Recent Advances in Digital Image Processing for Real-World Applications

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Abstract—**Image and Video Processing are hot topics in the field of research and development. Image processing is any form of signal 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. in digital image processing methods stems from two Interest principal application areas: improvement of pictorial information for human interpretation; and processing of image data for storage, transmission, and representation for autonomous machine perception. Theobjectives ofthis article are to define the meaning and scope of image processing, discuss the various steps and methodologies involved in a typical image processing, and applications of image processingtoolsandprocessesinthefrontier areas of research. Most image- processing techniques involve treating the image as a two-dimensional signal and applying standard signal-processing techniques to it. Video processing is a particular case of signal processing, where the input and output signals are video files or video streams. Video processing techniques are used in television sets, VCRs,DVDs,video codecs, video players and other devices. In This paper, we present Image and Video processing elements. We also present the current technologies related to Image and Video Processing.**

I. INTRODUCTION:

Image processing usually refers to digital image processing, but optical and analog image processing are also possible. The acquisition of images (producing the input image in the first place) is referred to as imaging. Digital video is a type of video recording system that works by using a digital rather than an analog video signal. The terms camera, video camera, and camcorder are used interchangeably in this article. In the following sections oof this paper, we will discuss the elements of Digital Image Processing. We will also discuss the elements of Digital Video Processing. And lastly, we will review the current technologies and techniques in the fields. 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. The se 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. from gamma to radio waves. They can operate onimages generated bysources 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.

II. IMAGEPROCESSING

Image processing is the process of manipulating

digital images. This is the process of applying an algorithm to digital pictures on a computer. Digital image processing, a subfield of digital signal processing, offers several benefits over analog image processing. It can prevent issueslikenoiseaccumulationanddistortion during processing and enables a far greater variety of algorithms to be applied to the incoming data. Digital image processing may be described as multidimensional systems as pictures are characterized in two dimensions, if not more. Three major elements influence the invention and advancement of digital image processing: first, the advancement of computers second, the advancement of mathematics (particularly the development and enhancement of discrete mathematics theory), and third, the need for a broad. There are two types of image processing:

1) Analogimageprocessing.
2) Digitalimageprocessing.

AnalogImageProcessing

Analog image processing refers to techniques used to process images in their analog form, such as photographs, printed pictures, or images captured on film. This type of processing involves modifying imagesthroughphysicalorchemical
means. Before the advent of digital technology, all image processing was done using analog methods. These methods are generally less flexible and more time- consuming compared to digital techniques, but they have historical significance and specific applications.

Digital Image Processing

Digitalimageprocessinginvolvestheuseof computer algorithms to perform operations on digital images Unlike analog processing, digital techniques offer more flexibility, precision, and automation. Digital images are composed of pixels and processing these images involves manipulating pixel values to achieve the desired effect The use of digital processing is wide spread due to its efficiency and the vast array of tools and techniques available.

Therearesomeoftheapplicationsinimage processing:

I. Image enhancement: This involves improving the visual quality of an image, such as increasing contrast, reducing noise and removing artifacts.
II. Image restoration: This involves removing degradation from an image, such as blurring, noise, and distortion.
III. Image segmentation: This involves dividing an image into regions or segments each of which corresponds to a specific object or feature in the image.
IV. Image analysis: This involves using algorithmsandmathematicalmodelsto extract information from an image, such as recognizing objects, detecting patterns, and quantifying features.
V. Morphological processing: It deals with tools for extracting image components that are useful in the representation and description of shape and boundary of objects. It is majorly used in automated inspection applications.
VI. Wavelets and Multiresolution Processing: These are the foundation for representing image in various degrees of resolution.

III. VIDEOPROCESSING:

Video processing is the process of manipulating and managing video data, such as compressing, converting colors
,and encrypting. In this a particular case of signal processing where the input and output signals are video files or video streams. Video processing techniques are used in television sets,VCRs,DVDs, video codecs, video players and other devices. For example
Commonly only design and video processing is different in TV sets of different manufactures. For instance generallyjust plan and video processing is diverse in televisions of various fabricates. The videos taken from hand held portable cameras experience the ill effectsofvariousundesiredand
a way that can be analyzed and manipulated by a computer, and describing the features of an image in a compact and meaningful way.

I. ImageStabilization
- OpticalImageStabilization
- Mechanicalimage Stabilization
- Motionestimation

II. Objectdetection
- Moving camera
- Stationarycamera

- Object detection approaches

IV. IMAGESTABILIZATION:

Image stabilization is a technique used to reduce the effects of camera movement while capturing images or videos. When a camera is held by hand or used in a moving environment, small vibrations and sudden movements can cause the image to appear blurred or shaky. Image stabilization helps to minimize these unwanted motions and produces clearer and smoother visual output. This technique is especially important in situations such as low-light photography, zoomed images, and video recording, where even a small movement can significantly affect image quality.
This technique is widely used in modern digital cameras, smartphones, drones, and surveillance systems.

I. Objectdetection:

Some fundamental issues of object detection are considered and reviewed in this section. Approaches have been categorized according to the method used to isolate the object from the background on a single frame or a sequence of frames.

➢ Thresholding:

This is one of the simplest, but less effective techniques, which operates on still images. It is based on the notion that vehicles are compact objects having different intensity form their background. Thus, by thresholding intensities in small regions we can separate the vehicle from the background. This approach depends heavily on the threshold used, which must be selected appropriately for a certain vehicle and its background. Adaptive thresholding can be used to account for lighting changes but cannot avoid the false detection of shadows or missed detection of parts of the vehicle with similar intensities as its environment.

V. CONCLUSION

Image processing is the act of examining images for the purpose of identifying objects and judging their significance" Image analyst study the remotely sensed data and attempt through logical processing detecting identifying classifying, measuring and evaluating the significance of physical and cultural objects, their patterns, and spatial relationships. Video processing is a particular case of signal processing, where the input and output signals are video files or video streams. Video processing techniques are used in television sets, VCRs, DVDs, video players, and other devices. Image and video processing are very helpful in many ways. In this paper, we discuss the elements of digital image processing and the elements of digital video processing. Lastly, we review the current technologies and techniques in these fields

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