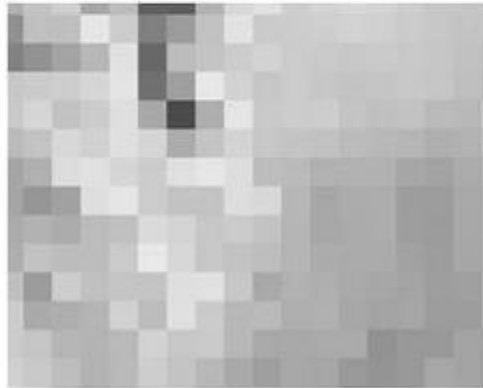
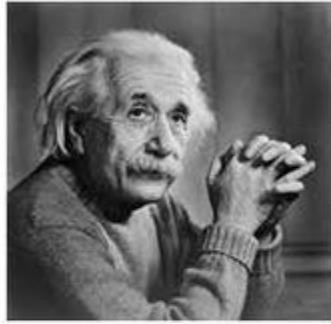
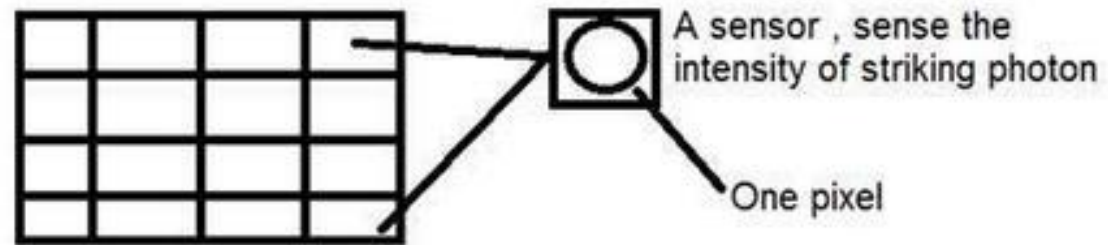


pixel



Relationship with CCD array



Calculation of total number of pixels

- Total number of pixels = number of rows (X) number of columns
- we can say that the number of (x,y) coordinate pairs make up the total number of pixels.

Gray level

- The value of the pixel at any point denotes the intensity of image at that location, and that is also known as gray level.

Pixel value.(0)

0	0	0
0	0	0
0	0	0

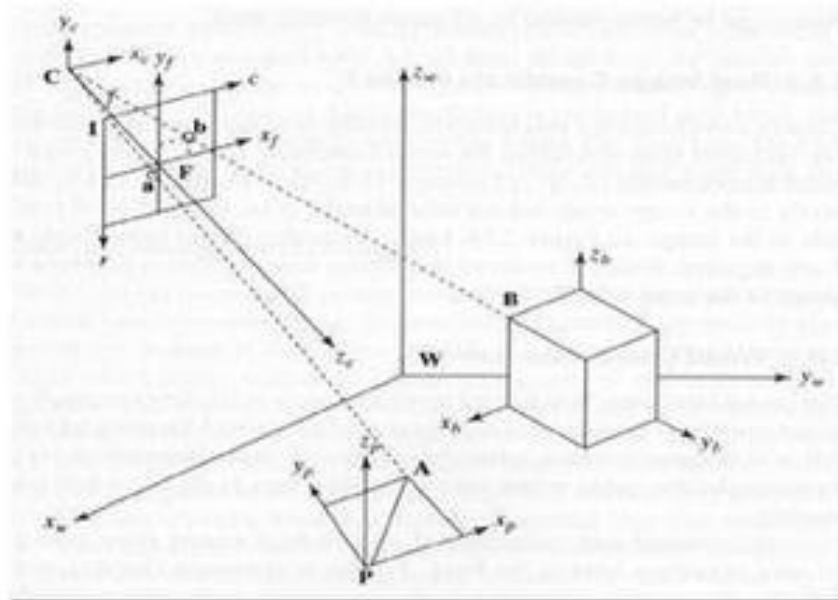
Total no of pixels = total no. of rows X total no. of columns
= 3 X 3
= 9.



Perspective Transformation

- When human eyes see near things they look bigger as compare to those who are far away. This is called perspective in a general way. Whereas transformation is the transfer of an object e.t.c from one state to another.

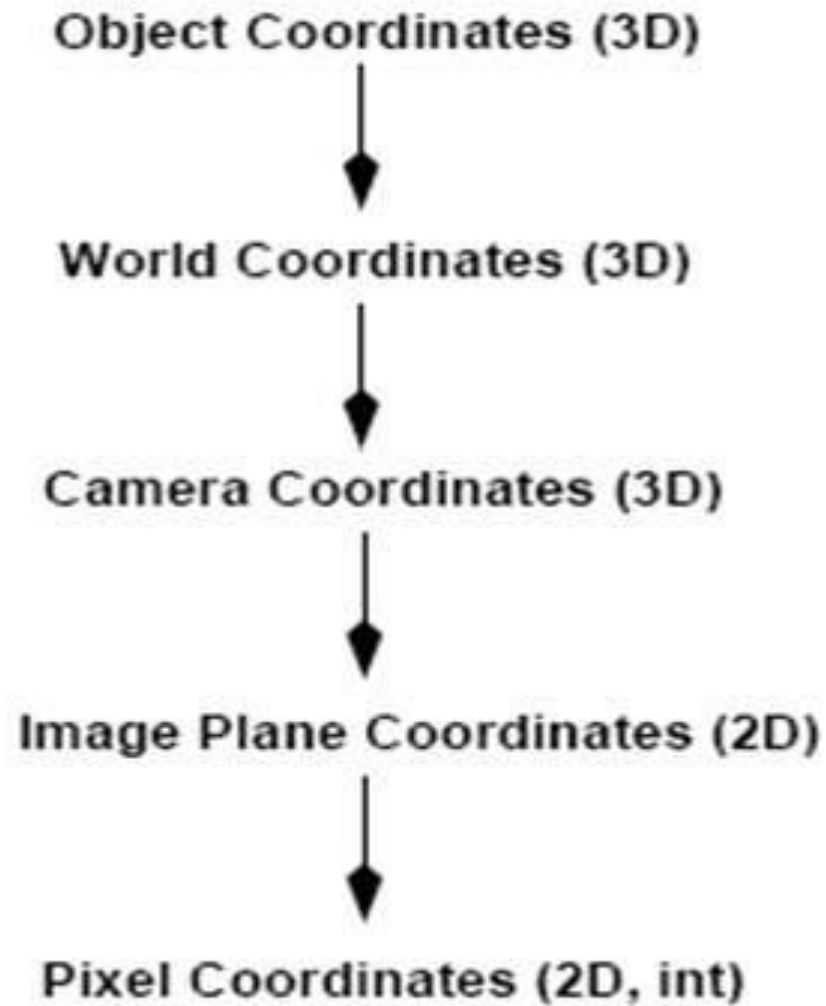
Frame of reference:

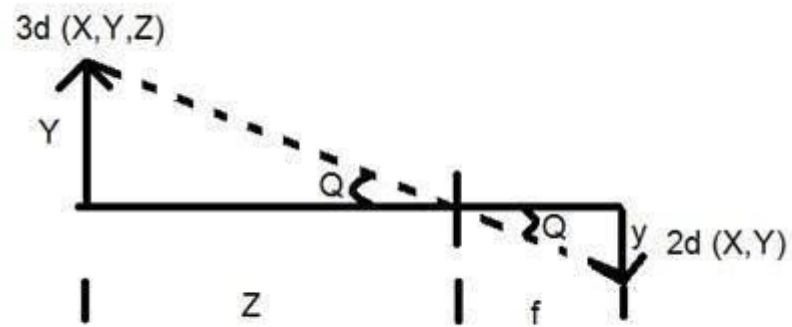


5 frames of reference

- In order to analyze a 3d world/image/scene, 5 different frame of references are required.
- Object
- World
- Camera
- Image
- Pixel

Transformation between these 5 frames





The first angle is

$$\tan \theta = -\frac{y}{f}$$

Where minus denotes that image is inverted. The second angle that is formed is:

$$\tan \theta = \frac{Y}{Z}$$

Comparing these two equations we get

$$Y = -f \frac{Y}{Z}$$

Calculating the size of image formed

- Since the focal length is in millimeter, so we have to convert every thing in millimeter in order to calculate it.
- So,
- $Y = 5000 \text{ mm.}$
- $f = 50 \text{ mm.}$
- $Z = 50000 \text{ mm.}$

Putting the values in the formula, we get

$$Y = - f \frac{Y}{Z} = - 50 \times 5000 / 50000$$

$= -5 \text{ mm.}$

Concept of Bits Per Pixel

Bits in mathematics:

How many numbers can be represented by one bit.

- 0
- 1

How many two bits combinations can be made.

- 00
- 01
- 10
- 11

$$(2)^{bpp}$$

Number of different colors:

Bits per pixel

1 bpp

2 bpp

3 bpp

4 bpp

5 bpp

6 bpp

7 bpp

8 bpp

10 bpp

16 bpp

24 bpp

32 bpp

Number of colors

2 colors

4 colors

8 colors

16 colors

32 colors

64 colors

128 colors

256 colors

1024 colors

65536 colors

16777216 colors (16.7 million colors)

4294967296 colors (4294 million colors)

Shades

- You can easily notice the pattern of the exponential growth. The famous gray scale image is of 8 bpp , means it has 256 different colors in it or 256 shades.

$$\text{Shades} = \text{number of colors} = (2)^{bpp}$$

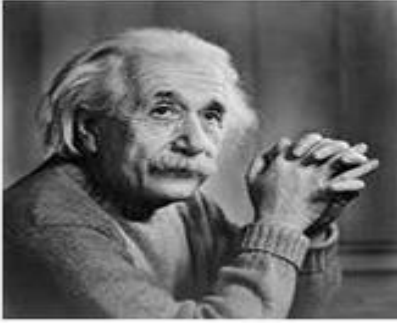
- **Color values:**
- We have previously seen in the tutorial of concept of pixel, that 0 pixel value denotes black color.
- **Black color:**
- Remember, 0 pixel value always denotes black color. But there is no fixed value that denotes white color.
- **White color:**
- The value that denotes white color can be calculated as :

$$\text{White color} = (2)^{bpp} - 1$$

Image storage requirements

Image size

- The size of an image depends upon three things.
- Number of rows
- Number of columns
- Number of bits per pixel
- The formula for calculating the size is given below.
- Size of an image = rows * cols * bpp



- Size of an image = rows * cols * bpp
- = $1024 * 1024 * 8$
- = 8388608 bits.
- But since its not a standard answer that we recognize, so will convert it into our format.
- Converting it into bytes = $8388608 / 8 = 1048576$ bytes.
- Converting into kilo bytes = $1048576 / 1024 = 1024$ kb.
- Converting into Mega bytes = $1024 / 1024 = 1$ Mb.