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Q1. Applications of image processing by considering X-Ray waves and ultra sound waves.

→ Applications of image processing:

1. UV sensing
The increase of geospatial technology and the advantage to provide recent and accurate imagery to the public through the advance of technology and the internet.

2. Medical field
Medical image processing incorprates the use and exploration of 3D image datasets of human body, found generally from a Computed Tomography or Magnetic Resonance Imaging Scanner.

3. Transmission and encoding
Transmission in digital image processing is obtaining an image in microscopy which shows the intensity of light or any radiation that has come through sample and they are generated by techniques such as light microscopy or transmission electron microscopy.

Q2. Explain sampling and quantization with the help of diagram.

→ In digital image processing, signals captured from the physical world need to be translated into digital form by 'Digitization' process. In order to become suitable for digital processing, an image function $f(x,y)$ must be digitized both spatially and in amplitude. This digitization process involves two main processes called:

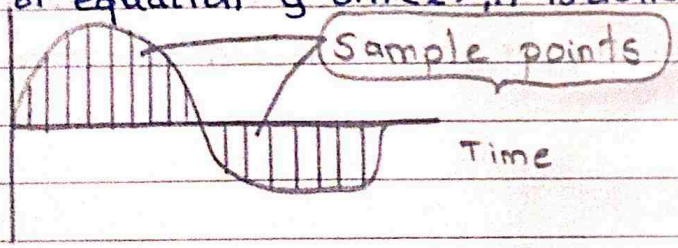
1] Sampling: Digitizing the co-ordinate value.

2] Quantization: Digitizing the amplitude value.

Typically a frame grabber or digitizer is used to sample and quantize the analogue video signal.

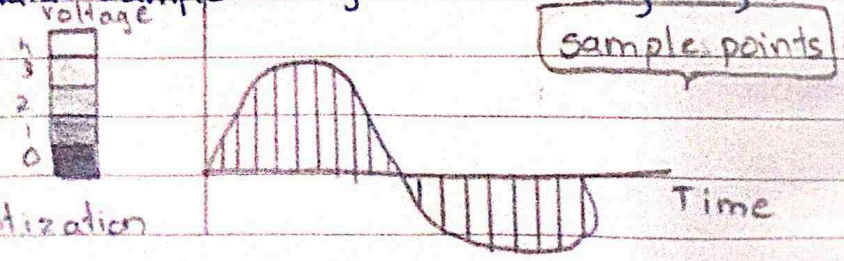
1. Sampling:

Since analogue image is continuous not just in its coordinates (x axis), but also in its amplitude (y axis), so the part that deals with digitizing of coordinates is known as Sampling. In digitizing sampling is done on independent variable. In case of equation $y = \sin(x)$, it is done on x variable.



2. Quantization:

Digitizing through amplitude value. Quantization is opposite to sampling because its done on y-axis while sampling is done on x-axis. Quantization is a process of transforming real value sampled image to one taking only finite no. of distinct valu



Q3. What is the effect of 1) Sampling frequency and 2) quantization levels on image.

→Ans) Effect of Sampling frequency and ~~image~~ quantization levels

The sampling rate determines the spatial resolution of the digitized image, while the quantization level determines the number of grey levels in the digitized image.

A magnitude of the sampled image is expressed as a digital value in image processing.

The transition 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.

The occurence of false contours is the main problem in image, which has been quantized with insufficient brightness levels.

a) Sampling theorem essentially says that signal has to be sampled at least with twice the frequency of original signal Signals & their respective speeds can be easily expressed by frequencies, most explainations of artifacts based on their representation in frequency domain.

b) Quantization effects:

Quantization effects in phasing are more compiler then the filter quantization since finite precision degrades the side lobe resolution for lower precision levels.

The quantization error exhibits non linear behaviour in the second side.

Quantization error is higher for lower precision levels.

Q.4. By considering pixel neighbourhood, explain ~~core~~ 4 adjacency 8 adjacency and m-adjacency.

→ An image is denoted by $f(x,y)$ and p,q are used to represent individual pixels of image.

* Neighbours of a pixel:

A pixel p at (x,y) has 4 horizontal/vertical neighbours at $(x+1,y)$ $(x-1,y)$, $(x,y+1)$, $(x,y-1)$. These are called 4-neighbours of p: $N4(p)$

A pixel p at (x,y) has 4 diagonal neighbours at $(x+1,y+1)$, $(x+1,y-1)$, $(x-1,y+1)$, $(x-1,y-1)$. These are called the diagonal neighbours of p: $ND(p)$.

The 4-neighbours and the diagonal neighbours of p are called 8-neighbours of p: $N8(p)$.

* Adjacency between pixels:

Let V be set of intensity values used to define adjacency.

In binary image, $V=\{1\}$ if we are referring to adjacency of pixels with value 1. In gray scale image, set V typically contains more elements.

a) 4-adjacency:

Two pixels p & q with values from V are 4 adjacent if q is in the set $N4(p)$

b) 8-adjacency:

Two pixels p & q with values from V are 8 adjacent if q is in the set $N8(p)$

c) m-adjacency:

Two pixels p & q with values from V are m adjacent if:

1) q is in $N4(p)$ or

2) q is in $ND(p)$ and the set $N4(p) \cap N4(q)$ has no pixels whose values are from V.