Day 8

Clr & Shading / Ray Tracing.

Chapter 12 → Color & Shading models

· Light is a form of electromagnatic radiation that is visible to the human eye. photons travel with straight line and helps us see objects by passing through them.

Basic Characteristics of Light:

Wavelength ① Distance between 2 consecutive peaks of an light wave. measured in nanometer (NM)

frequency ② no of electromagnatic wave complete its oscillation in a second. Typically measured in hertz (Hz)

Amplitude ③ hight of the wave from its middle position. Determine brightness of light

Saturation Describe Color purity

$$\text{Excitation purity} = \frac{\text{pure clr}}{\text{pure clr} + \text{white clr}}$$

(*) Range of visible light approximately (400 - 700) nm

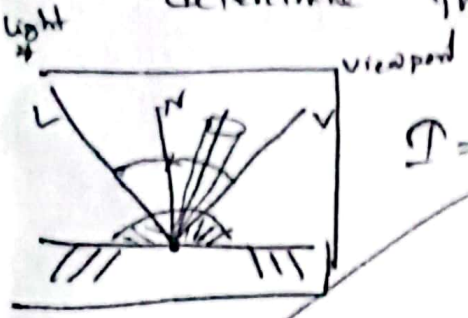
Constant, Gounaud, phong Shading:

Constant →	Single clr is applied to an entire polygon	Fast and Simple. Not and unrealistic blocky appearance
Gouraud →	Colon are calculated at vertices and interpolated across the polygon surface	- Smooth gradients. - better than constant but miss sharp highlights
phong →	- Computes shading at each pixel - interact with. Surface	- Suitible for Complex lighting lights and reflection - per pixel lighting. calculation - Smooth highlights.

Phong Model – realistic result

Simulate the reflection of light on surface.

Combines ambient, diffuse & Specular reflection to determine the color based on light hitting it.



$$I = I_a k_a + I_p (k_d \cos\theta + k_s \cos^n \phi)$$

- I_a — Ambient light intensity
- I_p — Point light intensity
- k_a, k_d, k_s — reflection coefficients: ambient (a), diffuse (d), Specular (s)
- θ — Angle between L & N
- ϕ — angle between R & V
- n — Specular exponent

Ambient Reflection → Account for constant light from the environment

Diffuse Reflection: Simulates rough surface reflection. depend on light angle

Specular Reflection: Simulates like mirror reflection depending on angle of reflection and viewer.

Ques

• A point has RGB clr (1, 0.5, 0) & line is has RGB (0.2, 0.5, 0.6). what is for 8 line?

Ans

for 8, ~~Avg 15 8 and 5~~

	R	G	B	
P_1 =	1,	0.5,	0	$x_1 = 5$
P_2 =	0.2	0.5	0.6	$x_2 = 15$
				$x = 8$

~~$\frac{0.2-1}{15-5}$~~ $= \cdot$ $P = P_1 + \left(\frac{x - x_1}{x_2 - x_1}\right)(P_2 - P_1)$

(8) $\Delta R = 1 + \frac{8-5}{15-5}(0.2-1) = 0.76$

(8) $\Delta G = 0.5 + \frac{8-5}{15-5}(0.5-0.5) = 0.5$

(8) $\Delta B = 0 + \frac{8-5}{15-5}(0-0) = 0.18$

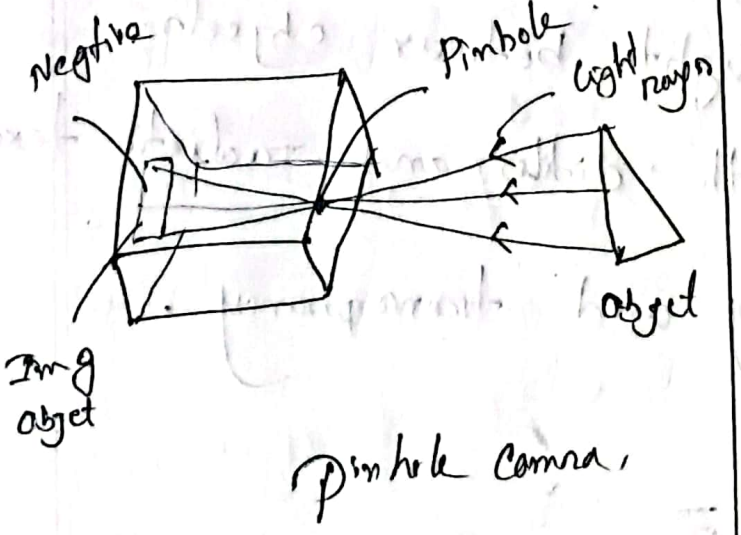
for line 8 = (R, G, B) = (0.76, 0.5, 0.18)

Ch-12
Ray tracing

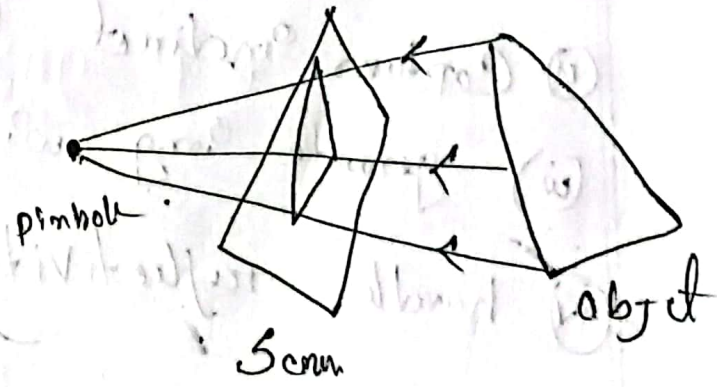
Ray tracing is a graphics technique that simulates how light interact with object to create realistic img by tracing lights paths from camera into the scene.

Pinhole Camera

It is capturing light rays as they pass through a tiny hole box. Light rays from a scene travel through the small hole and hit a screen or a surface create an img. This process is similar to how ray tracing simulates light path to generate image.



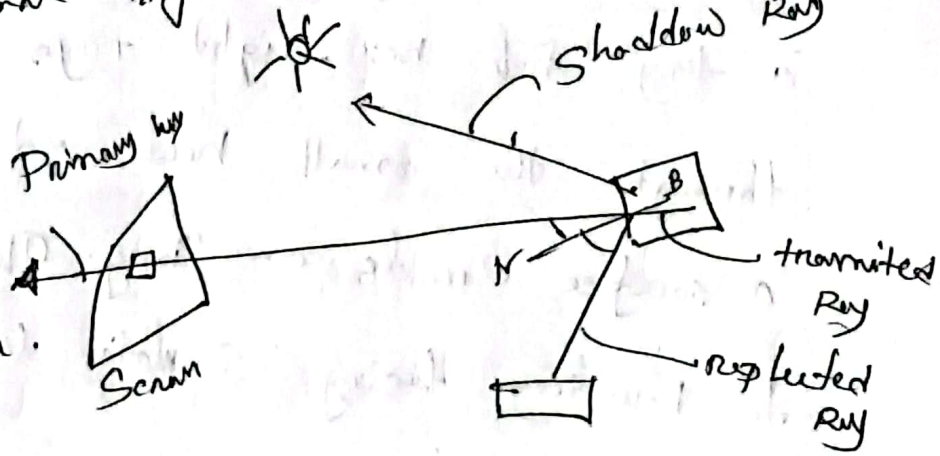
Pinhole Camera.



Recursive Ray tracing Method

⇒ here rays are cast from the viewer's eye into the scene, then recursively traced as they interact with objects

The Algo keeps tracks of the color and intensity of each rays as it travels and uses this information to determine the colour of each pixel in the final img.



realistic pictures produce are bcz accurate simulate the physical behavior.

Reasons

(i) Simulates shadow and reflection

(ii) Captures indirect light between objects.

(iii) generate img with ditles and realistic textures

(iv) handle reflectivity and transparency.

Sp 22 Math 12.5

(#) Ray Represented $r(t) = 2I + J - 3K$ and $d = I + 2K$.
find the point corresponds $t = 0, 1, 3$.

(Ans) Ray eqn $r(t) = \underbrace{S}_{\text{standing point}} + t\underbrace{d}_{\text{direction}}$

$S = 2i + j - 3k$

$d = i + 2k$

for $t = 0$

$r(t) = S + td = (2i + j - 3k) + (i + 2k) \cdot$

$= S + 0 \cdot d = 2i + j - 3k + 0 = (2, 1, -3)$

for $t = 1$.

$r(t) = S + td = (2i + j - 3k) + 1 \cdot d\, i + 2k.$

$= 3i + j - k = (3, 1, -1)$

for 3

$r(t) = S + td = 2i + j - 3k + 3 \cdot i + 6k.$

$= 5i + j + 3k$

$= (5, 1, 3)$

Ans

12.4 Sp22

* algebric eqn $y = mx + b$ or parametric eqn $L(t) = s + td$ for $s = I + J$, $d = I - J$ find equivalent algebric representation

Ans

Vector eq

$$L(t) = s + td.$$

given

$$s = I + J \qquad d = I - J$$
$$s = (1, 1) \qquad d = (1, -1)$$

So $L(t) = x(t)\,\hat{i} + y(t)\,\hat{j}$

$x(t)\,\hat{i}$: $s_x + t \cdot d_x = 1 + t$ ——— (i)

$y(t)\,\hat{j}$: $s_y + t \cdot d_y = 1 - 1t = 1 - t$ ——— (ii)

On (i) $x(t) = 1 + t \Rightarrow t = x - 1$

On same way $y(t) = 1 - t$

$= 1 - (x - 1)$ → put value

$y = 1 - x + 1$

$$\boxed{y = -x + 2}$$

Algebric eqn

* Vector is defined by its direction and magnitude.

* Ray is determined by its direction and starting point.

Math 12.13

$n = I + J + 2K$ be normal vector pass through $P_0(1,1,0)$

⇒ general eq 3D space.

$$n \cdot (P - P_0) = 0$$

$$I + J + 2K \,(x, y, z) - (1, 1, 0)$$

$$= (x-1) + (y-1) + 2z = 0$$

$$\therefore x + y + 2z = 2.$$

(*) Determin if a ray $S = -2I + J + 2K$ and $d = I - K$ intersects the plane.

⇒ one way parametric eqn

$$R(t) = S + td$$

$S = -2i + j + 2k = (-2, 1, 2)$

$d = i - k = (1, -1, 0)$

So $r(t) = S + td$.

$= (-2, 1, 2) + t \cdot (1, -0, 1)$

for $x = (-2 + t \cdot 1) = -2 + t$.

for $y = 1 + (-0 t) = 1 - t \cdot 0 = 1$.

for $z = 2 + (-1 t) = 2 - t$

if $T = 1$. then $d = (i - k)$ so x → pos direction, z = Neg " so ray 1 200

$x = -2 + 1 = -1$ $y = 1$ $z = 2 - t = 2 - 1 = 1$

$t(t) = (-1, 1, 1)$.