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Ans.: In digital Image, we define Image as 2 dimensional Intensity function,  $f(x,y)$  where  $x$  and  $y$  are the co-ordinates representing horizontally and vertically. The value of  $f(x,y)$  at any point gives the pixel value at the point of an image. In order to process images an image function  $f(x,y)$  must be digitized both spatially and in amplitude. For a frame grabber, a digitizer used to sample and quantize the analogue video signal. Here, in order to create digital image, we need to convert continuous data into digital form. This process involves Sampling and Quantization process.

The sampling rate governs the spatial resolution of the digitized image, while quantization level fixes the number of grey levels in the digitized image. A magnitude of the sampled image is expressed as a digital value in processor. The change over between

continuous values of the image function and its digital equivalent is called quantization.

The number of quantization levels should be high enough for human perception of fine shading details in the image.

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Ans Image pre-processing: It involves operations on images at the lowest level of abstraction where both input and output images are intensity images. The aim of pre-processing is an improvement of the image data that eliminates distortions or enhances some image features suitable for further processing. Image enhancement is the most appealing pre-processing technique. "The idea behind the enhancement techniques is to bring out detail that is obscured, or simply to highlight certain features of interest in an image such as changing brightness and contrast".

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Ans: The field of digital image processing has seen continuous and significant expansion in recent years. The usefulness of this technology is rising in many different fields covering medicine through remote sensing. The advances and wide availability of image processing hardware has further enhanced usefulness of image processing.

The major fields in which digital image processing is widely used are :

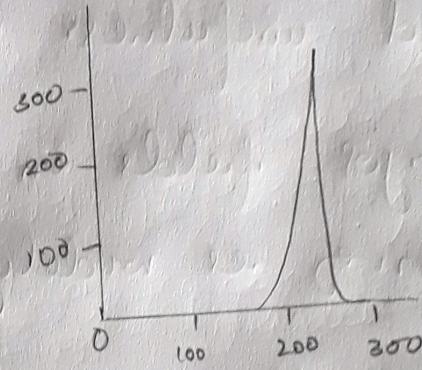
- Agriculture
- Augmented reality
- Autonomous vehicles
- Biometrics
- Character recognition
- Industrial quality inspection
- Medical field
- Transport
- Transmission and encoding
- Machine or Robotics

Image enhancement is also possible through image equalization which is another kind of image pre-processing. Due to image equalization, which the visibility is increased helps in improving machine perception.

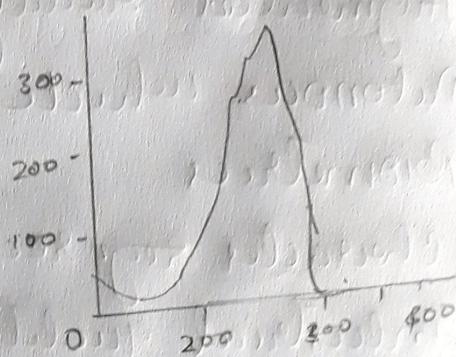
Eg: Histogram is used to enhance the brightness of an image.



Image



Histogram



stretched Histogram

systems for their control, sensory feedback  
and "Information processing".

- Autonomous vehicles.

Represents the role of Image Information  
in biometrics. Here we sensor the number plates  
of the vehicles, so that we able to  
detect receive all the information of the vehicles.

(4) Ans: We have seen several systems  
which adopt biometric based person  
authentication for secure transactions,  
airport entry etc. The kind of biometrics  
varies from face signature (Palm print,  
finger print, ear to speech, voice  
recognition, eyes sensor etc.).  
Biometrics is used for Authentication  
of a person.

- Pattern recognition
- video processing
- Banking.

- In Agriculture field , the role of image processing is used for weed detection and removal ; for harvesting , cleaning , for quality inspection , and disease identification etc .

- In Banking typical tasks are included such as document verification , Bankers Cheque analysis , person authentication .

It is used for cheque validation .  
The cheque is subjected to segmentation and subsequently subjected to automated cheque analysis for its understanding & hence validating the cheque .

- Robotics is the branch technology that deals with the design , construction , operations and application of robots and computer

Q Answe: Biometrics are widely used in several fields such as, in

- Banking
- Airport
- Electronic voting
- Defense sectors
- secured transactions

Finger print is most commonly used biometrics, it is used in several places such as for attendance of ~~for~~ faculty & in institution, employees in company, industries etc.

For example, we use biometrics for Aadhar card, so that it is easy to identify the person. In Aadhar we use biometrics such as finger print, optic (eyes) etc. In mobile phone security purpose we use biometrics password also.

such as finger printer, face recognition, voice recognition etc.

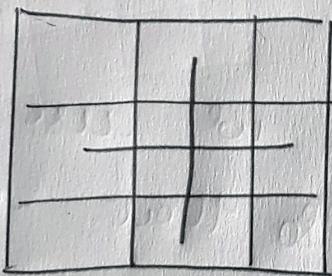
- In defence sector, to identify the victim we use biometrics. To identify the victim, tools we use finger prints, proof etc.

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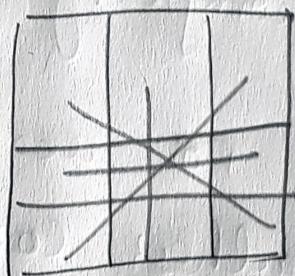
Ans: Image representation includes neighbours and Adjacency.

- We have interests in classifying pixels into different categories.

- Neighbourhoods.



4 neighbour



8 - Neighbour

- 2 pixels P and Q are 4 adjacent, if they are 4 neighbours of one another and 8 adjacent if they are 8 neighbours of one another.

## - Paths

Suppose that  $P$  &  $Q$  are any 2 pixels  
and suppose  $P$  and  $Q$  can be joined by a  
sequence of pixels as shown

