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قسم الانظمة الطبية الذكية

المحاضرة الرابعة

Computer Vision and Image Processing

المادة : DSP
المرحلة : الثالثة
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Study Year: 2024-2025

4.1- Computer Imaging Systems

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4.3- Image Processing

4.4- The Major Topics Within The Field of Image Processing Include

1. **Image restoration.**
2. **Image enhancement.**
3. **Image compression.**

4.5- Examples of Fields that Use Digital Image Processing (DIP)

4.1 Computer Imaging Systems

Computer Imaging Can be defined as acquisition and processing of visual information by computer. Computer representation of an image requires the equivalent of many thousands of words of data, so the massive amount of data required for image is a primary reason for the development of many sub areas with field of computer imaging, such as image compression and segmentation, object detection, face recognition.

Computer imaging systems are comprised of two primary components types: hardware and software.

• The hardware components can be divided into image acquiring sub system (computer, scanner, and camera) and display devices (monitor, printer).

• The software allows us to manipulate the image and perform any desired processing on the image data.

Computer imaging can be divided into two main category:

1. **Computer Vision. (Applications of the output are for use by computer)**
2. **Image Processing. (Applications of the output are for use by human)**

4.2 Computer Vision

Computer vision emulate human vision, which mean understanding the scene based on image data. It enables computers to interpret and understand visual information

from the world, such as images and videos. It involves techniques for image processing, pattern recognition, and machine learning.

- **One of the major topic within this field is image analysis**

Image analysis: involves the examination of image data to solve a vision problem, it involves two major process:

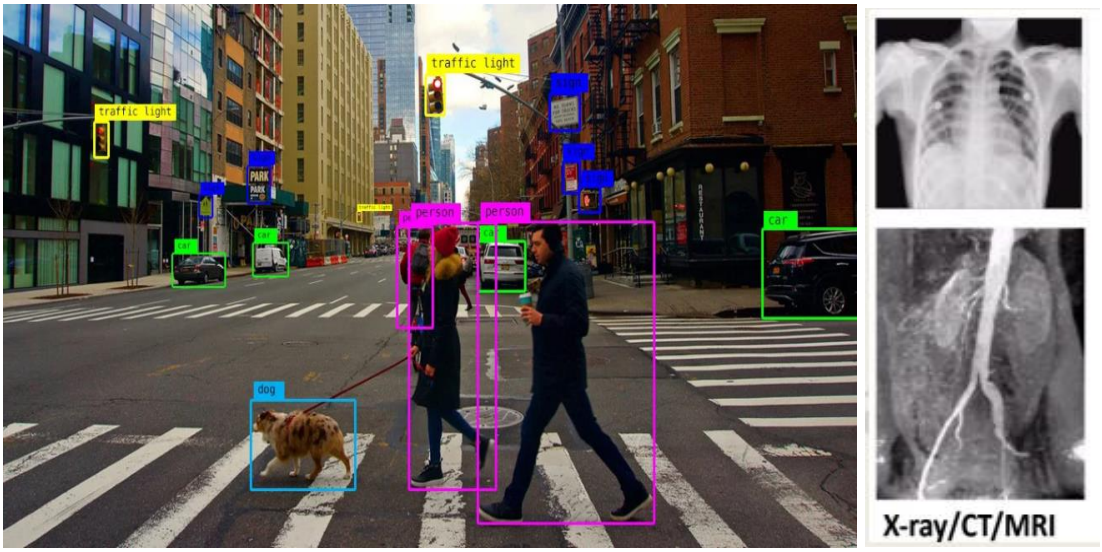
1. Feature extraction - acquiring higher level image information such as shape & color.

2. Pattern classification – taking the higher level information and classify the feature for pattern recognition/identification purposes.

The Applications of computer vision:

Most applications involve automate tasks that either are tedious for people to perform, require work in a hostile environment, require high rate of processing or access and use of large data base of information.

1. **Facial Recognition:** Used in security, social media, and mobile devices for user authentication and tagging.
2. **Autonomous Vehicles:** Enables cars to interpret and navigate their surroundings, recognizing traffic signs, pedestrians, and obstacles.
3. **Medical Imaging:** Assists in diagnosing diseases by analyzing images from X-rays, MRIs, and CT scans.
4. **Object Detection and Tracking:** Commonly used in retail for inventory management and in surveillance systems.



a b

Fig 4.1: Examples of Computer Vision

4.3 Image Processing

Processed images are to be used by human. Therefore, require some understanding of human visual system.

Image processing does some transformations on image such as: sharpening, contrasting, stretching on the image for making image more enhancive and readable that is input and output of a process are images.

Image processing systems are used in many and various types of environments, such as:

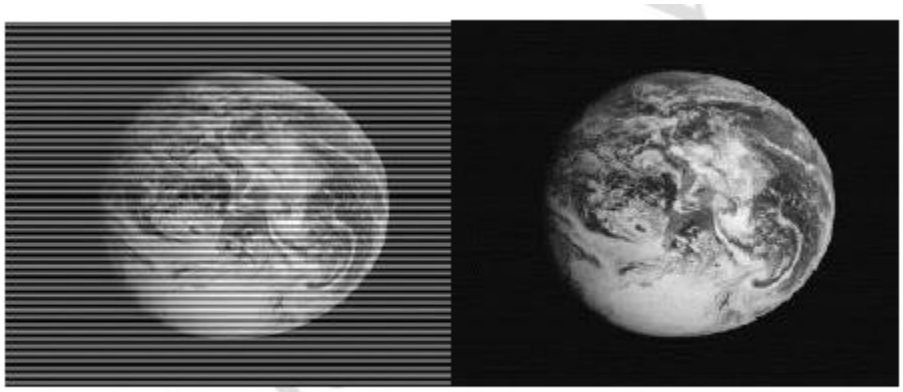
1. **Medical community**
2. **Computer – Aided Design**
3. **Virtual Reality**

4.4 The major topics within the field of image processing include:

1. **Image restoration.**
2. **Image enhancement.**
3. **Image compression.**

1- Image Restoration

Taking an image with some known, or estimated degradation and restore it back to original appearance by performing the reverse of the degradation process to the image. Example, eliminating artefact generated by noise, defect in telescope lens, blurring effect due to imperfect focusing, the field of photography, or publishing where an image needs to be improved before it can be printed as shown in fig 4.2.



a. Image with Distortion b. Restored image

Fig 4.2 Image Restoration

2- Image Enhanceme

Improve an image visually by taking advantage of Human Visual Systems (HVS). Example: improve contrast, image sharpening and image smoothing.

Enhancement methods tend to be problem specific. For example, a method that is used to enhance satellite images may not suitable for enhancing medical

images. Although enhancement and restoration are similar in aim to make an image look better, they differ in how they approach the problem. Restoration method attempt to model the distortion to the image and reverse the degradation, where enhancement methods use knowledge of the human visual systems responses to improve an image visually.

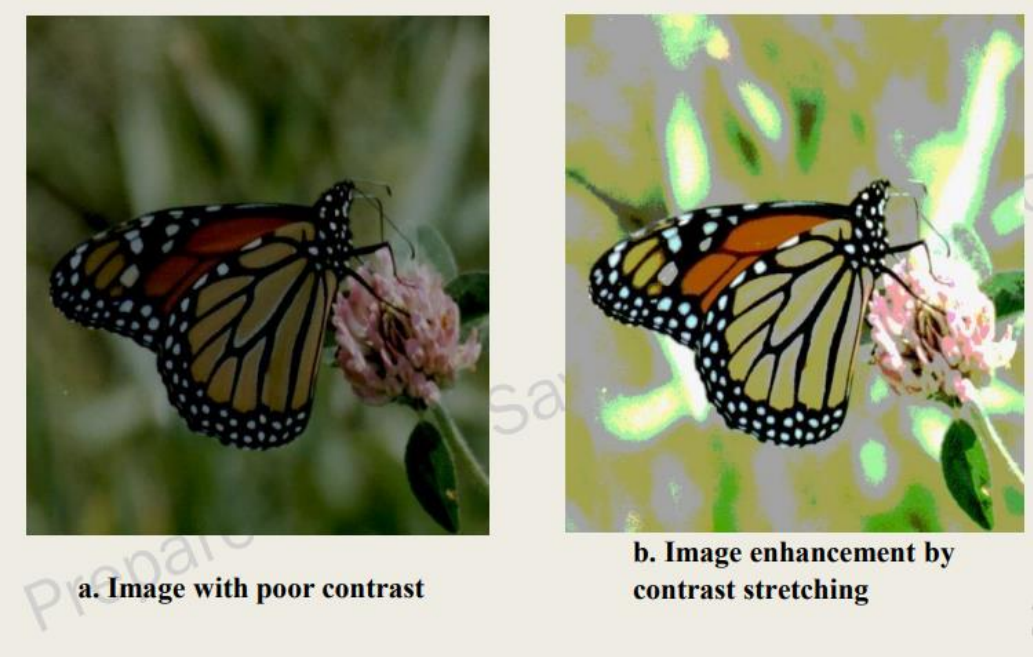


Fig 4.3 Image Enhancement

3- Image Compression

Involve reducing the typically massive amount of data needed to represent an image. This is done by eliminating data that are visually unnecessary and by taking advantage of the redundancy that is inherent in most images. See Figure (4.4)

a. Image before compression
92 KB

b. Image after compression
6.59 KB

Fig. 4.4: Image Compression

4.5 Examples of Fields that Use Digital Image Processing (DIP)

It is one of the simplest ways to categorize images according to their resources (e.g., visual, X-ray, and so on).

a. Gamma-Ray Imaging

Major uses of imaging based on gamma rays include nuclear medicine and astronomical observations as seen in Fig 4.5.

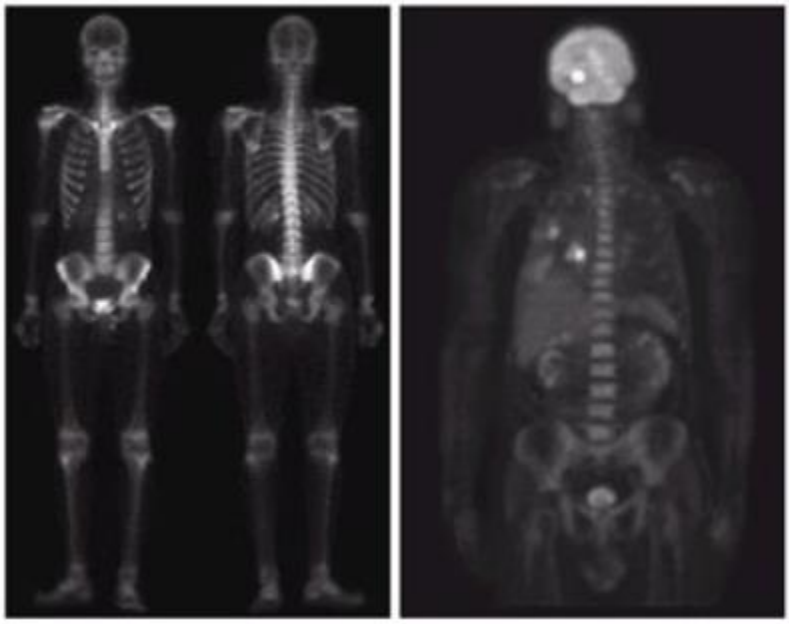


Fig 4.5 Gamma Ray Imaging

b. X-Ray Imaging

The best-known use of X-rays in medical diagnostics, but they also are used in industry and other areas, like astronomy.

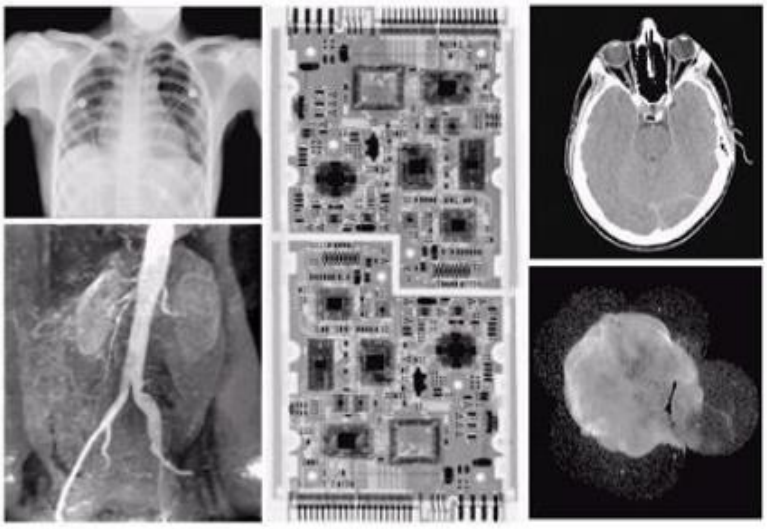


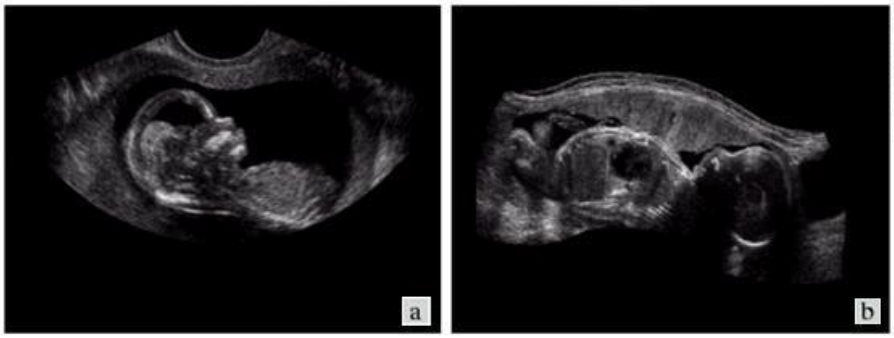
Fig 4.6 X-Ray imaging

c. Imaging in the Ultraviolet, Visible and Infrared Bands.

d. Imaging in the Microwave Band.

e. Ultrasound imaging

The best-known applications of ultrasound imaging are in medicine, especially in obstetrics.



Examples of ultrasound imaging. (a) Baby. (2) Another view of baby.

Fig 4.7 Ultrasound imaging