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CSE423

Section: 14

Assignment 03

Ans no 1

HLS color model: HLS is a cylindrical color model that shares two dimensions with HSV, while replacing the value dimension with a lightness dimension.

i) Hue specifies the angle of the color on the RGB color circle, exactly like HSV. (e.g., 0° = red, 120° = green, 240° = blue).

ii) Lightness controls the luminosity of the color. This dimension is different from the HSV value dimension in that the purest color is positioned midway between black and white ends of the scale. A color with 0% lightness is black, 50% is the purest color possible and 100% is white.

(iii) Saturation controls the purity of the color. (0 = gray, 1 = fully vivid color)

Even though the saturation dimension theoretically is similar between the two color models (controlling how much pure color is used), the resulting saturation scales differ between the models caused by brightness to lightness remapping. So the HLS color model is best depicted as a cylinder.

Application: Image editing, color pickers and design tools. Useful for adjusting brightness without altering color hue.

HSV to CMY

HSV $(184^\circ, 0.45, 0.71)$

$C = V \times S = 0.71 \times 0.45 = 0.3195$

$X = C \times (1 - |(\frac{H}{60} \% 2) - 1|)$

$= 0.3195 (1 - |(\frac{184}{60} \% 2) - 1|)$

$= 0.3195 (1 - |(3.067 \% 2) - 1|)$

$= 0.3195 (1 - |1.067 - 1|)$

$= 0.3195 (1 - 0.067)$

$= 0.3195 \times 0.933$

$= 0.298$

$m = V - C = 0.71 - 0.32 = 0.39$

$\therefore 180 \leq H < 240$

$R, G, B = (0, X, C) = (0, 0.29, 0.32)$

$R+m, G+m, B+m = (0.39, 0.68, 0.71)$

$C = 1 - R = 1 - 0.39 = 0.61$

$M = 1 - G = 1 - 0.68 = 0.32$

$Y = 1 - B = 1 - 0.71 = 0.29$

$CMY\,(0.61, 0.32, 0.29)$

Ans no 2

Parallel projection: A projection where the lines of sight (projectors) are parallel to each other and perpendicular (orthographic) or angled ~~(oblig~~ (oblique) to the projection plane.

Types:

Orthographic : Projectors are perpendicular to the projection plane (used in blueprints).

Oblique : Projectors are at an angle to the projection plane (used in some technical illustrations)

Characteristics:

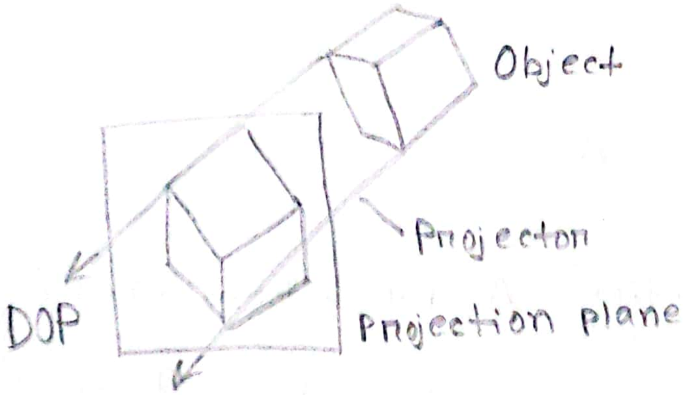
i) No perspective distortion – Objects stay the same size regardless of depth.

ii) No vanishing point – parallel lines remain parallel.

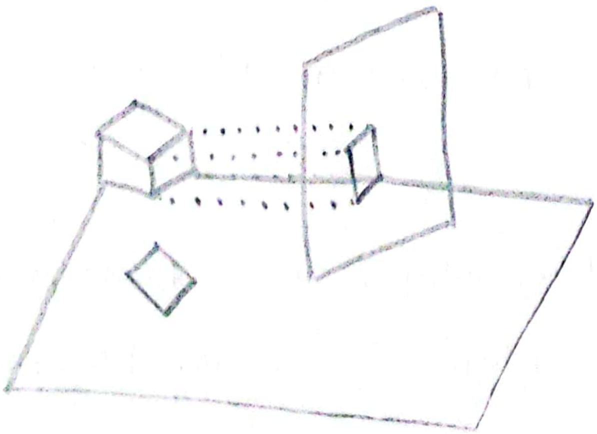
iii) More technical / diagrammatic – ideal for engineering or CAD.

iv) Uniform scale – good for precise measurments.

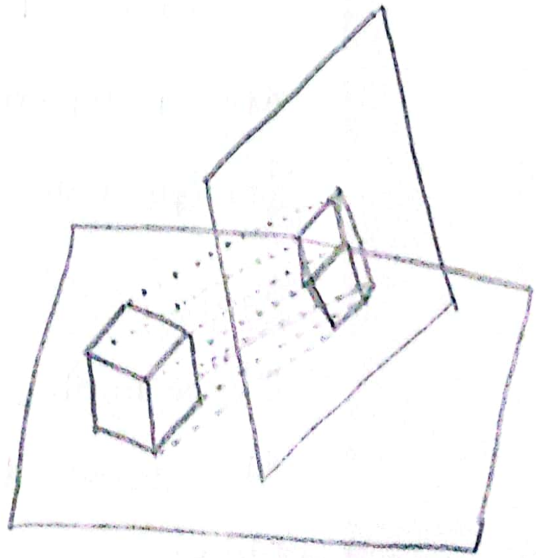
Example: Engineering and architectural drawings, CAD software, blueprints and schematics.



Parallel projection



Orthographic



Oblique (Cabinet)

For XZ projection:

$$\begin{vmatrix} x' \\ y' \\ z' \\ 1 \end{vmatrix} = \begin{vmatrix} 1 & \lambda \sin\beta & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & \lambda \cos\beta & 1 & 0 \\ 0 & 0 & 0 & 1 \end{vmatrix} \begin{vmatrix} x \\ y \\ z \\ 1 \end{vmatrix}$$

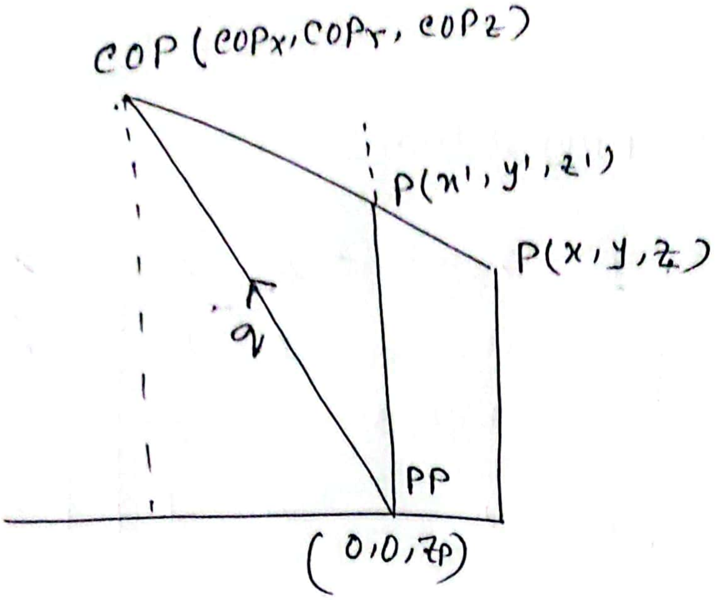
for orthographic projection: $\lambda = 0$

given $Y = 15$

So, in this case:

$$\begin{vmatrix} 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 15 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{vmatrix} \begin{vmatrix} 50 \\ 32 \\ 72 \\ 1 \end{vmatrix} = \begin{vmatrix} 50 \\ 15 \\ 72 \\ 1 \end{vmatrix}$$

$P'(50, 15, 72)$



$P(x, y, z) = (10, 10, -50)$

$COP(COPx, COPy, COPz) = (30, 20, 100+20)$

$q_x = COPx = 30$

$q_y = COPy = 20$

$q_z = COPz - z_p = \overset{120}{\cancel{80}} - 100 = 20$

$z_p = 100$

$PP(0, 0, 100)$

$$\begin{bmatrix} 1 & 0 & -q_x/q_z & z_p \cdot \frac{q_x}{q_z} \\ 0 & 1 & -q_y/q_z & z_p \cdot \frac{q_y}{q_z} \\ 0 & 0 & -z_p/q_z & z_p + \frac{z_p^2}{q_z} \\ 0 & 0 & -1/q_z & 1 + \frac{z_p}{q_z} \end{bmatrix} \begin{bmatrix} x \\ y \\ z \\ 1 \end{bmatrix} = \begin{bmatrix} x' \cdot w \\ y' \cdot w \\ z' \cdot w \\ w \end{bmatrix}$$

$$\begin{bmatrix} 1 & 0 & -30/20 & 100\cdot\frac{30}{20} \\ 0 & 1 & -20/20 & 100\cdot\frac{20}{20} \\ 0 & 0 & -100/20 & 100+\frac{100^2}{20} \\ 0 & 0 & -1/20 & 1+\frac{100}{20} \end{bmatrix} \begin{bmatrix} 10 \\ 10 \\ -50 \\ 1 \end{bmatrix}$$

$$= \begin{bmatrix} 1 & 0 & -3/2 & 150 \\ 0 & 1 & -1 & 100 \\ 0 & 0 & -5 & 600 \\ 0 & 0 & -1/20 & 6 \end{bmatrix} \begin{bmatrix} 10 \\ 10 \\ -50 \\ 1 \end{bmatrix}$$

$$= \begin{bmatrix} 235 \\ 160 \\ 850 \\ 8.5 \end{bmatrix} = \begin{bmatrix} 235/8.5 \\ 160/8.5 \\ 850/8.5 \\ 8.5/8.5 \end{bmatrix} = \begin{bmatrix} 27.65 \\ 18.82 \\ 100 \\ 1 \end{bmatrix}$$

$P'(27.65, 18.82, 100)$