods for processing pictorial information. They are:

1. Optical processing
2. Electronic processing.

Optical processing uses an arrangement of optics or lenses to carry out the process. An important form of optical image processing is found in the photographic dark room.

Electronic image processing is further classified as:

1. Analog processing
2. Digital processing.

1.2 Analog processing:

These kind of this control of brightness and contrast of television image. The television signal is a voltage level that varies in amplitude to represent brightness through out the image by electrically altering these signals, we correspondingly alter the final displayed image appearance.

1.3 Digital image processing:

Processing of digital images by means of digital computer refers to digital image processing. Digital images are composed of finite number of element of which has a particular location value. Picture elements, image elements, and pixels are used as elements used for digital image processing.

Digital Image Processing is concerned with processing of an image. In simple words an image is a representation of a real scene, either in black and white or in color, and either in print form or in a digital form i.e., technically a image is a two-dimensional light intensity function. In other words it is a data intensity values arranged in a two dimensional form, the required property of an image can be extracted from processing an image. Image is typically by stochastic models. It is represented by AR model. Degradation is represented by MA model.

Other form is orthogonal series expansion. Image processing system is typically non-casual system. Image processing is two dimensional signal

processing. Due to linearity Property, we can operate on rows and columns separately. Image processing is vastly being implemented by "Vision Systems" in robotics. Robots are designed, and meant, to be controlled by a computer or similar devices. While "Vision Systems" are most sophisticated sensors used in Robotics. They relate the function of a robot to its environment as all other sensors do.

"Vision Systems" may be used for a variety of applications, including manufacturing, navigation and surveillance.

Some of the applications of Image Processing are:

1. Robotics.
2. Medical Field.
3. Graphics and Animations.
4. Satellite Imaging.

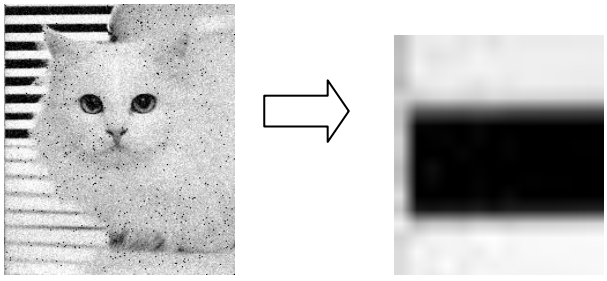
II. 2. STEPS INVOLVED IN DIGITAL IMAGE PROCESSING

Image Processing

Image processing is a subclass of signal processing concerned specifically with Pictures.Improve image quality for human perception and/or computer interpretation. Image Enhancement

To bring out detail is obscured, or simply to highlight certain features of interest in an image.

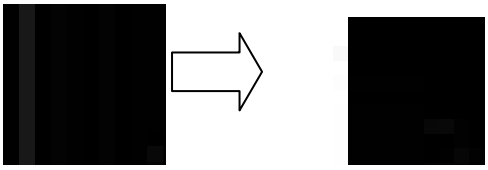
Example:



1. **Image Restoration**

Improving the appearance of an image tend to be based on mathematical or probabilistic models of image degradation.

Example:



DISTORTED IMAGE RESTORTED IMAGE

2. **Color Image Processing**

Gaining in importance because of the significant increase in the use of digital images over the Internet.

3. **Wavelets**

Foundation for representing images in various degrees of resolution. Used in image data compression and pyramidal representation (images are subdivided successively into smaller regions)

4. **Compression**

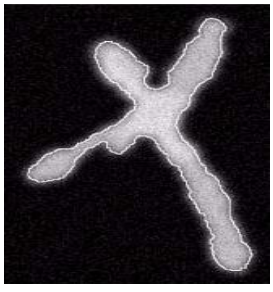
Reducing the storage required to save an image or the bandwidth required to transmit it. Ex. JPEG (Joint Photographic Experts Group) image compression standard.

5. **Morphological processing**

Tools for extracting image components that are useful in the representation and description of shape.

6. **Image Segmentation**

Computer tries to separate objects separate objects from the image background from the image background. It is one of the most difficult tasks in DIP. A rugged segmentation procedure brings the process a long way toward successful solution of an image problem. Output of the segmentation stage is raw pixel data, constituting either the boundary of a region or all the points in the region itself.



1) *3. IMAGE PROCESSING TECHNIQUES:*

Image Processing techniques are used to enhance, improve, or otherwise alter an image and to prepare it for image analysis. Usually, during image processing information is not extracted from

the image. The intention is to remove faults, trivial information, or information that may be important, but not useful, and to improve the image.

Image processing is divided into many sub processes, including Histogram Analysis, Thresholding, Masking, Edge Detection, Segmentation, and others.

4. STAGES IN IMAGE PROCESSING:

There are many stages in digital image processing as shown in fig.1

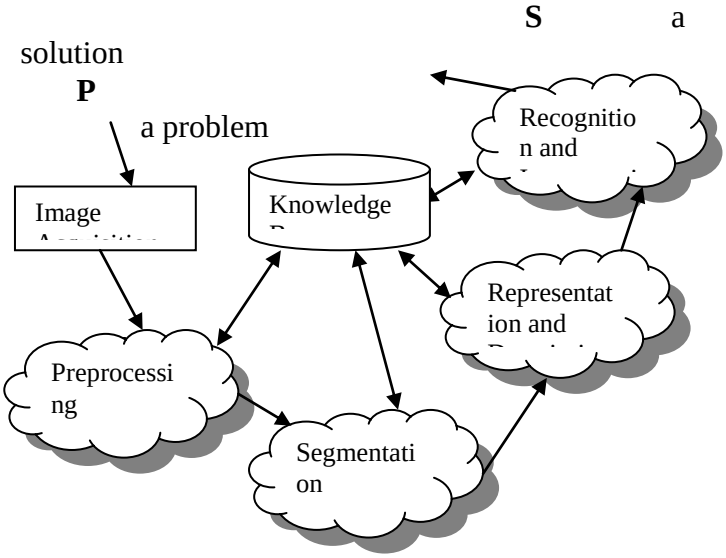


Fig.1 Steps in Image Processing

1. IMAGE ACQUISITION:

An image is captured by a sensor (such as a monochrome or color TV camera) and digitized. If the output of the camera or sensor is not already in digital form, an analog-to digital converter digitizes it.

2. RECOGNITION AND INTERPRETATION:

Recognition is the process that assigns a label to an object based on the information provided by its descriptors. Interpretation is assigning meaning to an ensemble of recognized objects.

3. SEGMENTATION:

Segmentation is the generic name for a number of different techniques that divide the image into segments of its constituents. The purpose of segmentation is to separate the information contained in the image into smaller entities that can be used for other purposes.

4.REPRESENTATION AND DESCRIPTION:

Representation and Description transforms raw data into a form suitable for the Recognition processing.

5. KNOWLEDGE BASE:

A problem domain detailing the regions of an image where the information of interest is known to be located is known as knowledge base. It helps to limit the search.

5. ADDITIONAL PROCESSES

5.1 THRESHOLDING:

Thresholding is the process of dividing an image into different portions by picking a certain grayness level as a threshold, comparing each pixel value with the threshold, and then assigning the pixel to the different portions, depending on whether the pixel's grayness level is below the threshold or above the threshold value. Thresholding can be performed either at a single level or at multiple levels, in which the image is processed by dividing it into " layers", each with a selected threshold.

Various techniques are available to choose an appropriate threshold ranging from simple routines for binary images to sophisticated techniques for complicated images.

5.2 CONNECTIVITY:

Sometimes we need to decide whether neighboring pixels are somehow "connected" or related to each other. Connectivity establishes whether they have the same property, such as being of the same region, coming from the same object, having a similar texture, etc. To establish the connectivity of neighboring pixels, we first have to decide upon a connectivity path.

5.3 NOISE REDUCTION:

Like other signal processing mediums, Vision Systems contains noises. Some noises are systematic and come from dirty lenses, faulty electronic components, bad memory chips and low resolution. Others are random and are caused by environmental effects or bad lighting. The net effect is a corrupted image that needs to be preprocessed to reduce or eliminate the noise. In addition, sometimes images are not of good quality, due to both hardware and software inadequacies; thus, they have to be enhanced and improved before other analysis can be performed on them.

5.4 CONVOLUTION MASKS:

A mask may be used for many different purposes, including filtering operations and noise reduction. Noise and Edges produces higher frequencies in the spectrum of a signal. It is possible to create masks that behave like a low pass filter, such that higher frequencies of an image are attenuated while the lower frequencies are not changed very much. There by the noise is reduced.

5.5 EDGE DETECTION:

Edge Detection is a general name for a class of routines and techniques that operate on an image and results in a line drawing of the image. The lines represented changes in values such as cross sections of planes, intersections of planes, textures, lines, and colors, as well as differences in shading and textures. Some techniques are mathematically oriented, some are heuristic, and some are descriptive. All generally operate on the differences between the gray levels of pixels or groups of pixels through masks or thresholds. The final result is a line drawing or similar representation that requires much less memory to be stored, is much simpler to be processed, and saves in computation and storage costs. Edge detection is also necessary in subsequent process, such as segmentation and object recognition. Without edge detection, it may be impossible to find overlapping parts, to calculate features such as a diameter and an area or to determine parts by region growing.

5.6 IMAGE DATA COMPRESSION:

Electronic images contain large amounts of information and thus require data transmission lines with large bandwidth capacity. The requirements for the temporal and spatial resolution of an image, the number of images per second, and the number of gray levels are determined by the required quality of the images. Recent data transmission and storage techniques have significantly improved image transmission capabilities, including transmission over the Internet.

5.7 REAL-TIME IMAGE PROCESSING:

In many of the techniques considered so far, the image is digitized and stored before processing. In other situations, although the image is not stored, the processing routines require long computational times before they are finished. This means that, in general, there is a long lapse between the time and image is taken and the time a result obtained. This may be acceptable in situations in which the decisions do not affect the process. However, in other situations, there is a need for real-time processing such that the results are available in real time or in a short enough time to be considered real time. Two different approaches are considered for real time processing. One is to design dedicated hardware such that the processing is fast enough to occur in real time. The other is to try to increase the efficiency of both the software and the hardware and thereby reduce processing and computational requirements.

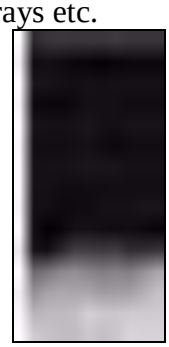
6. APPLICATION 1:

Image Processing is vastly being implemented in Vision Systems in Robotics. Robots capture the real time images using cameras and process them to fulfill the desired action. A simple application in robotics using Vision Systems is a robot hand-eye coordination system. Consider that the robot’s task is to move an object from one point to another point. Here the robots are fixed with cameras to view the object which is to be moved. The hand of the robot and the object that is to be captured are observed by the cameras, which are fixed to the robot in position, this real time image is processed by the image processing techniques to get the actual distance between the hand and the object. Here the base wheel of the robot’s hand is rotated through an angle which is proportional to the actual distance between hand and the object. Here a point in the target is obtained by using the Edge Detection Technique. The operation to be performed is controlled by the micro-controller, which is connected to the ports of the fingers of the robot’s hand. Using the software programs the operations to be performed are

assigned keys from the keyboard. By pressing the relative key on the keyboard the hand moves appropriately.

Here the usage of sensors/cameras and Edge Detection technique are related to Image Processing and Vision Systems. By this technique the complexity of using manual sensors is minimized to a great extent and thereby sophistication is increased. Hence image processing is used here in the study of robotics.

In the field of Medicine this is highly applicable in areas like Medical imaging, Scanning, Ultrasound and X-rays etc.


Bone Scan **Chest X-Ray and Aortic angiogram** **Baby Scan and Thyroids**

Image Processing is rapidly used for MRI SCAN (Magnetic Resonance Imaging) and CT SCAN (Computer Tomography). Tomography is an imaging technique that generates an image of a thin cross sectional slice of a test piece.

III. 7. ADVANTAGES

- In medicine by using the Image Processing techniques the sophistication has increased. This lead to technological advancement.
- Vision Systems are flexible, inexpensive, powerful tools that can be used with ease.
- In Space Exploration the robots play vital role which in turn use the image processing techniques.
- Image Processing is used for Astronomical Observations.
- Also used in Remote Sensing, Geological Surveys for detecting mineral resources etc.
- Also used for character recognizing techniques, inspection for abnormalities in industries.

IV. 8. DISADVANTAGES

- A Person needs knowledge in many fields to develop an application / or part of an application using image processing.
- Calculations and computations are difficult and complicated so needs an expert in the field related. Hence it's unsuitable and unbeneficial to ordinary programmers with mediocre knowledge.

CONCLUSION

It's a critical study, which plays a vital role in modern world as it is involved with advanced use of science and technology. The advances in technology have created tremendous opportunities for Vision System and Image Processing. There is no doubt that the trend will continue into the future. from the above discussion we can conclude that this field has relatively more advantages than disadvantages and hence is very useful in varied branches.

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