II - Internal Assesment

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Subject: Computer Graphics

1) Explain the reflection and share transformation in 3D geometric transformation.

3D - Reflection Transformation :-

→ Reflection is a kind of rotation where the ~~ag~~ angle of rotation is 180 degree.

→ The reflected object is always formed on the other side of mirror.

→ The size of reflected object is same as the size of original object.

* Consider a point object O has to be reflected in a 3D plane.

Let -

Initial coordinates of the object.
O = (xold, Yold, zold)

→ New coordinates of the reflected object. O after reflection =
(xnew, Ynew, znew)

There are Three possible types of Reflection

1] Reflection Relative to XY plane
2] Reflection Relative to YZ plane
3] Reflection Relative to XZ plane.

① Reflection Relative to XY plane:-

This relative reflection is actived by using the following reflection equations.

1] $X_{new} = X_{old}$.

2] $Y_{new} = Y_{old}$.

3] $Z_{new} = -Z_{old}$

In matrix form, the above reflection equation may be represented as-

$$\begin{bmatrix} X_{new} \\ Y_{new} \\ Z_{new} \\ 1 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & -1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \times \begin{bmatrix} X_{old} \\ Y_{old} \\ Z_{old} \\ 1 \end{bmatrix}$$

② Reflection Relative to YZ plane:-

This Reflection is actived by using the following equation.

1] $X_{new} = -X_{old}$

2] $Y_{new} = Y_{old}$

3] $Z_{new} = Z_{old}$

In matrix form,

$$\begin{bmatrix} X_{new} \\ Y_{new} \\ Z_{new} \\ 1 \end{bmatrix} = \begin{bmatrix} -1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \times \begin{bmatrix} X_{old} \\ Y_{old} \\ Z_{old} \\ 1 \end{bmatrix}$$

③ Reflection Relative to XZ plane:

This reflection is actived by using following equation.

1] $X_{new} = X_{old}$

2] $Y_{new} = -Y_{old}$

3] $Z_{new} = Z_{old}$

In matrix form.

$$\begin{bmatrix} x_{new} \\ y_{new} \\ z_{new} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & -1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \times \begin{bmatrix} x_{old} \\ y_{old} \\ z_{old} \end{bmatrix}$$

Example: Given a 3D triangle with coordinate points A (3, 4, 1), B (5, 6, 3), C (5, 6, 3) Apply the reflection on the xy plane and find out the new coordinates of the object.

sol^n * For coordinates A [3, 4, 1]
coordinates after reflection = (x_{new}, y_{new}, z_{new}) applying the reflection equations.

→ $x_{new} = x_{old} = 3$
→ $y_{new} = y_{old} = 4$
→ $z_{new} = -z_{old} = -1$.

New coordinates after reflection = (3, 4, -1)

Similarly:-

* for B (6, 4, 2)

→ $x_{new} = x_{old} = 6$
$y_{new} = y_{old} = 4$
$z_{new} = -z_{old} = -2$

new coordinates after reflection = (6, 4, -2)

* for C (5, 6, 3)

→ $x_{new} = x_{old} = 6$
→ $y_{new} = y_{old} = 6$
→ $z_{old} = z_{old} = -3$

New coordinates after reflection (5, 6, -3)

Thus New coordinates of the triangle after reflection = A (3, 4, -1) B (6, 4, -2) C (5, 6, 3) //

3D shearing transformation :-

→ 3D shearing is an ideal technique to change the shape at an exiting object in 3D-plane.

In a 3-Dimensinal plane the object size can be changed allong X direction Y-direction & Z-direction

* There are 3 versions of shearing
1) shearing in X axis
2) shearing in Y axis
3) shearing in Z axis.

→ Intial coordinates of the object O = (Xold, Yold, Zold)

→ shearing parameter towards X direction = shx
→ shearing parameter towards Y direction = shy
→ shearing parameter towards Z direction = shz
→ New coordinates of the object O after shearing = (Xnew, Ynew, Znew)

Shearing in X axis :-

~~Xnew = Xold + shy * Xold.~~
~~Ynew = Y~~

$X_{new} = X_{old}$

$Y_{new} = Y_{old} + sh_y * X_{old}$

$Z_{new} = Z_{old} + sh_z * X_{old}$

In matrix form :

$$\begin{bmatrix} X_{new} \\ Y_{new} \\ Z_{new} \\ 1 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 \\ sh_y & 1 & 0 & 0 \\ sh_z & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \times \begin{bmatrix} X_{old} \\ Y_{old} \\ Z_{old} \\ 1 \end{bmatrix}$$

shearing in Y axis :-

$X_{new} = X_{old} + sh_x * Y_{old}$

$Y_{new} = Y_{old}$

$Z_{new} = Z_{old} + sh_z * Y_{old}$.

In matrix form.

$$\begin{bmatrix} X_{new} \\ Y_{new} \\ Z_{new} \\ 1 \end{bmatrix} = \begin{bmatrix} 1 & sh_x & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & sh_z & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} * \begin{bmatrix} X_{old} \\ Y_{old} \\ Z_{old} \\ 1 \end{bmatrix}$$

shearing in Z axis :-

$X_{new} = X_{old} + sh_x * Z_{old}$

$Y_{new} = Y_{old} + sh_y * Z_{old}$

$Z_{new} = Z_{old}$.

In matrix form.

$$\begin{bmatrix} X_{new} \\ Y_{new} \\ Z_{new} \end{bmatrix} = \begin{bmatrix} 1 & 0 & sh_y & 0 \\ 0 & 1 & sh_y & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} * \begin{bmatrix} X_{old} \\ Y_{old} \\ Z_{old} \end{bmatrix}$$

Example:

Given an 3D triangle with paints (0,0,0) (1, 1, 2) & (1, 1, 3) Apply shear parameter 2 on X axis & 2 on Y axis & 3 on Z axis find out the new coordinates of the project.

Solution: Given, coordinater of triangle =

A (0,0,0) B (1, 1, 2), C (1, 1,3)

Shearing parameter towards X axis $sh_x = 2$

shearing parameter towards Y axis $sh_y = 2$

Shearing parameter towards Z axis $sh_z = 3$

shearing in X axis :-

(1). For coordinate A (0, 0, 0):

$X_{new} = X_{old} = 0$

$Y_{new} = Y_{old} + sh_y * X_{old} = 0 + 2 * 0 = 0$

$Z_{new} = Z_{old} + sh_z * X_{old} = 0 + 3 * 0 = 0$

∴ New coordinates of A = (0, 0, 0)

(2) For co-ordinates B (1, 1, 2)

$X_{new} = X_{old} = 1$

$Y_{new} = Y_{old} + sh_y * X_{old} = 1 + 2 \times 1 = 3$

$Z_{new} = Z_{old} + sh_z * X_{old} = 2 + 3 \times 1 = 5$

∴ New coordinate of B = (1, 3, 5)

(3). For coordinate C (1, 1, 3)

$X_{new} = X_{old} = 1$

$Y_{new} = Y_{old} + sh_y * X_{old} = 1 + 2 * 3 = 3$

$Z_{new} = Z_{old} + sh_z * X_{old} = 3 + 3 * 1 = 6$

∴ new coordinates of C = (1, 3, 6)

Shearing on Y axis :-

(1) For coordinate A (0, 0, 0)

$X_{new} = X_{old} + sh_x * Y_{old} = 0 + 2 * 0 = 0$

$Y_{new} = Y_{old} = 0$

$Z_{new} = Z_{old} + sh_z * Y_{old} = 0 + 2 * 0 = 0$

∴ new coordinats of A = (0, 0, 0)

(2) For coordinate B (1, 1, 2)

$X_{new} = X_{old} + sh_x * Y_{old} = 1 + 2 * 1 = 3$

$Y_{new} = Y_{old} = 1$

$Z_{new} = Z_{old} + sh_z \times Z_{old} = 1 + 3 \times 1 = 5$

∴ New coordinate of B = (3, 1, 5)

(3) For coordinate C (1, 1, 3)

$X_{new} = X_{old} + sh_x + Y_{old} = 1 + 2 * 1 = 3$

$Y_{new} = Y_{old} = 1$

$Z_{new} = Z_{old} + sh_z * Y_{old} = 1 + 3 * 1 = 4$

∴ New coordinates of C = (3.1.4)

<u>shearing on Z-axis</u>

(1) For coordinates A (0.0.0):

$X_{new} = X_{old} + sh_x * Z_{old} = 0 + 2 * 0 = 0$

$Y_{new} = Y_{old} + sh_y * Z_{old} = 0 + 2 * 0 = 0$

$Z_{new} = Z_{old} = 0$

∴ New coordinates of A = (0, 0, 0)

(2) For coordinate: B (1, 1, 2)

$X_{new} = X_{old} + sh_x * Z_{old} = 1 * 2 * 2 = 6$

$Y_{new} = Y_{old} + sh_y * Z_{old} = 1 * 2 \times 2 = 6$

$Z_{new} = \cancel{\phi}\ Z_{old} = 2.$

∴ New coordinate of B = (6.6.2)

(3) For coordinate C (1, 1, 3)

$X_{new} = X_{old} + sh_x * Z_{old} = 1 + 2 * 3 = 9$

$Y_{new} = Y_{old} + sh_y * Z_{old} = 1 + 2 \times 3 = 9$

$Z_{new} = Z_{old} = 3$

∴ New coordinate of C = (9.9.3)

∴ On x-axis = (0,0,0) (1,3,5) (1,3,6)
y-axis = (0,0,0) (3,1,5) (3,1,4)
z- axis = (0,0,0) (6,6,2) (9,9,9)

Q. No 2 Explain the basic illumination model in 3D object representation.

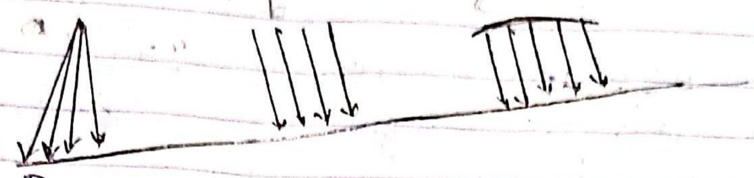
→ Lighting effects are described with mode that consider the interaction of light sources with object surface.

* The factors determining the lighting effect are:
→ The light source parameters:
* positions
* Electromagnetic spectrum.
* shape.
→ The surface parameters:
* position
* Reflectance properties.
* position of neare by surface
→ The eye (camera) parameters.
* position.
* Sensor Specturm sensitives.

→ Illumination model is used to calculate the intensity of the light that refflect at a given point on 'O' surface

* The are Three Models :-
① Light Source Model
② Ambient Illumination
③ Diffuse Reflection.

① light Source Models:-



* Point Source (a): All light rays originate at a point and radially diverge A reasunable approximation for sources whos diminsions are small compared. to the object size.

* Parallel source (b) light rays all parallel may be modeled as a point source at infinite distance (the sun).

* Distributed Source (c): All light rays originate at a finite area in Space. It models a nearby source, such as a ~~fours~~ flowersent light.

② Ambient Illumination :-

* Assume ~~that~~ there is some non-directional light in the environment + (background light)
* The amount of ambient light incident on each object is constant for all Surface & over all directions.

* Very simple ~~mod~~ model, not very realistic.

* OpenGL default.

* The reflected intensity Iamb of any point on the surface is :- ~~Iaaj~~

$I_{amb} = k_a I_a$

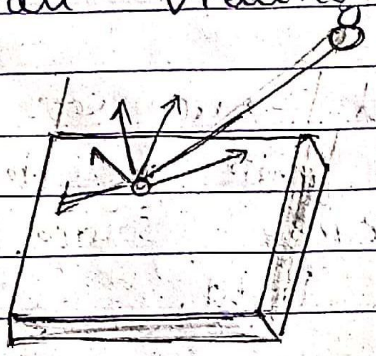
I_a - ambient light intensity.

$k_a \in [0,1]$ - surface ambient reflectivity.

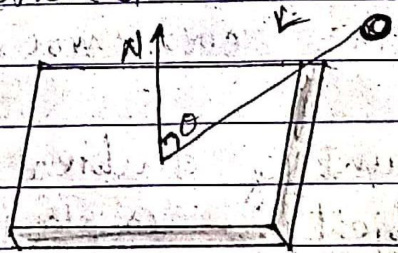
③ **Diffuse Reflection**

* Diffuse surface are rough or grainly like clay - soil , fabric.

* The surface appears equally bright from all viewing directions



* the brighteness at each paint is propotional to cosθ.



* The reflected intensity Idiff of a point on the surface is.

$I_{diff} = k_d I_p \cos(\theta) = k_d I_p (N.W)$

I_p - The point light intensity

$k_d \in [0,1)$ - The surface diffuse reffectivity

N - The ~~Norm~~ surface Normal

Scanned by CamScanner

L - The light direction

Q.No 3 Explain the object-space method for visible surface detection.

* Object space Method

compare objects and parts of object to each other within the scene differenition to determine which surfaces as a whole, we should label as visible.

for each object in the scene do begin.

1. Determine those parts of the object whose view is unobstructed by other parts of it or any other object with respect to the viewing specification.

2. Draw those parts in the object color End.

→ Compare each object with all other objects to determine the visibility of the object parts.

→ If there are n objects in the scene complexity = $O(n)^2$

→ Calculations are performed at the resolution in which the objects are defined.

→ process is unrelated to display resolution or the individual pixel in the image and the result of the ~~resolutr~~ processes is applicable to different display resolutions.

→ Display is more accurate but computationally more expensive as compared to image space methods because step 1 is typically more complex. Ex: Due to the possibility of intersection between surface.

→ Suitable for scene with small Number of objects & objects with simple with simple relationship with each other.

Q No 4: What is coherence? Discuss the types of coherence.

Chorence denotes similarities b/w items or entities. It describes the extent to which these items or entities are locally constant.

Types:

① Object coherance:

Visibility of an object can often be decided by examining a circumserbing solid.

Ex: A sphere or polyhedrom.

② Face coherance:

Surface properties computed to one part of a face can be applied to adjecent parts after small incremental modification

Ex: If the face is small, we sometimes

can assume if one part of the face invisible to the viewer the entire face is also invisible.

(3) Edge Coherance.

The visiblity of on edge changes only when it cowsses another edge. So if one segment of on - non-intersecting edge is vicible

(4) Scan line coherance:

Line or ~~segment~~ surface segments visible in one scan line are also likely to be visible in adjent scan lines, consequently, the image of scan line is similar to the image of adjent scan lines.

(8) Area and span coherance:

A Group of adjent pixls in an image is often covred by the some visible object. This coherance is based on the assumption that a small engough region of pixel will most likely lie within a single polygon. this reduces computation effort in searching for those polygon which contain a given screen area as in some subdivision algorithm

(9) Depth coherance.

The depth of adjent parts of

of the same surface are similar.

⑦ Frame Coherence

picture of the scene of successive points in time are likely to be similar. despite small changes in object and view point except near the edges of moving objects //

QNo5 What is computer animation? compare and contrast the various animation techniques.

Computer animation is a visual digital display technology that processes the making images on screen.

or

It can be put or defined as the art or power of giving life energy and emotions etc. to any Non-living or inanimate objects via computer.

Techniques.

① Frame by Frame (Traditional Method)

Earlier in traditional method animation was done by hands because of the absence of the computer-added drawing facilities and these traditional method required a lot of effort for even making a short video because of the fact that every second of animation requires 24 frames to process.

(2) Procedural:

According to this method set of rules are used to animate the objects Animation defines are specify the initial rules and procedure to process and later runs. Simulations many of the times rules or proccedure are based on real words physical rule which are shown by mathematical equation.

(3) Behavioral:-

According to this techiques to a contain extent the character or object specifics its own actions which helps fallows the character to improve later & in turn it dress the animations in determining each and every deatails of characters motion.

(4) Key Framings:

A key frame in computer animation is a frame where we can define changes in an animation.

According to key framing a Storyboard requirment is must as the animation draws the major frames of animation from it.

In framing character are objects key position are the must & need to be defined by the animation because the missing frames are filled in those key position via computer automatically.

⑤ motion capture:

This method of animation uses the live action footage of a living human character which recorded to the computer via video cameras & ~~makers~~ markers & later ~~action~~ that action or motion is used to animate the character which gives the real feel to the viwers as if the human character has been animated motion capture is quite famous among the animatore because of the fact that human action or motion can be capitured with relative ease.

⑥ Dynamic:

In this method simulations are used in order to produce a quite different sequance while maintaining physical reality physics laws are used in simulations to create the motion of pictures / characters high level interactivity can be achived in this method. via the use of real time simulators where a real person perdorms the action or motion of a simulated character.

//

QNO 6: Explain the animation functions with suitable examples.

1. **Morphing:** morphing is an animation function which is used to transforation object shape from one form to another is called morphing.

x It is one of the most complicated transformation this function is commonly used in movies, cartoons, advertisement and computer games.

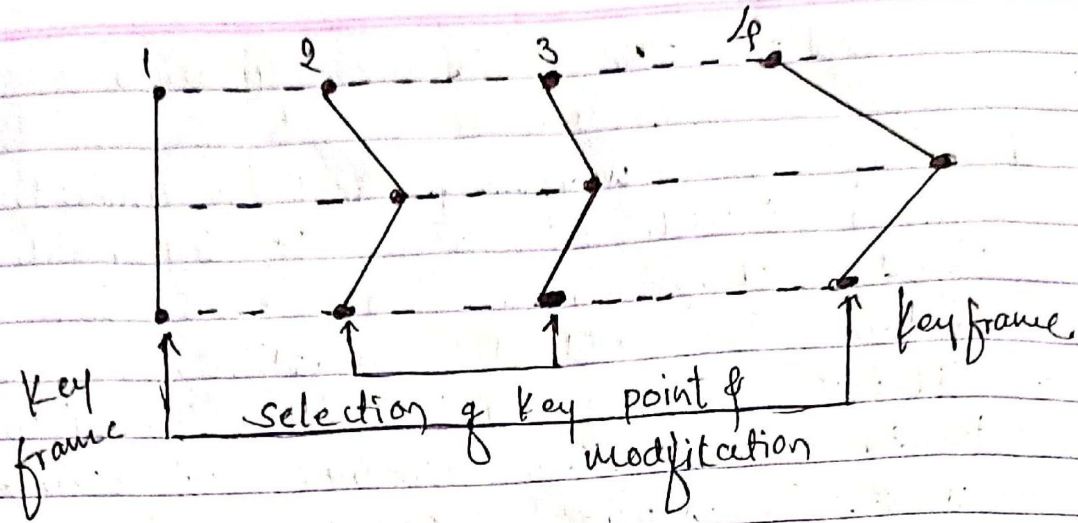
Ex Face of young person is converted into aged person.

→ The process of morphing involves 3 steps.

1] In the first step one initial image & other final image are added to morphing application where object considered as keyframe as show in fig: 1 & 4th

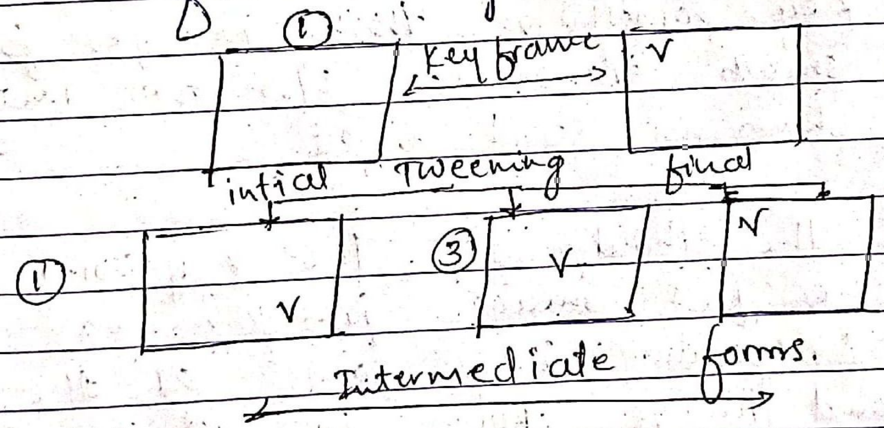
(2) The second step involves the selection of key points on both images for a smoth transition b/w two images as shown in 2nd object.

(3) In the third step: The key point at the first image transpormation a corresponding key point at the second image shown in 3rd object of the figure:

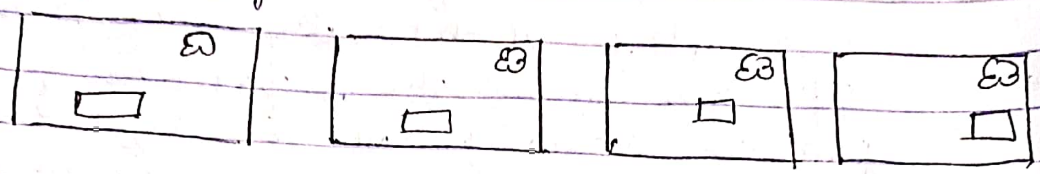


② **Wrapping** Wrapping function is similar to marpling function. It distrarti only the inital images so that it matches with final images & no fode occurs in this function.

③ Tweening: Tweening is the short form inbetweening: Tweening is the process of generating intermediate frames b/w the initial & last final images this function is popular in the film industry.



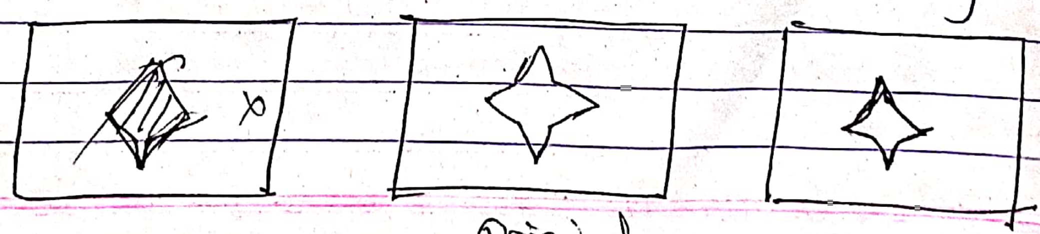
③ panning: Usually panning refers to rotation of the camera in horizontal plane in computer Graphics, paranning refer to the movement of fixed size window across the window object in a scene. In which direction the fixed sized window moves, the object appears to move in the opposite direction as shown fig..



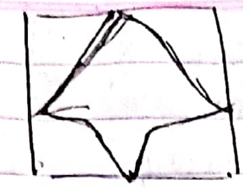
If the window movies backward direction. then the objet appear to move in forward direction & the window moves in forward direction then the object appear to moves in backward direction.

(5) Zooming - In zooming the window is fixed on objet & change its size the objet also appear. to change in size. When the window is made smaller about a fixed center. that object comes inside the window, appear more enlarged. This ~~de~~feature is known as zooming in.

When we increase the size of window about a fixed center, the object comes inside the window. appear small This feature is known as zooming out



Original   Zoom In



zoom out

(c) Fractals:

Fractals function is used to general a complex picture by using Iteration. Iteration means the repetition of a single forumala again ~~forumla~~ & again with slightly different value based on the privious iteration result. These results are displayed on the screen in the form of the display picture.