Govt. Women Engineering College, Ajmer

Btech VIII Semester I Mid Term Examination – Feb 2018

Subject: Digital Image Processing

Time: 1 Hr. **Max. Marks: 20**

Ques 1: Define Digital Image processing?What are the variou applications of Digital Image processing (8)

Ques 2: What do you mean by Image Compression.Explain in brief?(6)

Ques 3: Explain various steps in Digital Image processing ?(6)

DIGITAL IMAGE PROCESSING

by Gonzalez & Woods

DEF: Processing of Images which are digital in nature by a digital computer

Why do we need Image Processing:

It is motivated by ~~three~~ major applications:

→ Improvement of pictorial information for human perception: This means that whatever image we get we need to enhance the quality of image so that the image will have a better look.

→ Image processing for autonomous m/c application: This has various applications in industry particularly for quality control in assembly automation and many such applications.

→ Efficient storage and transmission: Suppose we want to store an image in a computer, then this image will occupy certain amount of disk space. We will look at whether it is possible to process the image using certain image processing properties so that the disk space required for storing the image will be less.

Not only that, we can also have the application where we want to transmit the image or the video signal over a transmission medium & in that case if the Bandwidth of the transmission medium is very low, we will see that how to process the image or the video so that it can be transmitted over low Bandwidth communication channel.

Applications:

Human Perception: Employ methods capable of enhancing pictorial information for human interpretation & analysis.

Typical applications are:

Noise filtering: In some cases the images that we get may be very very noisy so we have to filter those

→ Contrast enhancement

↳ Contrast enhancement: Sometimes the image may be very very poor contrast & we need to enhance the contrast of the image so that it is better visually.

↳ Deblurring: The image may be blurred. This blurring may occur due to various reasons. Maybe the camera setting is not proper or the lens is not focussed properly so that leads to one kind of blurring. Other kind of blurring is if we take a picture from a moving platform say from a moving car or a moving train. In that case also, the image is not a clear image but a blurred one.

So we need to look at whether the image processing techniques can help to rectify those images.

→ Remote Sensing: The type of images which are used are the aerial images and in most of the cases the aerial images are taken from the satellite. We can

Medical Imaging: CT scan picture m/c processed image is used to find the location of tumor in the brain. By the processed image, the Doctors will easily be able to find the exact location and size of tumor and many other things which can help the Doctors to plan the operation process.

→ Cancer Detection: image is very helpful to find the detect the formation of cancer.

→ Ultra Sonogram: Ultrasonic images are used to detect the growth of a baby when the baby is in the mother's womb & this also helps the doctor to monitor the health of a baby before the baby is actually born

Remote Sensing: Many information can be taken from aerial image. We can study things like, whether the river has changed its path, we can study that what is the growth of vegetable over certain region, we can study if there is some pollution in the region

Remote sensing images can also be used for planning a city. Suppose we have to build a city over a certain region. Then through this aerial image we can study that what is the nature of the region over which the city has to be build. & through this one can determine that where the residential area has to be given, where the industrial area has to be given, through which regions the roads have to be constructed & all other things.

→ **Terrain Mapping:** Hilly regions which are not easily accessible. Through remote sensing we can get the aerial image of the terrain, then process those images to find the 3D terrain map.

→ **Borneo Fire:** These satellite images are used to find the extent of fire or in which direction the fire is moving. Once you identify that, you can determine that what is the loss that has been made by this fire. Once knowing the direction, we can warn the people so that precautionary actions are made & many lives are saved.

Weather Forecasting: images show that what is the cloud formation in some areas. That gives us an idea about rain, storm etc.

→ Hurricase over Dennis 1990.

Atmospheric Study:

→ Ozone hole : Ozone layer is very important for us. Bcoz it gives us a protective layer over our atmosphere & bcoz of this ozone protective layer many of the unwanted rays from sun cannot enter our earth's surface. Whenever there is formation of an ozone hole, indicates that all the unwanted rays can enter the earth's surface through that ozone hole. So the region over which such an ozone hole is formed, people of that region should take some necessary precautions.

Astronomy:

→ Star formation : Image of star formation process.

→ Galaxy :

Machine Vision Applications: Here the interest is on procedures for extraction of image information suitable for computer processing. Here we are not much interested in improving the visual Quality but we are interested in processing the images so as to extract some description on features which can be used for further processing by a digital computer.

Typical Applications:

→ Industrial m/c vision for product assembly and inspection.

→ Automated target detection and tracking.

→ finger print recognition.

→ M/c processing of aerial and satellite imagery for weather prediction and crop assessment etc.

tomated Inspection:

Bottling Plant Automation: The plant fills some chemicals in the bottle & after filling, the bottles are carried away and after that they are packed & finally sailed to the customers. Checking the quality of product is important. Quality of product indicates that whether the bottles are filled properly or partially filled or empty. If through image processing we can find out those bottles which are partially filled or empty, then obviously we don't want those bottles to be delivered to the customers. Bcoz then the goodwill of the company will be lost. Image processing techniques can be used to detect such bottles.

Boundary Information:

→ Importance of Boundary information: Even if we don't have any other information, we can recognize many of the images only through the boundary.
Eg: giraffe
The boundaries contain most of the information of the objects in the scene and using these Boundaries we can develop various applications of image processing techniques.

VIDEO SEQUENCE PROCESSING: The different image frames which are displayed one after the other. If there is any movement in the image, than that movement is clearly detected. The major emphasis of image sequence processing is detection of moving parts. This has various applications:

→ Detection and tracking of moving targets for security surveillance purpose
→ To find out the trajectory of a moving target.
→ Monitoring the movements of organ boundaries in medical applications etc.

Image Compression: An image usually contains lot of redundancies that can be exploited to achieve compression. If the intensity of an area in an image is same, then we may store only one point and by some mechanism if we may predict that the intensity of the neighbouring points will be the same, then we can reduce the size of image to be stored on disk.

The image shows 3 kinds of redundancy:

→ Pixel Redundancy. - related to statistical dependencies or correlation b/w neighbouring pixel values

→ Coding Redundancy. → Temporal redundancy or correlation between neighbouring pixels in an image is represented in form of codes

→ Psychovisual Redundancy. → Human perception, how much info in an image is essential for visual processing

Image contains 2 types of entities:

→ Information content of the image.

→ Redundancy.

What is done for image compression purpose is we process the image and try to remove the redundancy present in the image and try to retain only the information present in the image. If we retain only the information, then the same image can be stored using much lower space.

Applications are:

→ Reduced storage.

→ Reduction in Bandwidth.

Brief History: In 1920's Submarine cables were used to transmit digitized Newspaper pictures b/w London and New York Bartlane systems. Specialized printing equipments were used to code the pictures for cable transmission and its reproduction on the receiving end.

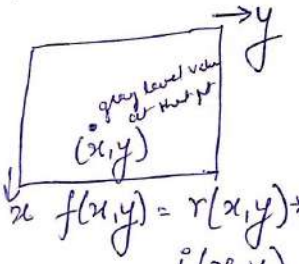
1921, printing procedure was changed to photographic reproduction from tapes perforated at telegraph receiving terminals. This improved both tonal Quality and resolution.

Bartlane System was capable of coding 5 distinct brightness levels. This was increased to 15 levels by 1929.

Improvement of processing techniques continued for next 35 years. In 1964 computer processing techniques were used to improve the pictures of moon transmitted by Ranger 7 at Jet Propulsion Laboratory. This was the basis of modern Image processing techniques.

Image Representation: Images in digital computer are represented as:

→ An image is a 2-D light intensity function $f(x,y)$.



→ A digital image $f(x,y)$ is discretized both in spatial coordinates and brightness.

→ It can be considered as a matrix whose row, column indices specify a point in the image and the element value identifies gray level value at that point.

→ These elements are referred to as pixels or pels.

$$f(x,y) = r(x,y) * i(x,y)$$

$r(x,y)$ → reflectivity of the surface of the corresponding image point.

$i(x,y)$ → intensity of the incident light.

There are infinite number of points in an analog image and at every point the intensity values is also continuous

The minimum value can be 0, and the maximum can be ∞. So can we store such an image in a digital computer where we have infinite points and infinite possible intensity values. Obviously NO.

So, we have to go for some processing of an image and instead of storing all intensity values at all points in the image, we try to take samples of the image at regular grid.

→ The first level that we need for representation of an image in a digital computer is spatial discretization by grids.

Once we get these sample values then at every point the value of that particular sample is continuous, so it can assume any of the infinite possible values which again could not be represented on a digital computer.

→ After sampling, the second level is Intensity discretization by Quantization.

$$I = \begin{bmatrix} f(0,0) & f(0,1) & f(0,2) & \cdots & f(0,N-1) \\ f(1,0) & f(1,1) & f(1,2) & \cdots & f(1,N-1) \\ f(2,0) & f(2,1) & f(2,2) & \cdots & f(2,N-1) \\ \vdots & \vdots & \vdots & & \vdots \\ f(M-1,0) & f(M-1,1) & f(M-1,2) & \cdots & f(M-1,N-1) \end{bmatrix}$$

Image size = 256 X 256, 512 X 512, 640 X 480, 1024 X 1024 etc.

Quantization = 8 bits. (for black and white)

24 bits (for coloured image)

Steps in Digital Image Processing: Digital Image processing involve following basic tasks:

→ Image Acquisition: An imaging sensor and the capability to digitize the signal produced by the sensor

→ Preprocessing: Enhances the image quality, filtering, contrast enhancement etc.

→ Segmentation: Partitions an input image into constituent parts of objects.

→ Description/Feature Selection: Extracts description of image objects suitable for further computer processing

→ Recognition & Interpretation: Assigning a label to the object based on the information provided by its description. Interpretation assigns meaning to a set of labelled objects.

→ Knowledge Base: Knowledge Base helps for efficient processing as well as inter module cooperation.