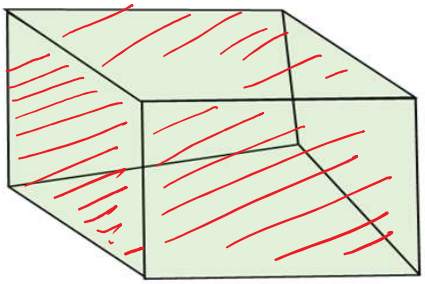
09 November 2021 16:24

6. Visible Surface Detection and Animation

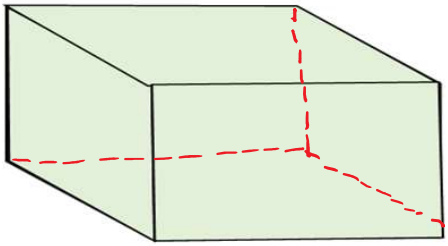
→ Z-buffer / Depth buffer algo
→ Area sub-division / Warnock algo
→ Scanline algo
→ Painter's algo

↳ What is animation
↳ Appln of animation
↳ Functions / operations in animation



observer

Object with hidden line



Object when hidden lines removed

Types of hidden surface detection algorithms

a. Object space methods → Random scan system / Vector scan system
b. Image space methods → Raster scan system

Object space methods: In this method, various parts of objects are compared. After comparison visible, invisible or hardly visible surface is determined. These methods generally decide visible surface. In the wireframe model, these are used to determine a visible line. So these algorithms are line based instead of surface based. Method proceeds by determination of parts of an object whose view is obstructed by other object and draws these parts in the same color.

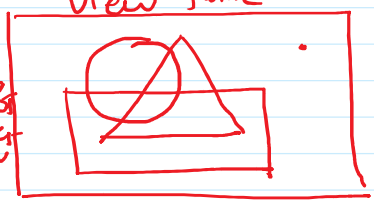
Image space methods: Here positions of various pixels are determined. It is used to locate the visible surface instead of a visible line. Each point is detected for its visibility. If a point is visible, then the pixel is on, otherwise off. So the object close to the viewer that is pierced by a projector through a pixel is determined. That pixel is drawn is appropriate color.

Differentiate between Object space and Image space method

Object Space	Image Space
1. Object space is object based. It concentrates on geometrical relation among objects in the scene.	1. It is a pixel-based method. It is concerned with the final image, what is visible within each raster pixel.
2. Here surface visibility is determined.	2. Here line visibility or point visibility is determined.
3. It is performed at the precision with which each object is defined, No resolution is considered.	3. It is performed using the resolution of the display device.
4. Calculations are not based on the resolution of the display so change of object can be easily adjusted.	4. Calculations are resolution base, so the change is difficult to adjust.
5. These were developed for vector graphics system.	5. These are developed for raster devices.
6. Object-based algorithms operate on continuous object data.	6. These operate on object data.
7. Vector display used for object method has large address space.	7. Raster systems used for image space methods have limited address space.
8. Object precision is used for application where speed is required.	8. There are suitable for application where accuracy is required.
9. It requires a lot of calculations if the image is to enlarge.	9. Image can be enlarged without losing accuracy.
10. If the number of objects in the scene increases, computation time also increases.	10. In this method complexity increase with the complexity of visible parts.

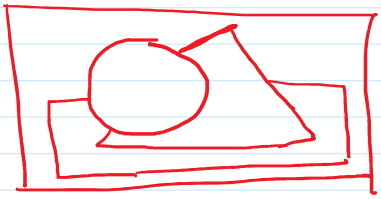
Random Scan

2bpp
3bpp $2^2 = 4$
$2^3 = 8$ 00-B
01-R
10-G
11-W



8bpp
$2^8 \Rightarrow 256$

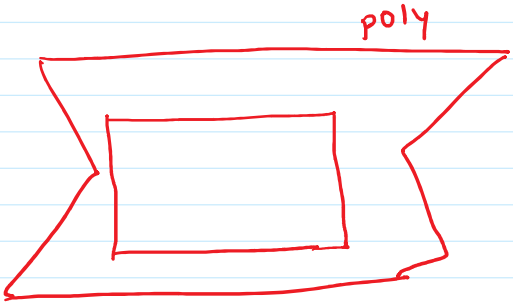
Z value is inversely proportional to the depth of obj



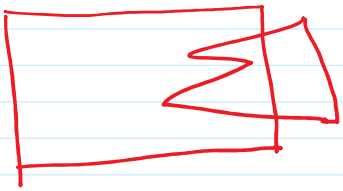
$Z \uparrow$ depth $\downarrow$
$Z \downarrow$ depth $\uparrow$

Warnock algo / Area Subdivision

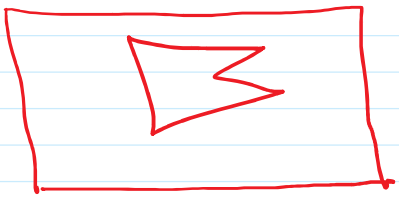
① Surrounding polygon -



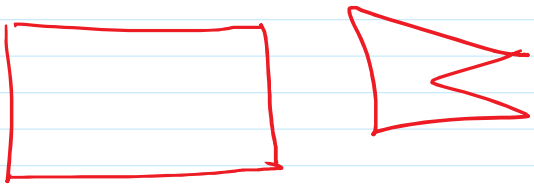
② overlapping polygon



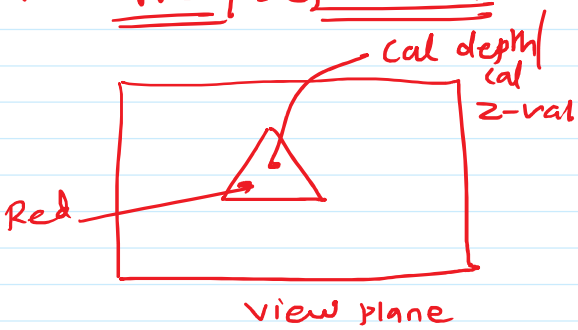
③ Inside / contained polygon



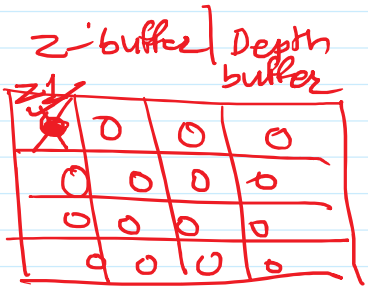
④ outside / disjoint poly.



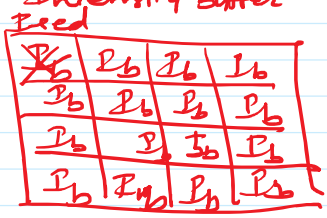
* Z-Buffer / Depth Buffer



z-buffer / Depth buffer

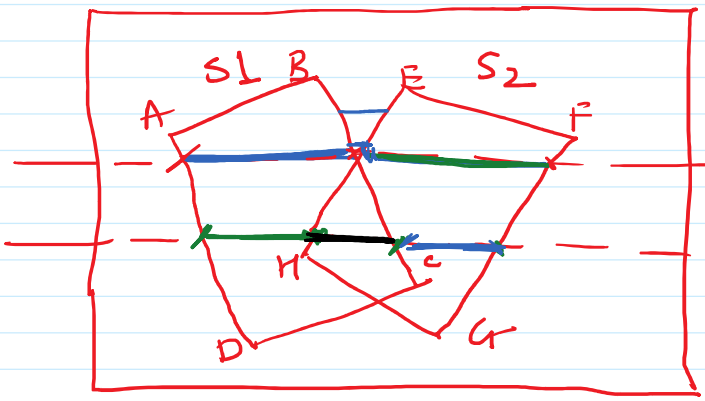


Intensity buffer

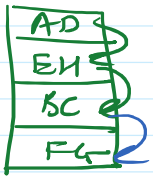


$Z_{new} > Z_{prev}$

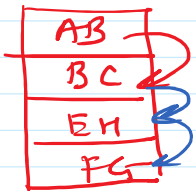
* Scanline algo for visible surface detection



AEL for Scanline S_2



AEL for scanline 1



AEL	Flag → S_1	Flag → S_2	Refresh buffer
AB → BC	ON	OFF	Intensity of S_1
BC → EH	OFF	OFF	Background Intensity
EH → FG	OFF	ON	Intensity of S_2

Scanline 2 →

AEL	Flag → S_1	Flag → S_2	Refresh buffer
AD → EH	ON	OFF	Intensity of S_1
EH → BC	ON	ON	Depth cal are made and intensity of closest surface is displayed
BC → FG	OFF	ON	Intensity of S_2

Animation:- Real time movement of an object-

Animation refers to the movement on the screen of the display device created by displaying a sequence of still images. Animation is the technique of designing, drawing, making layouts and preparation of photographic series which are integrated into the multimedia and gaming products. Animation connects the exploitation and management of still images to generate the illusion of movement. A person who creates animations is called animator. He/she use various computer technologies to capture the pictures and then to animate these in the desired sequence.

Animation includes all the visual changes on the screen of display devices. These are:

1. Change of shape as shown in fig:

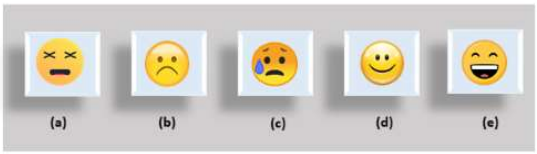


Fig: Change in Shape

2. Change in size as shown in fig:

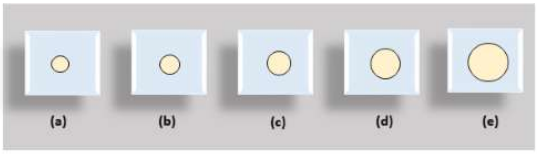


Fig: Change in Size

3. Change in color as shown in fig:

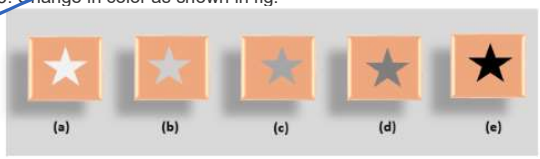


Fig: Change in Color

4. Change in structure as shown in fig:

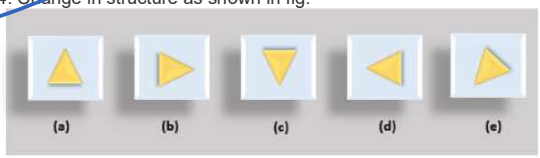


Fig: Change in Structure

5. Change in angle as shown in fig:

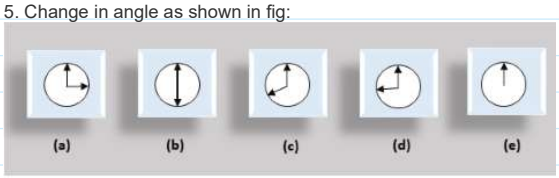


Fig: Change in angle

Application Areas of Animation:-

1. Education and Training: Animation is used in school, colleges and training centre's for education purpose. Flight simulators for aircraft are also animation based.

2. Entertainment: Animation methods are now commonly used in making motion pictures, music videos and television shows, etc.

3. Computer Aided Design (CAD): One of the best applications of computer animation is Computer Aided Design and is generally referred to as CAD. One of the earlier applications of CAD was automobile designing. But now almost all types of designing are done by using CAD application, and without animation, all these work can't be possible.

4. Advertising: This is one of the significant applications of computer animation. The most important advantage of an animated advertisement is that it takes very less space and capture people attention.

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5. Presentation: Animated Presentation is the most effective way to represent an idea. It is used to describe financial, statistical, mathematical, scientific & economic data.

Multimedia / AR-VR / Gamming zone

Animation Functions

1. Morphing: Morphing is an animation function which is used to transform object shape from one form to another is called Morphing. It is one of the most complicated transformations. This function is commonly used in movies, cartoons, advertisement, and computer games.

For Example:

1.Human Face is converted into animal face as shown in fig:

n no. of frames

2. Face of Young person is converted into aged person as shown in fig:

The process of Morphing involves three steps:

1. In the first step, one initial image and other final image are added to morphing application as shown in fig above, object consider as key frames.
2. The second step involves the selection of key points on both the images for a smooth transition between two images as shown in 2nd object.

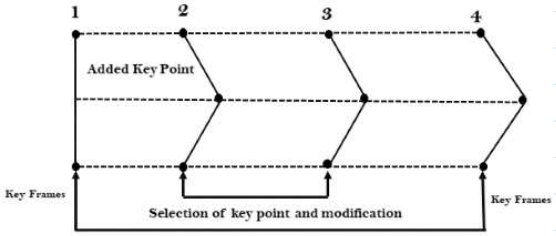


Fig: Process of Morphing

3. In the third step, the key point of the first image transforms to a corresponding key point of the second image as shown in the figure.

2. **Wrapping:** Wrapping function is similar to morphing function. It distorts only the initial images so that it matches with final images and no fade occurs in this function.

3. **Tweening:** Tweening is the short form of 'inbetweening.' Tweening is the process of generating intermediate frames between the initial & last final images. This function is popular in the film industry.

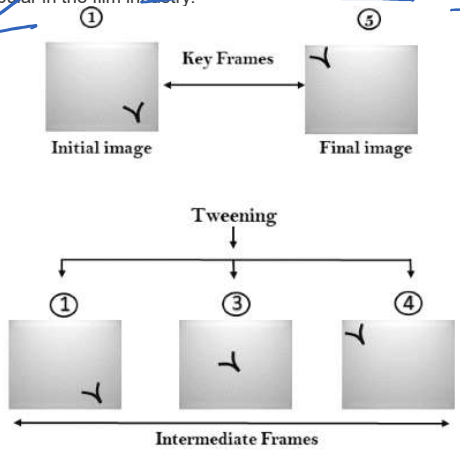


Fig: Tweening

4. **Panning:** Usually Panning refers to rotation of the camera in horizontal Plane. In computer graphics, Panning relates 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 in fig:

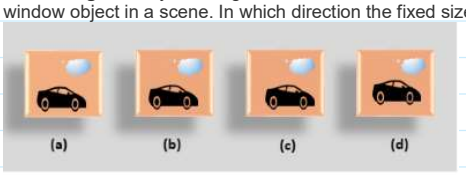


Fig: Panning

If the window moves in a backward direction, then the object appear to move in the forward direction and the window moves in forward direction then the object appear to move in a backward direction.

5. **Zooming:** In zooming, the window is fixed an object and change its size, the object also appear to change in size. When the window is made smaller about a fixed center, the object comes inside the window appear more enlarged. This feature is known as **Zooming In**.
When we increase the size of the window about the fixed center, the object comes inside the window appear small. This feature is known as **Zooming Out**.

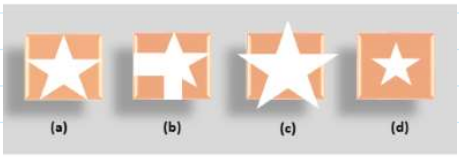
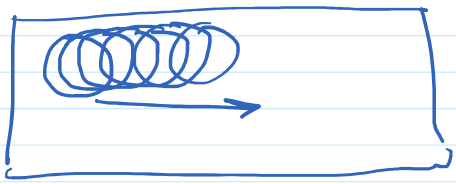


Fig: Zooming in & Zooming Out

6. **Fractals:** Fractal Function is used to generate a complex picture by using Iteration. Iteration means the repetition of a single formula again & again with slightly different value based on the previous iteration result. These results are displayed on the screen in the form of the display picture.

Moving object:-



25-30 frames/sec

```
draw()
{
  circle(50, 50, 25);
}

move()
{
  for(i=0; i<600; i++)
  {
    draw();
    clearviewport();
    delay(10);
  }
}
```

```
main()
{
  ____
  ====
  move();
}
```