B.Sc (IT) - 6

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Assignment

* Ques. & Ans...

1) Explain JPEG, GIF, PNG and BMP image formats in brief with examples.

Ans.

-> JPEG :-

- This file format uses a lossy compression algorithm, so that some information is removed from the image when compressing.
- JPEG is compressed into either full color or grayscale images.
- JPEG compressing mainly works by identifying similar areas of color inside the image and converting them to actually the same color code.
- JPEG uses the DCT method to compress for coding transformation
- It has very good compression rate, image quality also has good transmission rate.

->GIF :- Graphics Interchange Format

- GIF image files are commonly used on the web to display graphics and logos.
- They also supports basic animation which means they are a popular file format for memes on social media sites.
- GIF is a raster file format designed for relatively basic images that appear mainly on the internet.
- GIF files also allow images or frames to be combined creating basic animation.
- Originally designed to speed up the download process for large images.

->PNG :- Portable Network Graphics

- The PNG file format is widely used on websites to display high quality digital images.

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• Created to exceed the performance of GIF files. PNG offers not just lossless compression but also a much broader and brighter color palette.
• It can handle graphics with transparent or semi-transparent backgrounds.
• PNG are the next evolution of the GIF format.

->BMP :- Bitmap

• The BMP format is an uncompressed raster file designed to display high quality images on windows and store printable photos.
• Microsoft developed for its windows OS to maintain the resolution of digital image across different screens & devices.
• It can store 2D images either in color or black & white.
• Mac and android devices are now compatible with them.
• Storing high-quality digital photos supporting the photo printing process.

2 Write a note on sampling and quantization.

Ans.

- The output of the sensors is a continuous voltage that has to be digitized. This involves two processes : Sampling and quantization.

->Sampling :-

• It is a process of digitizing the spatial coordinate values. It may be viewed as partitioning the x-y plane into a grid of M rows and N columns with the coordinates the center of each cell in the grid being a pair from the cartesian product Z^2 so f(x,y)

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is a digital image if $x, y \in Z^e$. Each cell is called a picture element.

- We sample the continuous image into a 2-D array f(x,y) containing M rows and N columns, where (x,y) are discrete coordinates taking up integer values $x = 0, 1, \ldots, M-1$ and $y = 0, 1, \ldots, N-1$. So, f(0,1) indicates the second sample along the first row. Here 0 and 1 are not the values of physical coordinates when the image was sampled.

-> Quantization :

- It is the process of digitizing the amplitude or intensity values.
- Let f(s,t) represent a continuous image function of two continuous variables and convert it to a digital image.
- The values of the above samples that span a continuous range of intensity values must be converted to discrete quantities. This is done by dividing the entire continuous intensity scale into L discrete intervals, ranging from black to white. Where black is represented by a value 0 and white represented by L-1. Depending on the proximity of a sample to one of these L levels, the continuous intensity levels are quantized. In addition to the number of discrete levels used the accuracy achived in quantization is highly dependent on the noise content of the sample singal.

3] Mention the fundamental steps used in digital image processing.

Ans.

- Image Acquisition :
- Retrieving an image from some source usually hardcore based source for processing.
- Image acquisition involves pre-processing such as scaling.

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- Image Enhancement :-

• Image Enhancement is a process of manipulating an image. So that the result is more suitable than the original image for a specific application.

• It is application specific.

• Enhancement Techniques are problem oriented.

• Viewer is the ultimate judge for image enhancement techniques.

- Image Restoration :-

• It is a process that attemps to reconstruct or recover an image.

• Similar to enhancement improve the quality of the image.

• Removal of blur by using a deblurring function is considered as a restoration techniques.

- Color image processing :-

• Color is used as the basis for extracting features of interest in an image.

• Color image processing is an area that has been gaining its importance because of the significant increase in the use digital image.

- Wavelets and Multiresolution Processing :-

• Wavelets are the faundation for representing images in various degree of resolution.

- Image Compression :-

• Compression techniques are used to reduce the redundant information in the image data in order to facilitate the storage transmission and distribution of image.

- Morphological processing :-

- Extract image components that are useful in the representation and description of region shape.
- Morphological operations apply a structuring element to an input image, creating an output image of the same size.

- Segmentation :-

- It is the process of partitioning of digital image into multiple segments.
- Used to locate objects and boundries in an image.
- Autonomous segmentation is one of the most difficult task in image processing.

- Image Representation and Discription :-

- After an image is segmented into regions the resulting aggregate of segmented pixels is represented & discribed for further computer processing.

- Object Recognition :-

- Object detection is the process of finding instances of objects in images. This allows for multiple objects to be identified and located within the same image.
- Object recognition can be termed as identifying a specific object in a digital image or video.

4] Describe the image sensing and acquisition process.

Ans.

- Images are generated by the combination of an illumination source and the reflection lubsorption of energy from that source by the elements of the scene being imaged.

-> Single imaging sensor :-

· This can be a photo diode which is constructed with sillicon material and its output voltage is proportional to the amount of falling on it.

- Line Sensor :

· It is consists of an in-line arrangement of sensors in the form of a sensor strip, which provides imagine element in one direction movement perpendicular to the strip provides imaging in the other direction.

- Array Sensor :

· Here the single imaging sensor are arranged in the form of a 2-D array. as the sensor array is 2-dimensional a complet image can be obtained by focusing the & pattern on to the surface of the array and hence movement in any direction is not necessary.

-> Image Acquisition :-

· The response of each sensor is proportional to the integral of light energy projected onto the surface of the sensor. The sensor integrates this energy over minutes or hours to reduce the noise.

· The energy from an illumination source is reflected from the scene element being imaged.

· The imaging system collects this reflected and focuses it onto the image plane.

· The front end of the imaging system projects the viewed sence onto the lens focus ~~parate~~ plane.

· The sensor array which is coincidental with the focal plane produces output proportional to the integral of light received at each sensor which are then digitized resulting in a digital output image.

5] What is Histogram ? Explain equlization with suitable example.

Ans.

- Histogram is a graphical representation of the intensity distribution of an image. In simple terms, it represents the number of pixels for each intensity value cosidered.

- Histogram equlization is a method to process image in order to adjust the contrast an image by modifying the intensity distribution of the histogram.

- Example :-

$$f(x,y) = \begin{matrix} 4 & 4 & 4 & 4 & 4 \\ 3 & 4 & 5 & 4 & 3 \\ 3 & 5 & 5 & 5 & 3 \\ 3 & 4 & 5 & 4 & 3 \\ 4 & 4 & 4 & 4 & 4 \end{matrix}$$

Gray level	0	1	2	3	4	5	6	7
No. of Pixel	0	0	0	6	14	5	0	0

Gray level	No. of Pixel nk	PDF $P_k = n_k/n$	CDF sk	maximum gray level (7) * sk	Histogram equalization level
0	0	0/25 = 0	0	0	0
1	0	0	0	0	0
2	0	0	0	0	0
3	6	0.24	0.24	1.68	2
4	14	0.56	0.8	5.6	6
5	5	0.2	1	7	7
6	0	0	1	7	7
7	0	0	1	7	7

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6	6	6	6	6
2	6	7	6	2
2	7	7	7	2
2	6	7	6	2
6	6	6	6	6

Gray level	:	0	1	2	3	4	5	6	7
No. of Pixel	:	0	0	6	0	0	0	14	5

6) Write a note on spatial filtering.

Ans.

- Filter are use for bluring and noise reduction.

- Blurring use in preprocessing task such as removal of small detail from an image prior to object extraction.

- Noise reduction can be accomplished by blurring with a linear filter and also by non-linear filtering.

-> Linear Filter :-

- They are also known as averaging filter or low pass filture.
- Take the average of pixel contain in the neighbourhood of the filter mask.
- The process results in an image with reduce share transition in intensity which ultimatly lead to noise reduction.

1) Mean / Box Filter :- All co-efficients are equal

$$\frac{1}{9} \times \begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix}$$

2) Weighted Average :-

$\frac{1}{16} \times$

1	2	1
2	4	2
1	2	1

- It give more weight to pixel near the location.

3) Gaussion :-

$$G_\sigma(x,y) = \frac{1}{2\pi\sigma^2} e^{\frac{-x^2+y^2}{2\sigma^2}}$$

- It is use blur edges and reduce contrane in an image. Similar to median but faster.

-> Non-Linear Filter :-

- These response based on ordering the pixel contain in the image area and compass by the filter and than replacing the value determine by the ranking result.

- Median :- Take the mid value of the list
- Min :- Take min value of the list
- Max :- Take the max value of the list

7) Describe the CMY color model.

Ans.

-> The CMY color model also known as the subtractive color model. It is a representation of color based on primary colors of Cyan, Magenta and yellow. This model is primary use in color printing, where colors are created by subtracting varying amounts of these primary colors from white light.

1. Cyan (C) :- It is a blue-green color that absorbs red light. In the cyan CMY model cyan is considered a primary color meaning it cannot be created by mixing other colors. It is essential in subtractive color mixing because it is the complement of red.

2. Magenta (M) :- Magenta is a purplish-red color that absorbs green light. Like cyan magenta is a primary color in the CMY model and cannot be derived from other colors. It is the complement of green.

3. Yellow (Y) :- Yellow is a primary color in the CMY model absorbing blue light. It complements blue.

→ In the CMY model colors are created by subtracting varying amounts of these primary colors from white light when all three primary colors are combined, and their maximum intensity they theoretically absorb all colors resulting in black. However in practical applications like printing a true black ink is typically added to improve the depth and richness of dark colors as the combination of Cyan, Magenta and Yellow alone often result in a dark brown color rather than true black.

8) Explain the psudo color image processing.

Ans.

→ Psudo-color image processing also known as false-color image processing is a technique use to enhance the visual representation of images by mapping pixel intensities to color in a way that may not directly correspond to the colors observed in the original scene. This method is particularly useful in situations where the human eye may have difficulty discering

details or patterns in the original image due to imitations in contrast or dynamic range.

1) Assigning colors to intensity levels :- In psudo color image processing colors are assigned to different intensity level of the original gray-scale image.

2) Color Mapping :- The gray-scale intensity values of the original image are mapped to corresponding colors based on the predefined color map.

3) Enhanced Visualization :- By assigning colors to intentsity levels the psudo-color image can enhance the visual contrast and highlight feature that may not be redily apparent in the original gray image.

4) Applications :- Pseudo-color image processing finds application in various fields such as medical imaging, remote and scientific visualization.

5) Customization :- The choice of color map can significantly impact the interpretation of the pseudo-color image. Different color maps may emphasize different feature or convoy different information.

6) Cautionary Note :- While psuedo-color image processing can be a valuable tool for enhancing image visulization. It's important to exeer cise caution in its use the choise of color map and interpretation of pseudo-color images should be done carefully to avoid misleadir visualization.

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Q. Describe Image degradation / Restoration with proper diagram.

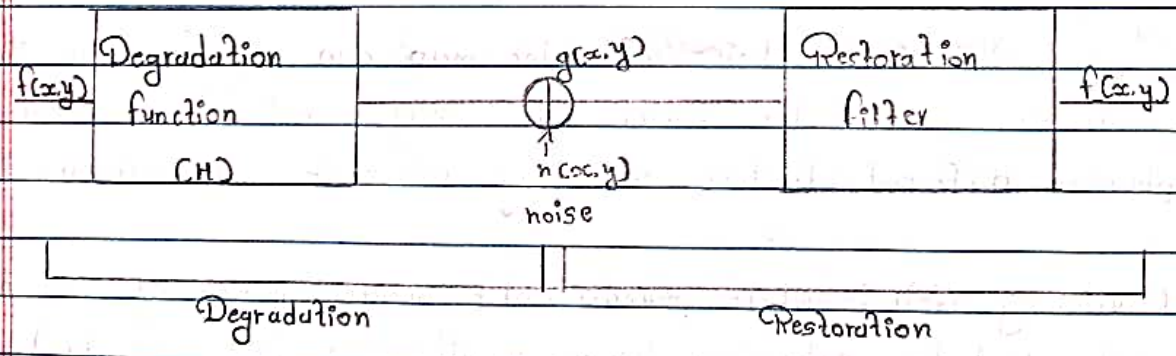
Ans.

-> Image Degradation :-

Image Degradation refers to the process by which the quality of an image deteriorates due to various factors such as noise, blurring, compression or other forms of distoration. This degredation can occure during image acquisition, transmission or processing several factor contribute to image degredation.

-> Image Restoration :-

Image restoration is the process of recovering the original image form a degraded version by minimizing the effects of degradation factors. It involves various techniques aimed at enhancing image quality and improving visual fidelity.



f(x,y) = original image
h(x,y) = degradation function
g(x,y) = degraded image
n(x,y) = Noise in the image

-> Operator H has following properties.

1) It is a linear operator
2) It is position invarient
3) It obeys the rules of homogeneity

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- Additive Noise,

$$g(x,y) = f(x,y) * n(x,y)$$

- Linear Blurring,

$$g(x,y) = f(x,y) * h(x,y)$$

- Additive Noise & Linear Blurring,

$$g(x,y) = f(x,y) * h(x,y) + n(x,y)$$

-> Applying fouriers transform the equation in frequency domain.

$$\therefore G(u,v) = H(u,v)\ F(u,v) + N(u,v)$$

$$\therefore F(u,v) = \frac{G(u,v)}{H(u,v)} - \frac{F(u,v)}{H(u,v)}$$

10] Draw and explain machine vision system.

Ans.

- A machine vision system is a technology that allows machines to perceive and understand the environment through visual data similar to how human use vision to perceive the world around them. It typically involves the use of cameras, image processing and sometimes additional hardware such as lighting or lenses. here's basic overview of how a machine vision system works:

-> Image Acquisition :- The process begins with capturing images or video footage of the object or scene that needs to be analyzed. This is usually done using digital, cameras. Which can range from simple webcams to specialized high-resolution cameras designed for specific application.

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→ Pre-processing :- Raw image captured by the camera often contain noise, distortion or other unwanted artifacts. pre-processing technique are applied to clean up the image and enhance quality.

→ Feature Extraction :- Once the images are pre-processed the next step is to extract relevant feature or characteristics from the image. This cloud include identifying edge shapes color texture or other visual attributes that are important for the task at hand.

→ Pattern Recognition :- In this step the extracted feature are analyzed and compared to known patterns or models stored in the systems memory. This allow the system to recognize object detect classify items or perform other ~~detect~~ tasks based on the visual information contained in the image.

→ Decision Making :- Based on the result of patterns recognition the machine vision system makes decisions or takes actions accordingly this cloud involve storing objects on a production line guiding robotic arms to perform specific tasks triggring alarm for quality control issues or providing feedback to human operators.

Here diagram of machine vision system :-

Image Acquisition
↓
Pre-Processing
↓
Feature Extraction
↓
Pattern-Recognition
↓
Decisionmaking