**IT6005 - DIGITAL IMAGE PROCESSING**

**INTERNAL ASSESSMENT –I [KEY]**

**PART-A**

**1.Digital image:**

An image may be defined as two dimensional light intensity function f(x,

y)where x and y denote spatial co-ordinate and the amplitude or value of f at

any point (x, y) is called intensity or gray scale or brightness of the image at

that point.

**2. Digital Image Processing:**

The process of converting analog into digital image in which the resultant image is suitable for further processing.

**3. pixel depth:**

The number of bits used to represent each pixel in the RGB space is

called the pixel depth.

**4.Image acquisition:**

Is the first step which involves capturing of images using

cameras. It also involves steps like preprocessing and scaling.

Process of acquiring digital image.

**5.Sampling:**

Sampling means digitizing the co-ordinate value (x, y).

**6.Quantization:**

Quantization means digitizing the amplitude value.

**PART-B**

**8.i. components of an Image Processing System:**

**1. Image Sensors**

Image sensing or image acquisition is used to acquire i.e., to get digital

images. It requires two elements, which are,

a)A physical device which is use to sense the object.

b)The second device is the digitizer which is used to convert the output

of the physical sensing device into digital form.

**2. Specialized image processing hardware**

This hardware usually consists of digitizer plus ALU that performs some

primitive operations like arithmetic and logical.

**3. Computer**

The computer in an image processing system is a general purpose

computer and can range from PC to a supercomputer.

**4. Software**

The software for image processing system consists of specialized

modules that can perform specific tasks. Some software packages have the

facility for the user to write code using specialized modules.

**5. Mass storage**

Mass storage capability is needed if the image is not compressed.

There are three principal categories.

 Short term storage for use during processing, example: computer

memory, frame buffers. Frame buffers are specialized boards that can

store one or more images and can be accessed rapidly at video rates.

This method allows instantaneous image zoom, scroll (vertical shifts)

and pan (horizontal shifts also.

 On- line storage for relatively fast recall, example; magnetic disk or

optical media. This type of storage gives frequent access to the storage

data.

 Archival storage characterized by frequent access, example: magnetic

tapes and optical disks. It requires large amount of storage space and

the stored data is accessed infrequently.

**6. Image displays**

Image displays are color TV monitors. These monitors are driven by the

output of image and graphics display cards which are a part of the computer

system.

**7. Hard copy**

Hard copy devices are used for recording images. These devices

include laser printers, film cameras, heat sensitive devices, inkjet printers and

digital units such as optical and CD ROM disks.

**8. Networking**

Networking is useful for transmitting images. It includes optical fiber and

other broad band technologies.

**ii. The fundamental steps in digital image processing are:**

 Image acquisition

 Image enhancement

 Image restoration

 Image compression

 Image segmentation

 Image representation and description

**Image Acquisition** is the first step which involves capturing of images using

cameras. It also involves steps like preprocessing and scaling.

Image Enhancement is the process of highlighting certain features of interest

in an image.

**Image Restoration** deals with improving the appearance of an image.

Color image processing involves the processing of images which are in

color rather than in binary or gray. It finds applications in the use of digital

images in the internet.

**Wavelets** are foundation for representing images in various degrees of

resolution.

**Image compression** deals with the techniques for reducing the size of the

image for storage and reducing the bandwidth for transmitting.

**Morphological processing** deals with the tools for extracting the image

components that are useful in the representation and description of shape.

Segmentation partition an image into its constituent parts or objects.

**Representation** transforms raw data into a suitable form subsequent for

computer processing. Description deals with extracting attributes that result

in some quantitative information of interest or are basic for differentiating one

class of objects from another.

**Recognition** is the process that assigns label to an object based on its

descriptors.

Knowledge about the problem domain is coded into the image processing

system in the form of a knowledge database.

**9.i. elements of visual perception:**

**Cornea &sclera outer cover.**

The cornea is a tough, transparent tissue that covers the anterior i.e.,

front surface of eye. The sclera is an opaque membrane that is continuous

with the cornea and encloses the remaining portion of the eye.

**Choroid**

It is located directly below the sclera. It contains network of blood

vessels which provides nutrition to the eye. Slight injury in choroid can lead to

severe eye damage as it causes restriction of blood flow. The outer cover of

the choroid is heavily pigmented to reduce amount of extraneous light entering

the eye. Also contains the iris diaphragm and ciliary body.

ris diaphragm

It contracts and expands to control the amount of light enteringinto the

eye. The central opening of the iris is known as pupil whose diameter varies

from 2-8 mm.

**Lens**

It is made up of many layers of fibrous cells. It is suspended and is

attached to the ciliary body. It contains 60% to 70% water and 6% fat and

more protein. The lens is colored by a slightly yellow pigmentation. This

coloring increases with age, which leads to clouding of lens. Excessive

clouding of lens happens in extreme cases which are known as cataracts.

This leads to poor color discrimination and loss of clear vision.

**Retina**

It is the inner most membrane, objects are imaged on the surface. The

central portion of retina is called the fovea.

There are two types of receptors in the retina.

 The rods are long slender receptors

 The cones are generally shorter and thicker in structure

The rods and cones are not distributed evenly around the retina. Rods

and cones operate differently.

**Cones**

Cones are highly sensitive to color and are located in the fovea. There

are 6 to 7 million cones. Each cone is connected with its own nerve end.

Therefore humans can resolve fine details with the use of cones. Cones

respond to higher levels of illumination; their response is called photopic

vision or bright light vision

**Rods**

Rods are more sensitive to low illumination than cones. There are

about 75 to 159 million rods. Many numbers of rods are connected to a

common, single nerve. Thus the amount of detail recognizable is less.

Therefore rods provide only a general overall picture of the field of view. Due

to stimulation of rods the objects that appear color in daylight will appear

colorless in moon light. This phenomenon is called scotopic vision or dim

light vision.

**ii. sampling and quantization process:**

To be suitable for computer processing an image, f(x, y) must be

digitized both spatially and in amplitude. Digitizing the spatial coordinates is

called image sampling. Amplitude digitization is called gray-level quantization.

The one dimensional function shown

The location of each sample is given by vertical tick mark in the bottom

part of the figure. The samples are shown as white square box superimposed

on the function. The set of these discrete locations gives the sampled

function.

In order to form a digital function, the gray values must be quantized

into digital values. The right side shows the gray level scale

divided into eight discrete levels, ranging from black to white. The vertical tick

marks indicate the specific value assigned to each of the eight gray levels.

The continuous values are quantized simply by assigning one of the eight gray

levels to each sample. The digital sample resulting from sampling and

quantization is shown . Starting from the top of the image and

carrying out this procedure line by line produces a two dimensional image.

**Representing digital images**

The result of sampling and quantization is a matrix of real numbers.

Assume that f(x, y) is sampled so that the resulting digital image has M rows

and N columns. The values of the coordinates (x,y) now become discrete

quantities. The values of the coordinates at the origin are (x, y) = (0, 0).

The complete digital image in matrix form can be represented as

Each element of this matrix array is called an image element, picture

element, pixel or pel. Common practice is to let N and M be powers of two;

N=2n and M=2k And L =2m where L denotes the number of gray levels.

The range of values spanned by the gray scale is called dynamic range. It is

given by the interval [0,L-1]

The assumption here is that gray levels are equally space in the interval [0,L]

The number of bits, b, necessary to store the image is then

b = N\*M\*m

or if N = M

b = N 2m

For example, a 128x128 image with 64 gray levels would require 98,304 bits

of storage.

**10. Color Model:**

Color models provide a standard way to specify a particular color, by

defining a 3D coordinate system, and a subspace that contains all

constructible colors within a particular model. Any color that can be specified

using a model will correspond to a single point within the subspace it defines.

Each color model is oriented towards either specific hardware (RGB, CMY,

YIQ), or image processing applications (HSI).

Hardware oriented models:

 RGB (red, green, blue): Monitor video camera.

 CMY (cyan, magenta, yellow), CMYK (CMY, black) model for color

printing.

 HSI model, which corresponds closely with the way humans describe

and interpret color.

Application oriented models

 These models are used in applications where color manipulation is a

goal

 One example is the creation of color graphics for animation

**The RGB Model**

In the RGB model, an image consists of three independent image

planes, one in each of the primary colors: red, green and blue. (The standard

wavelengths for the three primaries are as shown in figure). Specifying a

particular color is by specifying the amount of each of the primary components

present. Figure 6.1 shows the geometry of the RGB color model for specifying

colors using a Cartesian coordinate system. The grayscale spectrum, i.e.

those colors made from equal amounts of each primary, lies on the line joining

the black and white vertices.

. The gray scale spectrum lies on the line

joining the black and white vertices.

This is an additive model, i.e. the colors present in the light add to form

new colors, and is appropriate for the mixing of colored light for example. The

image shows the additive mixing of red, green and

blue primaries to form the three secondary colors yellow (red + green), cyan

(blue + green) and magenta (red + blue), and white ((red + green + blue). The

RGB model is used for color monitors and most video cameras.

**Pixel Depth:**

The number of bits used to represent each pixel in the RGB space is

called the pixel depth.

**The CMY Model**

The CMY (cyan-magenta-yellow) model is a subtractive model

appropriate to absorption of colors, for example due to pigments in paints.

Whereas the RGB model asks what is added to black to get a particular color,

the CMY model asks what is subtracted from white. In this case, the primaries

are cyan, magenta and yellow, with red, green and blue as secondary colors.

When a surface coated with cyan pigment is illuminated by white light,

no red light is reflected, and similarly for magenta and green, and yellow and

blue. The relationship between the RGB and CMY models is given by:

The CMY model is used by printing devices and filters