IMAGE PROCESSING QUESTION BANK AND ANS

UNIT: 1

1. DEFINE IMAGE. EXPLAIN DIGITAL AND ANALOG IMAGE. EXPLAIN DIGITAL IMAGE PROCESSING?

- **IMAGE:** An image is a visual representation of something, while a digital image is a binary representation of visual data. These images can take the form of photographs, graphics and individual video frames. For this purpose, an image is a picture that was created or copied and stored in electronic form.
- **DIGITAL IMAGE**: If x, y and the intensity values are all finite and discrete, then the image is known as a digital image. The digital image is composed of a finite number of elements which has a particular location and value.
- **ANALOG IMAGE:** The images are manipulated by electrical signals. In analog image processing, analog signals can be periodic or non-periodic. Examples of analog images are television images, photographs, paintings, and medical images etc.
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2. DESCRIBE FUNDAMENTAL STEPS IN IMAGE PROCESSING?

1. **Image acquisition** The image is captured by a sensor like camera or any analog device and digitized if the output of the camera or sensor is not already in digital form, using analogue-to-digital converter. It involves pre-processing of images.

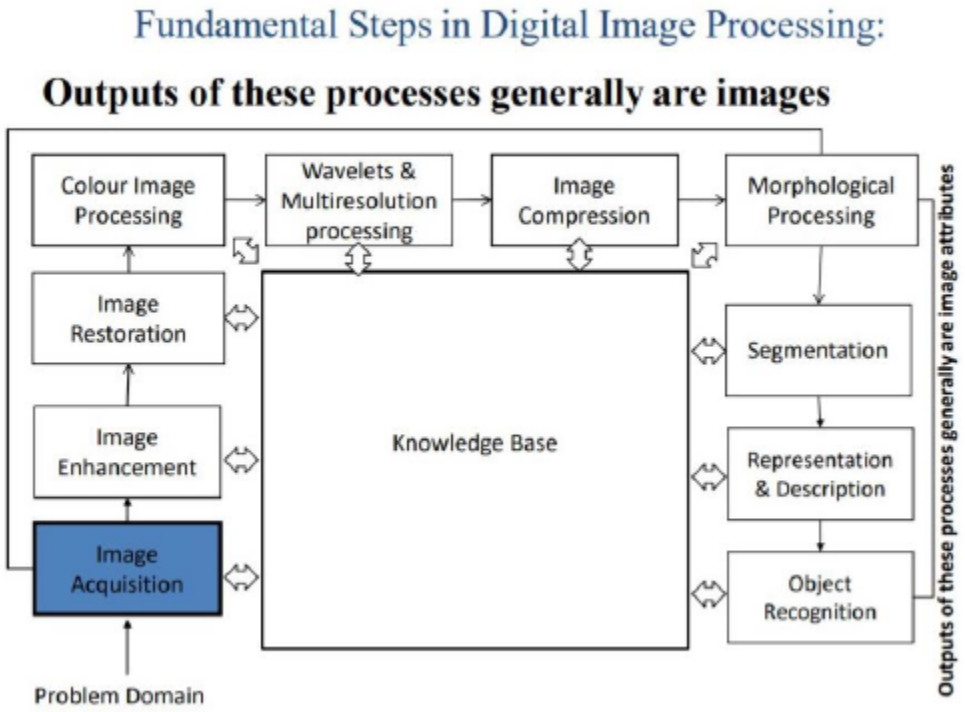
2. Image Enhancement The process of manipulating an image so that the result is more suitable than the original for specific applications. The idea behind enhancement techniques is to bring out details that are hidden, or simple to highlight certain features of interest in an imagE.
3. Image Restoration Deals with improving the appearance of an image. Based on mathematical or probabilistic models of image degradation.
4. Colour Image Processing Use the colour of the image to extract features of interest in an image. Understand the basics concepts of color models and color processing in digital domain.
5. Wavelets Wavelets are the foundation of representing images in various degrees of resolution. It is used for image data compression and for representation of images in smaller regions.
6. Compression Deals with various techniques used for reducing the storage required to save an image in digital form or the bandwidth required to transmit the images.
7. Morphological Processing Deals with tools for extracting image

components that are useful in the representation and description of shape. In this step, there would be a transition from processes that output images, to processes that output image attributes.

8. Segmentation Segmentation partitions an image into its constituent parts or objects. Autonomous segmentation is the most difficult tasks in digital image processing.

9. Feature extraction It consists of feature detection and feature description. Feature detection refers to finding a feature in an image, region or boundary. Feature description assigns quantitative attributes to the detected features.

10. Image pattern classification The process that assigns a label to an object based on its feature descriptors. There are various classification algorithms like correlation, Bayes classifiers to identify and predict the class label for the object.



2. **WRITE DOWN ADVANTAGES AND DISADVANTAGES OF DIGITAL IMAGE?**

Advantages	Disadvantages
Enhanced Image Quality	Complexity
Improved Medical Diagnosis	Cost
Increased Efficiency	Quality
Enhanced Security	Time-consuming
Creative Applications	Ethics

3. LIST VARIOUS IMAGE FILE FORMATS. EXPLAIN ANY ONE IN DETAIL.

- An image file format is a file format for a digital image. There are many formats that can be used, such as JPEG, PNG, and GIF. Most formats up until 2022 were for storing 2D images, not 3D ones. The data stored in an image file format may be compressed or uncompressed.
- Raster formats are for 2D images. A 3D image can be represented within a 2D format, as in a stereogram or auto stereogram, but this 3D image will not be a true light field, and thereby may cause the vergence-accommodation conflict.
- Image files are composed of digital data in one of these formats so that the data can be displayed on a digital (computer) display or printed out using a printer. A common method for displaying digital image information has historically been rasterization.
- For example, a 640 × 480 pixel image with 24-bit color would occupy almost a megabyte of space:
- 640 × 480 × 24 = 7,372,800 bits = 921,600 bytes = 900 KiB

4. EXPLAIN THE COMPONENTS OF DIGITAL IMAGE PROCESSING WITH LABELLED DIAGRAM?

1 **Image Sensors** Two subsystems are required to acquire digital images. The first is the physical device that is sensitive to the energy radiated by the object we wish to image (Sensor). The second, called a digitizer, is a

device for converting the output of the physical sensing device into digital form.

2 **Specialized Image Processing Hardware** It usually consists of the digitizer, and the hardware that performs other primitive operations, such as an arithmetic logic unit (ALU), which performs arithmetic and logical operations in parallel on entire images. This type of hardware is called as frontend subsystem.

3 **Computer** The computer in an image processing system is a general-purpose computer and can range from a PC to a supercomputer .

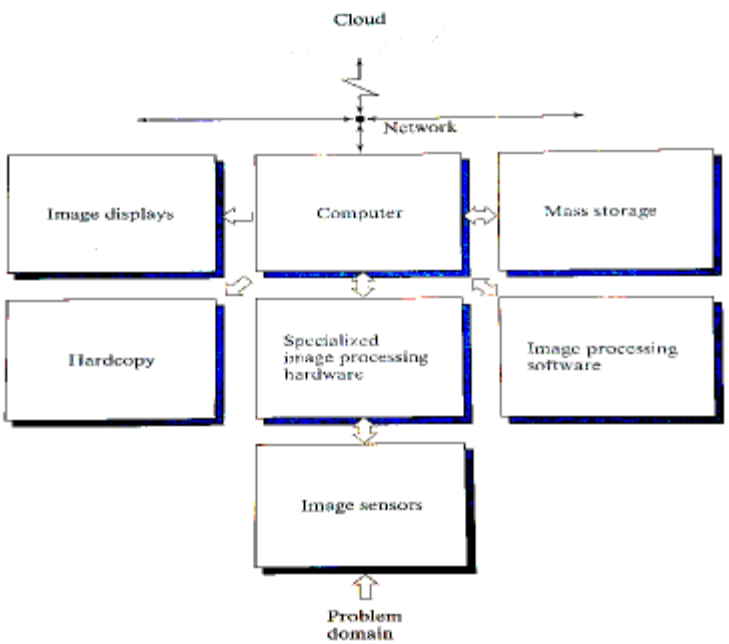
4 **Image Processing Software** The software performs tasks with the help of specialized modules. There are many software's available commercially.

5 **Mass Storage** Digital storage for image processing applications basically is divided into three principal categories. a) Short-term storage for use during processing b) On-line storage for fast recall c) Archival storage which is characterized by infrequent access. Storage is measured in bytes (Kbytes, Mbytes, Gbytes and Tbytes)

6 **Image Displays** Monitors are driven by the outputs of the image and graphics display cards that are an integral part of a computer system. There are variants in monitor displays.

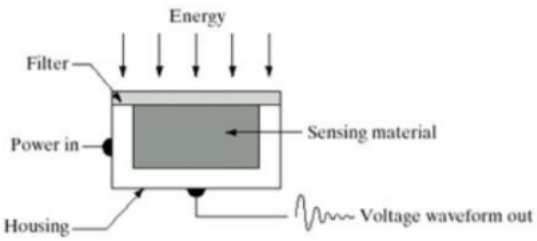
7 **Hardcopy devices** Used for recording images, include laser printers, film cameras, heat-sensitive devices, inkjet units and digital units, such as optical and CD-ROM disks.

8 **Networking and cloud communication** Transmission bandwidth has improved due to optical fibre and other cloud technologies



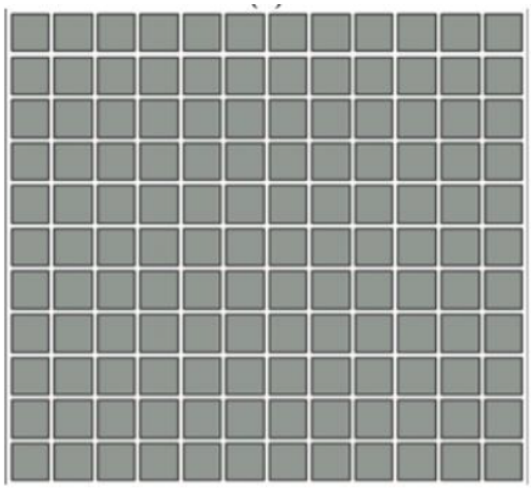
9 EXPLAIN IMAGE SENSING AND ACQUISITION WITH ITS TYPES?

- Images are generated by the combination of illumination of source and the reflection or absorption of energy from that source by element of the scene being imaged.
- There are three principal sensor arrangements that can be used to transform incident energy into digital images. Incoming energy is transformed into a voltage pulse by input electric power and sensor response where a digital quantity is obtained by digitizing the response.
- The most common sensor is the photodiode constructed of silicon materials and output voltage waveform proportional to light. Using a filter in front of the sensor improves its selectively. In order to generate a 2-D image using a single sensor, there have to be relative displacements in both the x- and y-directions between the sensor and the area to be imaged.



1.7.2 Image Acquisition using Line sensor

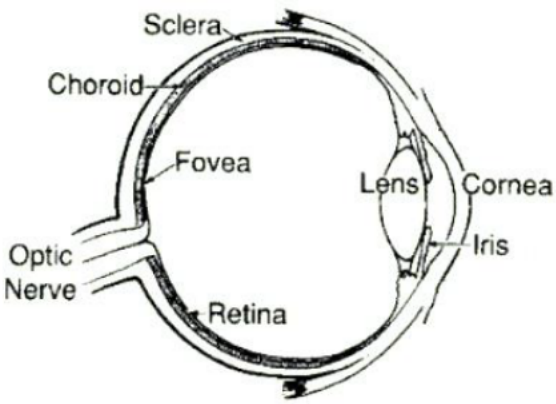
1.7.3 Image Acquisition using Array sensor



10 HOW IS IMAGE FORMED IN HUMAN EYE?

- The first part of the visual system is the eye. Its form is nearly spherical and its diameter is approximately 20 mm. Its outer cover consists of the ‘cornea' and ‘sclera'
- At its anterior extreme lies the iris diaphragm. The light enters in the eye through the central opening of the iris, whose diameter varies from 2mm to 8mm, according to the illumination conditions. Behind the iris is the “lens” which consists of concentric layers of fibrous cells and contains up to 60 to 70% of water.
- It focuses the light on the “retina” which is the innermost membrane of the eye.
- Retina has two kinds of photoreceptors: cones and rods. The cones are highly sensitive to color. Their number is 6-7 million and they are mainly located at the central part of the retina. Each cone is connected to one nerve end
- This is the scotopic or dim-light vision. Their number is 75 to 150 million and they are distributed over the retinal surface. Several rods are connected to a single nerve end. This fact and their large spatial distribution explain their low resolution.
- Both cones and rods transform light to electric stimulus, which is carried through the optical nerve to the human brain for the high-level image processing and perception.

Elements of Human Visual Perception



11 WRITE A SHORT NOTE ON SAMPLING AND QUANTIZATION.

- An image may be continuous with respect to the x and y coordinates and also in amplitude. To convert it into digital form we have to sample the function in both coordinates and in amplitudes. Digitalizing the coordinate values is called sampling. Digitalizing the amplitude values is called quantization. There is a continuous image along the line segment AB.

- To sample this function, we take equally spaced samples along line AB. The location of each sample is given by a vertical tick back (mark) in the bottom part. The samples are shown as block squares superimposed on function the set of these discrete locations gives the sampled function. In order to form a digital image, the gray level values must also be converted (quantized) into discrete quantities. So, we divide the gray level scale into eight discrete levels ranging from black to white.
- The vertical tick mark assigns the specific value assigned to each of the eight level values. The continuous gray levels are quantized simply by assigning one of the eight discrete gray levels to each sample. The assignment it made depending on the vertical proximity of a simple to a vertical tick mark.

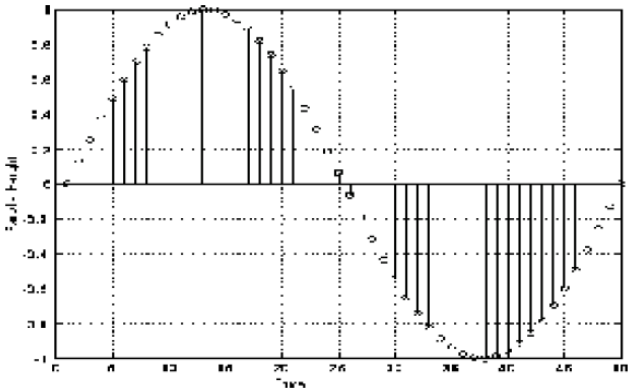


Fig 1.5: Sampling

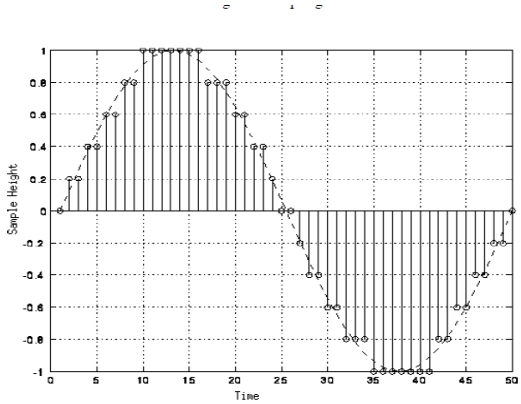


Fig 1.6: Quantization

12 EXPLAIN THE DIFFERENT TYPES OF CONNECTIVITY OF PIXELS WITH SUITABLE EXAMPLE?

- a) 4-connectivity: Two or more pixels are said to be 4-connected if they are 4-adjacent with each others.
- b) 8-connectivity: Two or more pixels are said to be 8-connected if they are 8-adjacent with each others.
- c) m-connectivity: Two or more pixels are said to be m-connected if they are m-adjacent with each others.

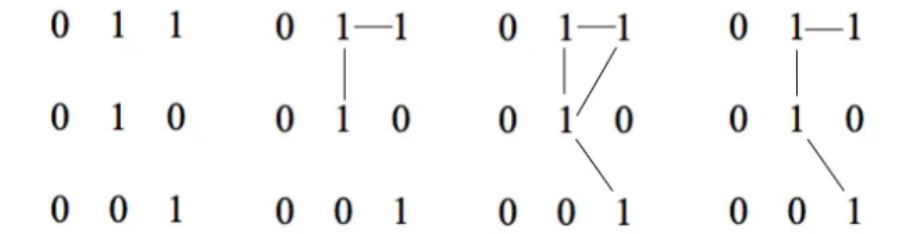


Fig: An arrangement of pixels | Fig: 4-connectivity of pixels | Fig: 8-connectivity of pixels | Fig: m-connectivity of pixels

13 EXPLAIN THE CONCEPT OF BRIGHTNESS ADAPTATION AND DISCRIMINATION?

- *Brightness Adaptation and Discrimination: Digital images are displayed as a discrete set of intensities. The eyes ability to discriminate black and white at different intensity levels is an important consideration in presenting image processing result.*
- *an apparent decrease in the intensity of a stimulus after exposure to a high level of incident illumination. For example, the inside of a house appears very dim to someone coming in from a snow-covered garden.*
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14 WRITE A SHORT NOTE ON BIT PLANE SLICING TECHNIQUE WITH EXAMPLE.

- It is important to highlight the contribution made to the total image appearance by specific bits. Suppose that each pixel is represented by 8 bits.
- Imagine that an image is composed of eight 1-bit planes ranging from bit plane 0 for the least significant bit to bit plane 7 for the most significant bit. In terms of 8-bit bytes, plane 0 contains all the lowest order bits in the image and plane 7 contains all the high order bits.

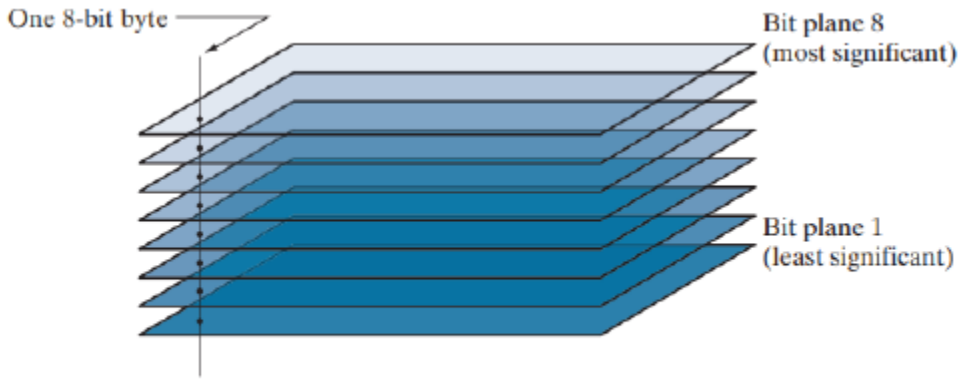

Fig 2.9 Bit-planes of an image

15 DEFINE IMAGE ENHANCEMENT. EXPLAIN GRAY LEVEL SLICING?

IMAGE ENHANCMENT: Image enhancement is the process of adjusting digital images so that the results are more suitable for display or further image analysis. For example, you can remove noise, sharpen, or brighten an image, making it easier to identify key features.

GRAY SLICING: This technique is used to highlight a specific. range of gray levels in a given image. – Similar to thresholding. – Other levels can be suppressed or maintained. – Useful for highlighting features in an image.

$$L = 2^k$$

Where $k = 8$

$$L = 2^8$$

$$L = 256.$$

16 APPLY THE FOLLOWING IMAGE ENHANCEMENT TECHNIQUES FOR THE GIVEN 3 BITS PER PIXEL IMAGE SEGMENT. DIGITAL NEGATIVE

THRESHOLDING T=5 I = [2 1 2 1 0 7 1 4 3 2 2 4 1 3 7 1 3 4 6 3 1 4 1 3 4]?

UNIT: 2

1. WRITE A SHORT NOTE ON DFT?

2. EXPLAIN ANY TWO PROPERTIES OF 2D DFT?
3. EXPLAIN SAMPLING THEOREM. DESCRIBE THE FOURIER TRANSFORM OF SAMPLED FUNCTION?
4. EXPLAIN THE TERMS: (A)SMOOTHING (B) SHARPENING?
5. WRITE A NOTE ON IMAGE ENHANCEMENT USING SPATIAL FILTER?
6. WHAT IS HISTOGRAM OF AN IMAGE? COMPARE BETWEEN HISTOGRAM EQUALIZATION AND HISTOGRAM MATCHING?
7. EXPLAIN FOURIER TRANSFORM AND 2D FOURIER SERIES WITH ITS EQUATION AND FREQUENCY RESPONE?
8. JUSTIFY "BUTTERWORTH LOW PASS FILTER IS PREFERRED TO IDEAL LOW PASS FILTER?
9. EXPLAIN GAUSSIAN LOW PASS FILTER TRANSFER FUNCTION WITH DIAGRAM?
10. STATE AND EXPLAIN THE PROPERTIES OF SYMMETRY AND PERIODICITY AS APPLY TO 2-D DFT?
11. PERFORM HISTOGRAM EQUALIZATION ON GRAY LEVEL DISTRIBUTION SHOWN IN THE TABLE. DRAW THE HISTOGRAMS OF THE ORIGINAL AND EQUALIZED IMAGES. GRAY LEVELS 0 1 2 3 4 5 6 7 NO. OF PIXELS 100 250 100 300 150 0 0 0 ?

UNIT: 3

1. PROVE THE HEISENBERG UNCERTAINTY PRINCIPLE IN SIGNAL PROCESSING?
2. WHY SCALING FUNCTIONS ARE USED? EXPLAIN THE HAAR SCALING FUNCTION.?
3. DISCUSS VARIOUS COLOR MODELS USED IN IMAGE PROCESSING
4. EXPLAIN THE COLORS CONVERSIONS OF RGB TO HIS MODEL?
5. USE ARITHMETIC DECODING PROCESS TO DECODE THE MESSAGE 0.23355 GIVEN SYMBOL {A, E, I, O, U, M } AND THEIR PROBABILITY {0.2, 0.3, 0.1, 0.2, 0.1, 0.1}?

6. WHAT IS MEANT BY PSEUDO-COLORING? FOR WHAT PURPOSE IS IT USEFUL? EXPLAIN HOW A PSEUDO COLORED IMAGE CAN BE OBTAINED?
7. GENERATE THE HUFFMAN CODE FOR THE WORD "COMMITTEE"?
8. COMPARE LOSSY AND LOSSLESS IMAGE COMPRESSION?
9. WRITE DOWN STEPS OF SHANNON-FANO CODING.
10. EXPLAIN DIGITAL IMAGE WATERMARKING WITH EXAMPLE?
11. EXPLAIN WALSH-HADAMARD TRANSFORMS (WHTS)?

UNIT: 4

1. EXPLAIN DILATION AND EROSION AND EXPLAIN HOW OPENING AND CLOSING ARE RELATED WITH THEM.?
2. WRITE A NOTE ON MORPHOLOGICAL SMOOTHING?
3. EXPLAIN VARIOUS TECHNIQUES OF IMAGE ARITHMETIC.
4. HOW CONNECTED COMPONENTS OF AN IMAGE ARE DETECTED? LIST ANY ONE OF ITS APPLICATIONS?
5. HOW CONNECTED COMPONENTS OF AN IMAGE ARE DETECTED? LIST ANY ONE OF ITS APPLICATIONS?
6. HOW IS THRESHOLDING USED IN IMAGE SEGMENTATION?
7. WRITE A SHORT NOTE ON THINNING AND THICKENING?
8. WHAT IS BLOCK PROCESSING? EXPLAIN IN DETAIL?
9. WHAT IS THRESHOLDING? EXPLAIN BASIC GLOBAL THRESHOLDING
10. WRITE SHORT NOTES ON I) SEGMENTATION BY REGION SPLITTING AND MERGING II) OPENING?

UNIT: 5

1. EXPLAIN GRADIENT OPERATOR AND LAPLACIAN OPERATOR?
2. WHAT IS EDGE LINKING? HIGHLIGHT ITS SIGNIFICANCE IN IMAGE SEGMENTATION?
3. DESCRIBE IMAGE SEGMENTATION USING SNAKES?
4. EXPLAIN THE METHOD OF EDGE LINKING USING HOUGH

TRANSFORM?

5. WRITE A SHORT NOTE ON REGION SPLITTING AND MERGING?
6. WRITE A SHORT NOTE ON SIFT?
7. EXPLAIN SIFT ALGORITHM WITH STEPS?
8. HOW TO OPTIMIZE THE USE OF MATHEMATICAL MORPHOLOGY OPERATORS?
9. DISCUSS THE HARRIS-STEPHENS (HS) CORNER DETECTOR ALGORITHM?
10. EXPLAIN A CHAIN CODE REPRESENTATION (FREEMAN CHAIN CODE).