



# MUTHAYAMMAL ENGINEERING COLLEGE

(An Autonomous Institution)



(Approved by AICTE, New Delhi, Accredited by NAAC & Affiliated to Anna University)  
Rasipuram - 637 408, Namakkal Dist., Tamil Nadu

L-1

## LECTURE HANDOUTS

CSE

III/VI

Course Name with Code : Computer graphics-16CSD13

Course Faculty : M GANTHIMATHI

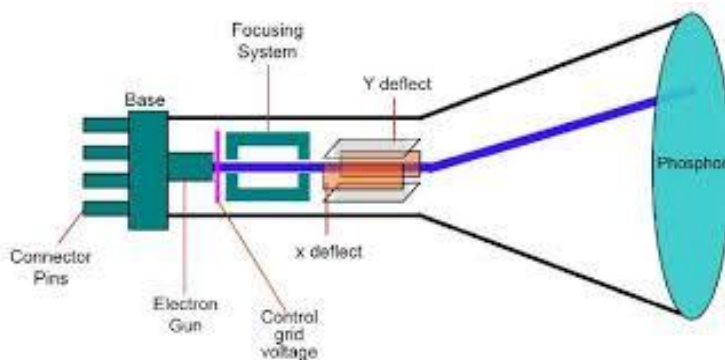
Unit : I - Introduction

Date of Lecture:

<b>Topic of Lecture:</b> Introduction & Data representation Techniques
<b>Introduction : ( Maximum 5 sentences) :</b> Computer Graphics the discipline of producing picture or images using a computer which include modelling, creation, manipulation, storage of geometric objects, rendering, converting a scene to an image, the process of transformations, rasterizing, shading, illumination and animation of the image.
<b>Prerequisite knowledge for Complete understanding and learning of Topic: ( Max. Four important topics)</b> <ul style="list-style-type: none"> <li>• Input devices</li> <li>• Output devices</li> </ul>
<b>Detailed content of the Lecture:</b> <ul style="list-style-type: none"> <li>➤ A CRT is an evacuated glass tube.</li> <li>➤ An electron gun at the rear of the tube produces a beam of electrons which is directed towards the front of the tube (screen).</li> <li>➤ The inner side of the screen is coated with phosphor substance which gives off light when it is stroked by electrons.</li> <li>➤ It is possible to control the point at which the electron beam strikes the screen, and therefore the position of the dot up on the screen, by deflecting the electron beam. The fig below shows the electrostatic deflection of the electron beam in a CRT.</li> <li>➤ The deflection system of the cathode-ray-tube consists of two pairs of parallel plates, referred to as the vertical and horizontal deflection plates.</li> <li>➤ The voltage applied to vertical plates controls the vertical deflection of the electron beam and voltage applied to the horizontal deflection plates controls the horizontal deflection of the electron beam.</li> <li>➤ There are two techniques used for producing image on the CRT screen: Vector scan/random scan and Raster scan.</li> </ul> <p><b>Persistence:</b> It is defined as the time they continue to emit light after the CRT beam is removed.</p> <ul style="list-style-type: none"> <li>➤ Persistence is defined as the time it take the emitted light from the screen to decay to one-tenth of its original intensity.</li> <li>➤ Lower persistence phosphors require higher refresh rates to maintain a picture on the screen without flicker.</li> <li>➤ A phosphor with low persistence is useful for animation ; a high-persistence phosphor is useful for displaying highly complex, static pictures.</li> <li>➤ Although some phosphor have a persistence greater than 1 second, graphics monitor are usually constructed with a persistence in the range from 10 to 60 microseconds.</li> </ul> <p><b>Resolution</b> The number of points per centimeter that can be used be plotted horizontally and vertically. (or) Total number of points in each direction.</p> <ul style="list-style-type: none"> <li>➤ The resolution of a CRT is depend on</li> </ul>

- type of phosphor
- intensity to be displayed
- focusing and deflection system

**Aspect Ratio:** It is ratio of horizontal to vertical points.



S.NO	RANDOM SCAN	RASTER SCAN
1.	The resolution of random scan is higher than raster scan.	While the resolution of raster scan is lesser or lower than random scan.
2.	It is costlier than raster scan.	While the cost of raster scan is lesser than random scan.
3.	In random scan, any alteration is easy in comparison of raster scan.	While in raster scan, any alteration is not so easy .
4.	In random scan, interweaving is not used.	While in raster scan, interweaving is used.
5.	In random scan, mathematical function is used for image or picture rendering.	While in which, for image or picture rendering, random scan uses pixels.
6.	It is suitable for applications requiring polygon drawings.	It is suitable for creating realistic scenes.

**Video Content / Details of website for further learning (if any):**

<https://www.javatpoint.com/computer-graphics-cathode-ray-tube>

[http://www.miet.edu/course/wp-content/uploads/2019/07/3.5-CG-cse\\_Optimized.pdf](http://www.miet.edu/course/wp-content/uploads/2019/07/3.5-CG-cse_Optimized.pdf)

**Important Books/Journals for further learning including the page nos.:**

Donald Hearn and M. Pauline Baker, "Computer Graphics C Version", Pearson Education, 2003,Page No: (17-99)

<https://www.journals.elsevier.com/computers-and-graphics>

<http://airccse.org/journal/ijcga/index.html>

Course Faculty

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L-2

## LECTURE HANDOUTS

CSE

III/VI

Course Name with Code : Computer graphics-16CSD13

Course Faculty : M GANTHIMATHI

Unit : I - Introduction

Date of Lecture:

Topic of Lecture: Line

Introduction : ( Maximum 5 sentences ) :

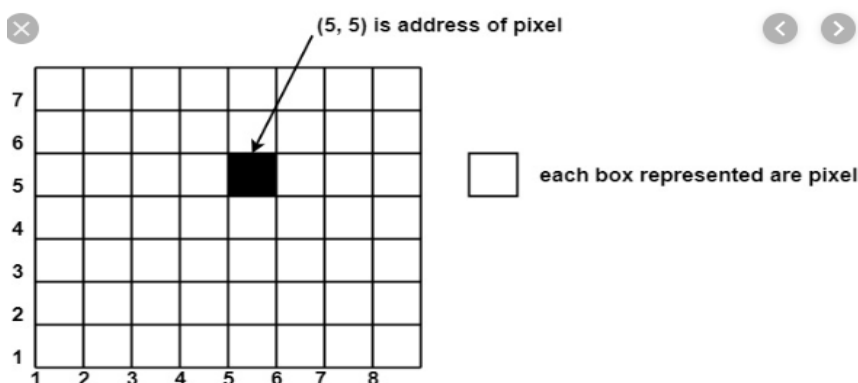
- The pixel (a word invented from "picture element") is the basic unit of programmable color on a computer display or in a computer image.
- Each pixel typically consists of 8 bits (1 byte) for a Black and White (B&W) image or 24 bits (3 bytes) for a color image-- one byte each for Red, Green, and Blue. 8 bits represents  $2^8 = 256$  tonal levels (0-255).

Prerequisite knowledge for Complete understanding and learning of Topic:  
( Max. Four important topics)

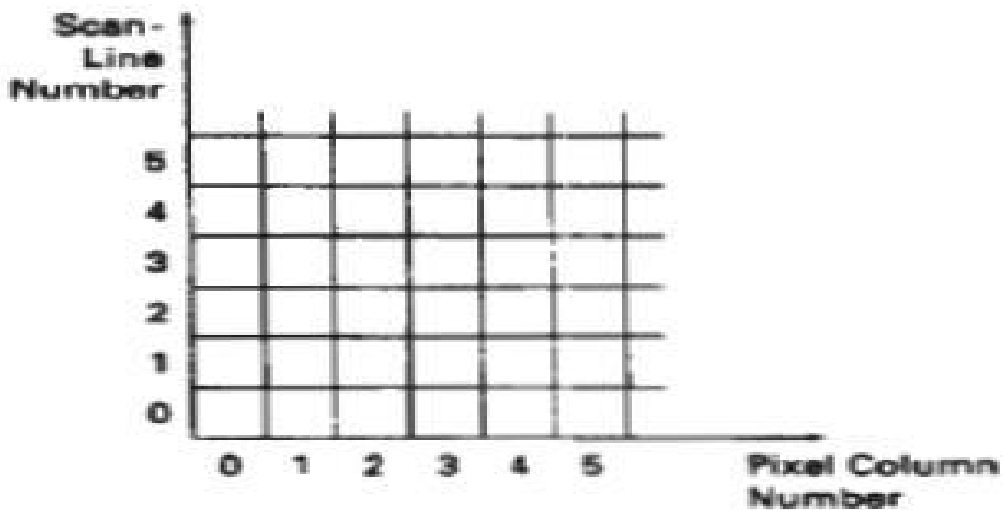
- Point
- Line
- Line equation

Detailed content of the Lecture:

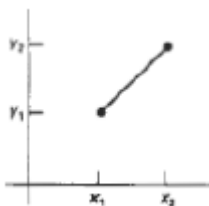
- It is a process of representing graphics objects a collection of pixels. The graphics objects are continuous.
- The pixels used are discrete. Each pixel can have either on or off state.
- The circuitry of the video display device of the computer is capable of converting binary values (0, 1) into a pixel on and pixel off information. 0 is represented by pixel off. 1 is represented using pixel on.
- Using this ability graphics computer represent picture having discrete dots.
- Any model of graphics can be reproduced with a dense matrix of dots or points. Most human beings think graphics objects as points, lines, circles, ellipses.
- For generating graphical object, many algorithms have been developed.



- Line drawing is accomplished by calculating intermediate positions along the line path between two specified end points positions.
- An output device is then directed to fill in these positions between the end points
- Digital devices display a straight line segment by plotting discrete points between the two end points.
- Discrete coordinate positions along the line path are calculated from the equation of the line.
- For a raster video display, the line color (intensity) is then loaded into the frame buffer at the corresponding pixel coordinates.
- Reading from the frame buffer, the video controller then plots "the screen pixels".
- Pixel positions are referenced according to scan-line number and column number (pixel position across a scan line).
- Scan lines are numbered consecutively from 0, starting at the bottom of the screen; and pixel columns are numbered from 0, left to right across each scan line



- To load an intensity value into the frame buffer at a position corresponding to column  $x$  along scan line  $y$ ,  
setpixel ( $x, y$ )
- To retrieve the current frame buffer intensity setting for a specified location we use a low level function  
getpixel ( $x, y$ )



- The Cartesian slope-intercept equation for a straight line is  
$$y = m \cdot x + b \text{ --- (1)}$$

Where  $m$  as slope of the line and  $b$  as the  $y$  intercept

- Given that the two endpoints of a line segment are specified at positions  $(x_1, y_1)$  and  $(x_2, y_2)$  as in figure we can determine the values for the slope  $m$  and  $y$  intercept  $b$  with the following calculations.

$$m = \Delta y / \Delta x = y_2 - y_1 / x_2 - x_1 \text{ ---(2)}$$

$$b = y_1 - m \cdot x_1 \text{ ---(3)}$$

- For any given x interval  $\Delta x$  along a line, we can compute the corresponding y interval  $\Delta y$  as  $\Delta y = m \Delta x$  ----(4)

We can obtain the x interval  $\Delta x$  corresponding to a specified  $\Delta y$  as

$$\Delta x = \Delta y / m \text{ ----(5)}$$

- For lines with slope magnitudes  $|m| < 1$ ,  $\Delta x$  can be set proportional to a small horizontal deflection voltage and the corresponding vertical deflection is then set proportional to  $\Delta y$  as calculated from Eq (4).
- For lines whose slopes have magnitudes  $|m| > 1$ ,  $\Delta y$  can be set proportional to a small vertical deflection voltage with the corresponding horizontal deflection voltage set proportional to  $\Delta x$ , calculated from Eq (5)

For lines with  $m = 1$ ,  $\Delta x = \Delta y$  and the horizontal and vertical deflections voltage are equal.

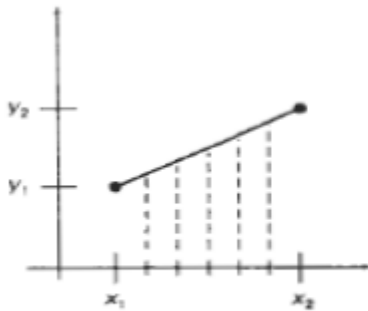


Figure : Straight line Segment with five sampling positions along the x axis between  $x_1$  and  $x_2$

#### Video Content / Details of website for further learning (if any):

<https://www.javatpoint.com/computer-graphics-scan-converting-a-straight-line>  
[http://www.miet.edu/course/wp-content/uploads/2019/07/3.5-CG-cse\\_Optimized.pdf](http://www.miet.edu/course/wp-content/uploads/2019/07/3.5-CG-cse_Optimized.pdf)

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L-3

## LECTURE HANDOUTS

CSE

III/VI

Course Name with Code : Computer graphics-16CSD13

Course Faculty : M GANTHIMATHI

Unit : I - Introduction

Date of Lecture:

**Topic of Lecture:** Line Drawing Algorithms-DDA and Bresenham

**Introduction : ( Maximum 5 sentences ) :**

- A line drawing algorithm is a graphical algorithm for approximating a line segment on discrete graphical media.
- On discrete media, such as pixel-based displays and printers, line drawing requires such an approximation (in nontrivial cases).
- Basic algorithms rasterize lines in one color.

**Prerequisite knowledge for Complete understanding and learning of Topic:**  
( Max. Four important topics)

- Line equation
- Slope formula
- Intersection formula

## Detailed content of the Lecture:

### Digital Differential Analyzer (DDA) Algorithm

- The digital differential analyzer (DDA) is a scan-conversion line algorithm based on calculation either  $\Delta y$  or  $\Delta x$
- The line at unit intervals in one coordinate and determine corresponding integer values nearest the line path for the other coordinate.
- A line with positive slope, if the slope is less than or equal to 1, at unit  $x$  intervals ( $\Delta x=1$ ) and compute each successive  $y$  values as

$$y_{k+1} = y_k + m \quad (6)$$

- Subscript  $k$  takes integer values starting from 1 for the first point and increases by 1 until the final endpoint is reached.  $m$  can be any real number between 0 and 1 and, the calculated  $y$  values must be rounded to the nearest integer
- For lines with a positive slope greater than 1 we reverse the roles of  $x$  and  $y$ , ( $\Delta y=1$ ) and calculate each succeeding  $x$  value as

$$x_{k+1} = x_k + (1/m) \quad (7)$$

- Equation (6) and (7) are based on the assumption that lines are to be processed from the left endpoint to the right endpoint.
- If this processing is reversed,  $\Delta x=-1$  that the starting endpoint is at the right  $y_{k+1} = y_k - m$  (8)
- When the slope is greater than 1 and  $\Delta y = -1$  with

$$x_{k+1} = x_k - 1(1/m) \quad (9)$$

- If the absolute value of the slope is less than 1 and the start endpoint is at the left, we set  $\Delta x = 1$  and calculate  $y$  values with Eq. (6)
- When the start endpoint is at the right (for the same slope), we set  $\Delta x = -1$  and obtain  $y$  positions from Eq. (8). Similarly, when the absolute value of a negative slope is greater than 1, we use  $\Delta y = -1$  and Eq. (9) or we use  $\Delta y = 1$  and Eq. (7).

### Algorithm Description:

Step 1 : Accept Input as two endpoint pixel positions

Step 2: Horizontal and vertical differences between the endpoint positions are assigned to parameters  $dx$  and  $dy$  (Calculate  $dx=x_b-x_a$  and  $dy=y_b-y_a$ ).

Step 3: The difference with the greater magnitude determines the value of parameter steps.

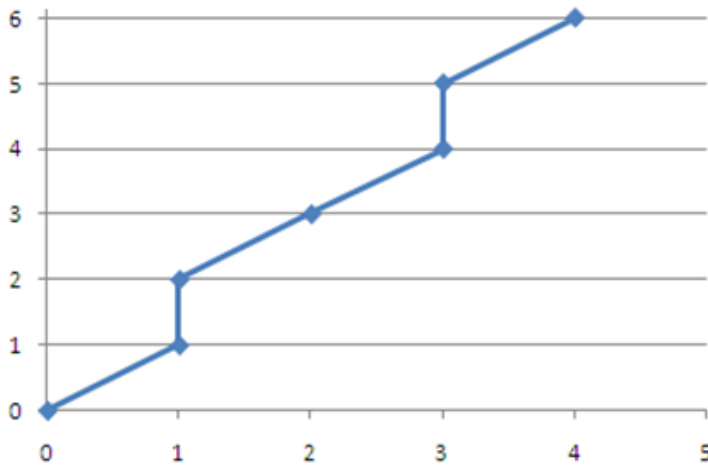
Step 4 : Starting with pixel position  $(x_a, y_a)$ , determine the offset needed at each step to generate the next pixel position along the line path.

Step 5: loop the following process for steps number of times

- Use a unit of increment or decrement in the  $x$  and  $y$  direction
- if  $x_a$  is less than  $x_b$  the values of increment in the  $x$  and  $y$  directions are 1 and  $m$
- if  $x_a$  is greater than  $x_b$  then the decrements  $-1$  and  $-m$  are used.

**Example : Consider the line from (0,0) to (4,6)**

k	x	Y	Plotting points (Rounded to Integer)
0	$0+0.66=0.66$	$0+1=1$	(1,1)
1	$0.66+0.66=1.32$	$1+1=2$	(1,2)
2	$1.32+0.66=1.98$	$2+1=3$	(2,3)
3	$1.98+0.66=2.64$	$3+1=4$	(3,4)
4	$2.64+0.66=3.3$	$4+1=5$	(3,5)
5	$3.3+0.66=3.96$	$5+1=6$	(4,6)



### Bresenham's Line Algorithm

An accurate and efficient raster line generating algorithm developed by Bresenham, that uses only incremental integer calculations.

In addition, Bresenham's line algorithm can be adapted to display circles and other curves.

To illustrate Bresenham's approach, we first consider the scan-conversion process for lines with positive slope less than 1.

1. Input the two line endpoints and store the left end point in  $(x_0, y_0)$
2. load  $(x_0, y_0)$  into frame buffer, ie. Plot the first point.
3. Calculate the constants  $\Delta x$ ,  $\Delta y$ ,  $2\Delta y$  and obtain the starting value for the decision parameter as  $P_0 = 2\Delta y - \Delta x$
4. At each  $x_k$  along the line, starting at  $k=0$  perform the following test If  $P_k < 0$ , the next point to plot is  $(x_{k+1}, y_k)$  and
 
$$P_{k+1} = P_k + 2\Delta y$$
 otherwise, the next point to plot is  $(x_{k+1}, y_{k+1})$  and  $P_{k+1} = P_k + 2\Delta y - 2\Delta x$
5. Perform step 4  $\Delta x$  times.

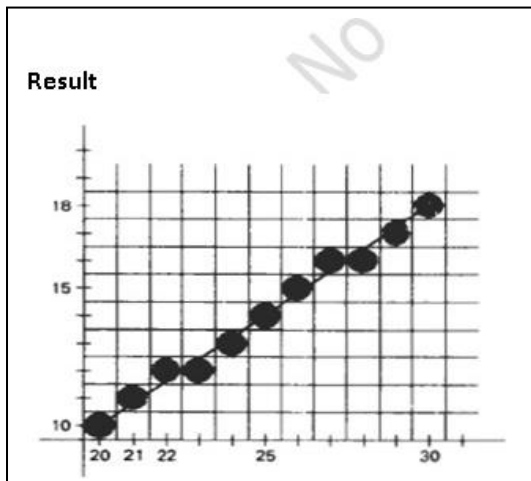
**Example :** Consider the line with endpoints (20,10) to (30,18)

The line has the slope  $m = (18-10)/(30-20) = 8/10 = 0.8$

The initial decision parameter has the value  $p_0 = 2\Delta y - \Delta x = 6$



k	$p_k$	$(x_{k+1}, y_{k+1})$
0	6	(21,11)
1	2	(22,12)
2	-2	(23,12)
3	14	(24,13)
4	10	(25,14)
5	6	(26,15)
6	2	(27,16)
7	-2	(28,16)
8	14	(29,17)
9	10	(30,18)



**Video Content / Details of website for further learning (if any):**

<https://www.javatpoint.com/computer-graphics-dda-algorithm-line>

[http://www.miet.edu/course/wp-content/uploads/2019/07/3.5-CG-cse\\_Optimized.pdf](http://www.miet.edu/course/wp-content/uploads/2019/07/3.5-CG-cse_Optimized.pdf)

**Important Books/Journals for further learning including the page nos.:**

Donald Hearn and M. Pauline Baker, "Computer Graphics C Version", Pearson Education, 2003, Page no: 106-114

<https://www.journals.elsevier.com/computers-and-graphics>

<http://airccse.org/journal/ijcga/index.html>

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L-4

**LECTURE HANDOUTS**

**CSE**

**III/VI**

**Course Name with Code : Computer graphics-16CSD13**

**Course Faculty : M GANTHIMATHI**

**Unit : I - Introduction**

**Date of Lecture:**

<p><b>Topic of Lecture:</b> Curve drawing algorithms</p> <p><b>Introduction : ( Maximum 5 sentences) :</b></p> <ul style="list-style-type: none"> <li>• It is not easy to display a continuous smooth arc on the computer screen as our computer screen is made of pixels organized in matrix form.</li> <li>• So, to draw a circle on a computer screen we should always choose the nearest pixels from a printed pixel so as they could form an arc.</li> <li>• There are two algorithm to do this:             <ul style="list-style-type: none"> <li>✓ Mid-Point circle drawing algorithm</li> <li>✓ Bresenham’s circle drawing algorithm</li> </ul> </li> </ul>
<p><b>Prerequisite knowledge for Complete understanding and learning of Topic:</b> <b>( Max. Four important topics)</b></p> <ul style="list-style-type: none"> <li>• Circle formula</li> <li>• Properties of circle</li> </ul>
<p><b>Detailed content of the Lecture:</b></p> <p><b>Midpoint circle Algorithm:</b></p> <ul style="list-style-type: none"> <li>➤ In the raster line algorithm at unit intervals and determine the closest pixel position to the specified circle path at each step for a given radius r and screen center position <math>(x_c, y_c)</math> set up our algorithm to calculate pixel positions around a circle path centered at the coordinate position by adding <math>x_c</math> to x and <math>y_c</math> to y.</li> <li>➤ To apply the midpoint method we define a circle function as <math>f_{circle}(x,y) = x^2+y^2-r^2</math></li> <li>➤ Any point <math>(x,y)</math> on the boundary of the circle with radius r satisfies the equation <math>f_{circle}(x,y)=0</math>. If the point is in the interior of the circle, the circle function is negative.</li> <li>➤ And if the point is outside the circle the, circle function is positive</li> </ul> $f_{circle}(x,y) < 0, \text{ if } (x,y) \text{ is inside the circle boundary}$ $= 0, \text{ if } (x,y) \text{ is on the circle boundary}$ $> 0, \text{ if } (x,y) \text{ is outside the circle boundary}$ <ul style="list-style-type: none"> <li>➤ The tests in the above eqn are performed for the midposition sbtween pixels near the circle path at each sampling step. The circle function is the decision parameter in the midpoint algorithm.</li> <li>➤ Midpoint between candidate pixels at sampling position <math>x_{k+1}</math> along a circular path. Fig -1 shows the midpoint between the two candidate pixels at sampling position <math>x_{k+1}</math>.</li> <li>➤ To plot the pixel at <math>(x_k, y_k)</math> next need to determine whether the pixel at position <math>(x_{k+1}, y_k)</math> or the one at position <math>(x_{k+1}, y_{k-1})</math> is circular to the circle.</li> </ul> <ol style="list-style-type: none"> <li>1. Input radius r and circle center <math>(x_c, y_c)</math> and obtain the first point on the circumference of the circle centered on the origin as</li> </ol>

$$(x_0, y_0) = (0, r)$$

2. Calculate the initial value of the decision parameter as  $P_0 = (5/4) - r$
3. At each  $x_k$  position, starting at  $k=0$ , perform the following test. If  $P_k < 0$  the next point along the circle centered on  $(0,0)$  is  $(x_{k+1}, y_k)$  and  $P_{k+1} = P_k + 2x_{k+1} + 1$ . Otherwise the next point along the circle is  $(x_{k+1}, y_{k-1})$  and  $P_{k+1} = P_k + 2x_{k+1} + 1 - 2y_{k+1}$ . Where  $2x_{k+1} = 2x_{k+2}$  and  $2y_{k+1} = 2y_{k-2}$
4. Determine symmetry points in the other seven octants.
5. Move each calculated pixel position  $(x, y)$  onto the circular path centered at  $(x_c, y_c)$  and plot the coordinate values.

$$x = x + x_c \quad y = y + y_c$$

6. Repeat step 3 through 5 until  $x >= y$ .
- Given a circle radius  $r=10$

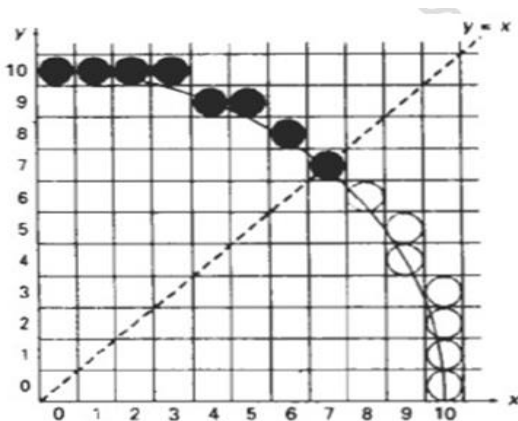
The circle octant in the first quadrant from  $x=0$  to  $x=y$ . The initial value of the decision parameter is  $P_0 = 1 - r = -9$

For the circle centered on the coordinate origin, the initial point is  $(x_0, y_0) = (0, 10)$  and initial increment terms for calculating the decision parameters are

$$2x_0 = 0, \quad 2y_0 = 20$$

Successive midpoint decision parameter values and the corresponding coordinate positions along the circle path are listed in the following table.

k	$p_k$	$(x_{k+1}, y_{k-1})$	$2x_{k+1}$	$2y_{k+1}$
0	-9	(1,10)	2	20
1	-6	(2,10)	4	20
2	-1	(3,10)	6	20
3	6	(4,9)	8	18
4	-3	(5,9)	10	18
5	8	(6,8)	12	16
6	5	(7,7)	14	14



**Video Content / Details of website for further learning (if any):**

<https://www.javatpoint.com/computer-graphics-midpoint-circle-algorithm>  
[http://www.miet.edu/course/wp-content/uploads/2019/07/3.5-CG-cse\\_Optimized.pdf](http://www.miet.edu/course/wp-content/uploads/2019/07/3.5-CG-cse_Optimized.pdf)

**Important Books/Journals for further learning including the page nos.:**

Donald Hearn and M. Pauline Baker, "Computer Graphics C Version", Pearson Education, 2003, Page No: 117-122



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L-5

**LECTURE HANDOUTS**

**CSE**

**III/VI**

Course Name with Code : Computer graphics-16CSD13

Course Faculty : M GANTHIMATHI

Unit : I - Introduction

Date of Lecture:

<b>Topic of Lecture:</b> Ellipse mid point drawing algorithms
<p><b>Introduction : ( Maximum 5 sentences)</b></p> <ul style="list-style-type: none"> <li>• An ellipse is an elongated circle. It has along the major and minor axes.</li> <li>• It can be given in terms of the distances from any point on the ellipse to two fixed positions called the <b>foci</b> of the ellipse.</li> <li>• The sum of these two distances is the same values for all points on the ellipse.</li> </ul>
<p><b>Prerequisite knowledge for Complete understanding and learning of Topic:</b> ( Max. Four important topics)</p> <ul style="list-style-type: none"> <li>• Ellipse formula</li> <li>• Properties of ellipse</li> <li>• Circle drawing algorithm</li> </ul>
<p>Detailed content of the Lecture: Mid point Ellipse Algorithm</p> <p>1. Input <math>r_x, r_y</math> and ellipse center <math>(x_c, y_c)</math> and obtain the first point on an ellipse centered on the origin as</p> $(x_0, y_0) = (0, r_y)$ <p>2. Calculate the initial value of the decision parameter in region 1 as</p> $P_{10} = r_y^2 - r_x^2 r_y + (1/4)r_x^2$ <p>3. At each <math>x_k</math> position in region 1 starting at <math>k=0</math> perform the following test. If <math>P_{1k} &lt; 0</math>, the next point along the ellipse centered on <math>(0,0)</math> is <math>(x_{k+1}, y_k)</math> and</p> $p_{1k+1} = p_{1k} + 2 r_y^2 x_k + 1 + r_y^2$ <p>Otherwise the next point along the ellipse is <math>(x_{k+1}, y_{k-1})</math> and <math>p_{1k+1} = p_{1k} + 2 r_y^2 x_k + 1 - 2 r_x^2 y_{k+1} + r_y^2</math> with</p> $2 r_y^2 x_k + 1 = 2 r_y^2 x_k + 2 r_y^2 \quad 2 r_x^2 y_{k+1} = 2 r_x^2 y_k + 2 r_x^2$ <p>And continue until <math>2 r_y^2 x \geq 2 r_x^2 y</math></p> <p>4. Calculate the initial value of the decision parameter in region 2 using the last point <math>(x_0, y_0)</math> is the last position calculated in region 1.</p> $p_{20} = r_y^2 (x_0 + 1/2)^2 + r_x^2 (y_0 - 1)^2 - r_x^2 r_y^2$ <p>5. At each position <math>y_k</math> in region 2, starting at <math>k=0</math> perform the following test, If <math>p_{2k} &gt; 0</math> the next point along the ellipse centered on <math>(0,0)</math> is <math>(x_k, y_{k-1})</math> and</p> $p_{2k+1} = p_{2k} - 2 r_x^2 y_{k+1} + r_x^2$ <p>Otherwise the next point along the ellipse is <math>(x_{k+1}, y_{k-1})</math> and</p> $p_{2k+1} = p_{2k} + 2 r_y^2 x_{k+1} - 2 r_x^2 y_{k+1} + r_x^2$ <p>Using the same incremental calculations for <math>x</math> any <math>y</math> as in region 1.</p>

6. Determine symmetry points in the other three quadrants.

7. Move each calculate pixel position  $(x,y)$  onto the elliptical path centered on  $(x_c,y_c)$  and plot the coordinate values

$$x=x+x_c, y=y+y_c$$

8. Repeat the steps for region until  $2r_x^2x \geq 2r_y^2y$

**Example:**

Input ellipse parameters  $r_x=8$  and  $r_y=6$  the mid point ellipse algorithm by determining raster position along the ellipse path in the first quadrant. Initial values and increments for the decision parameter calculations are

For region 1 the initial point for the ellipse centered on the origin is  $(x_0,y_0) = (0,6)$  and the initial decision parameter value is

$$p_{1_0} = r_x^2 - r_y^2 + 1/4r_x^2 = -332 \quad x$$

Successive midpoint decision parameter values and the pixel positions along the ellipse are listed in the following table.

k	$p_{1_k}$	$x_{k+1}, y_{k+1}$	$\Delta r_y$ $x_{k+1}$	$\Delta r_x$ $y_{k+1}$
0	-332	(1,6)	72	768
1	-224	(2,6)	144	768
2	-44	(3,6)	216	768
3	208	(4,5)	288	640
4	-108	(5,5)	360	640
5	288	(6,4)	432	512
6	244	(7,3)	504	384

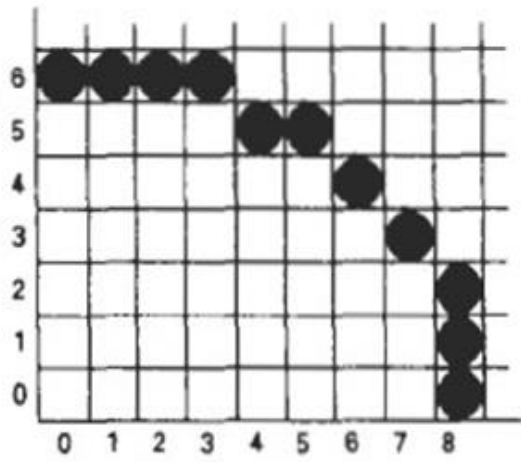
Move out of region 1,  $2r_y^2x > 2r_x^2y$ .

For a region 2 the initial point is  $(x_0,y_0)=(7,3)$  and the initial decision parameter is

$$p_{2_0} = f_{\text{ellipse}}(7+1/2, 2) = -151$$

The remaining positions along the ellipse path in the first quadrant are then calculated as

k	$P_{2_k}$	$x_{k+1}, y_{k+1}$	$\Delta r_y$ $x_{k+1}$	$\Delta r_x$ $y_{k+1}$
0	-151	(8,2)	576	256
1	233	(8,1)	576	128
2	745	(8,0)	-	-



**Video Content / Details of website for further learning (if any):**

<https://www.javatpoint.com/computer-graphics-midpoint-circle-algorithm>

[http://www.miet.edu/course/wp-content/uploads/2019/07/3.5-CG-cse\\_Optimized.pdf](http://www.miet.edu/course/wp-content/uploads/2019/07/3.5-CG-cse_Optimized.pdf)

**Important Books/Journals for further learning including the page nos.:**

Donald Hearn and M. Pauline Baker, "Computer Graphics C Version", Pearson Education, 2003, Page No: 122-130

<https://www.journals.elsevier.com/computers-and-graphics>

<http://airccse.org/journal/ijcga/index.html>

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L-6

## LECTURE HANDOUTS

CSE

III/VI

Course Name with Code : Computer graphics-16CSD13

Course Faculty : M GANTHIMATHI

Unit : I - Introduction

Date of Lecture:

**Topic of Lecture:** Attributes

**Introduction : ( Maximum 5 sentences ) :**

- Any parameter that affects the way a primitive is to be displayed is referred to as attribute parameter. Example attributes are color, size, etc.

**Prerequisite knowledge for Complete understanding and learning of Topic:**  
**( Max. Four important topics)**

- Line and curve concepts
- Pattern knowledge
- Text and character

Detailed content of the Lecture:

- Definition
- Line Attribute
- Curve Attribute
- Color and Gray scale level
- Area Filled attributes
- Text and Characters

Definition

Parameter that affects the way a primitive will be displayed

Line Attribute

- . Type
- . Width
- . Color
- . Pen & Brush

Line Attribute:

## Type

. Solid —————

. Dotted - very short dash with spacing equal to

.....  
or greater than dash itself

. Dashed - displayed by generating an interdash -----  
spacing

Pixel count for the span and interspan length is specified

by the mask . Ex. 111100011110001111

## Line Width:

. Specify in pixels and proportion of a standard line width.

. Thicker line can be produced by.

. Adding extra pixel vertically when  $|m| < 1$

. Adding extra pixel horizontally when  $|m| > 1$

## Line Endcaps



Butt Cap



Round Cap



Projecting  
Square Cap

## Line Joins



Miter Join



Round Join



Bevel Join

## Pen and Brush

. The selected "pen" or "brush" determine the way a line will be drawn.

. Pens and brushes have size, shape, color and pattern attribute.

. Pixel mask is applied in both of them.

Color information is stored in frame buffer or in separate table and use pixel values as index to the color table.


Two ways to store color information :

1. Direct
2. Indirect



## Indirect

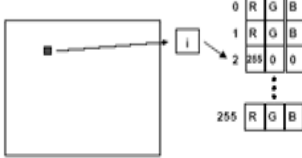
**Full-color (RGB) displays**



- For 24 bit color:
  - store 8 bits each of red, green, and blue per pixel.
  - E.g. (255,0,0) is pure red, and (255, 255, 255) is white.
  - Yields  $2^8 \cdot 2^8 = 16$  million colors.
- For 15 bit color:
  - 5 bits red + 5 green + 5 blue
  - The video hardware uses the values to drive the R, G, and B guns.
  - You can mix different levels of R, G, and B to get any color you want

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**Color maps (LUT's)**



0	R	G	B
1	R	G	B
2	0	0	0
⋮			
255	R	G	B

- A single number (e.g. 8 bits) stored at each pixel.
- Used as an *index* into an array of RGB triples.
- With 8 bits per pixel, you get 256 colors of your choice
- Simple things to fill up color-maps with:
  - A grey ramp (for grey scale pictures)
  - A bunch of random colors (for color drawings.)
  - A very poor representation of full color

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### Text and Characters

- Very important output primitive
- Many pictures require text
- Two general techniques used
  - Bitmapped (raster)
  - Stroked (outline)

### Video Content / Details of website for further learning (if any):

[http://www.eenadupratibha.net/pratibha/engineering-colleges/engineering-jobs/cse\\_sem\\_att\\_out\\_pri\\_un3.html](http://www.eenadupratibha.net/pratibha/engineering-colleges/engineering-jobs/cse_sem_att_out_pri_un3.html)

[http://www.miet.edu/course/wp-content/uploads/2019/07/3.5-CG-cse\\_Optimized.pdf](http://www.miet.edu/course/wp-content/uploads/2019/07/3.5-CG-cse_Optimized.pdf)

### Important Books/Journals for further learning including the page nos.:

Donald Hearn and M. Pauline Baker, "Computer Graphics C Version", Pearson Education, 2003, Page No: 164-199

<https://www.journals.elsevier.com/computers-and-graphics>

<http://airccse.org/journal/ijcga/index.html>

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L-7

**LECTURE HANDOUTS**

**CSE**

**III/VI**

Course Name with Code : Computer graphics-16CSD13

Course Faculty : M GANTHIMATHI

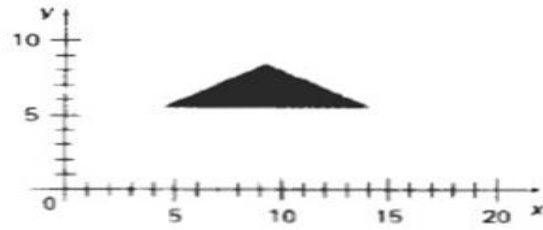
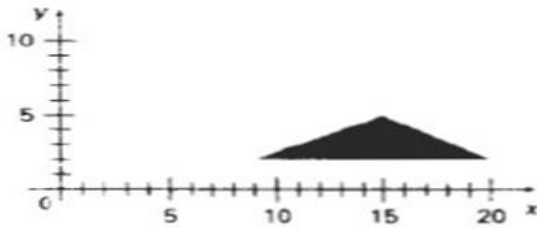
Unit : I - Introduction

Date of Lecture:

<b>Topic of Lecture:</b> Two dimensional Transformations
<p><b>Introduction : ( Maximum 5 sentences) :</b></p> <ul style="list-style-type: none"> <li>• Changes in orientations, size and shape are accomplished with geometric transformations that alter the coordinate description of objects.</li> </ul>
<p><b>Prerequisite knowledge for Complete understanding and learning of Topic:</b> ( Max. Four important topics)</p> <ul style="list-style-type: none"> <li>• Line and curve concepts</li> <li>• Two dimensional object representation concepts</li> </ul>
<p>Detailed content of the Lecture:</p> <p>Basic transformation</p> <p>Translation</p> <ul style="list-style-type: none"> <li>▪ <math>T(t_x, t_y)</math></li> <li>▪ Translation distances •</li> </ul> <p>Scale</p> <ul style="list-style-type: none"> <li>▪ <math>S(s_x, s_y)</math></li> <li>▪ Scale factors •</li> </ul> <p>Rotation</p> <ul style="list-style-type: none"> <li>▪ <math>R( ) \quad \theta</math></li> <li>▪ Rotation angle</li> </ul> <p><b>Translation</b></p> <p>A translation is applied to an object by representing it along a straight line path from one coordinate location to another adding translation distances, tx, ty to original coordinate position (x,y) to move the point to a new position (x',y') to</p> $x' = x + tx, \quad y' = y + ty$

$$\begin{bmatrix} x' \\ y' \end{bmatrix} = \begin{bmatrix} x \\ y \end{bmatrix} + \begin{bmatrix} t_x \\ t_y \end{bmatrix}$$

$$P' = P + T$$



### Rotations:

A two-dimensional rotation is applied to an object by repositioning it along a circular path on xy plane with angle  $\theta$

$$x' = x \cos \theta - y \sin \theta$$

$$y' = x \sin \theta + y \cos \theta$$

### Rotation equation

$$P' = R \cdot P$$

### Rotation Matrix

$$\begin{bmatrix} x' \\ y' \end{bmatrix} = \begin{bmatrix} \cos(\theta) & -\sin(\theta) \\ \sin(\theta) & \cos(\theta) \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix}$$

### Scaling

- A scaling transformation alters the size of an object.
- This operation can be carried out for polygons by multiplying the coordinate values (x,y) to each vertex by scaling factor  $S_x$  &  $S_y$  to produce the transformed coordinates (x',y')

$$x' = x \cdot S_x$$

$$y' = y \cdot S_y$$

$$\begin{bmatrix} x' \\ y' \end{bmatrix} = \begin{bmatrix} s_x & 0 \\ 0 & s_y \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix}$$

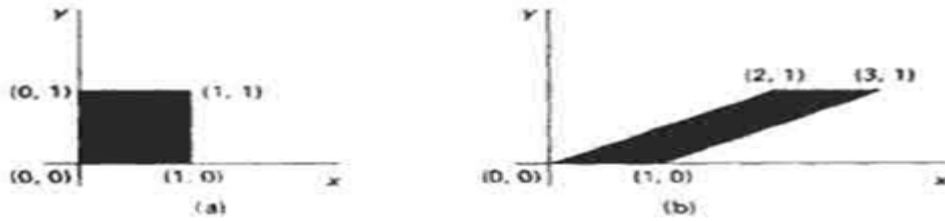
or

$$P' = S \cdot P$$

### 4. Shearing:

A Transformation that slants the shape of an object is called the shear transformation

NotesEngine.com



The Transformations matrix for x-shear is

$$\begin{bmatrix} 1 & sh_x & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

which transforms the coordinates as

$$x'' = x + sh_x \cdot y$$

$$y'' = y$$

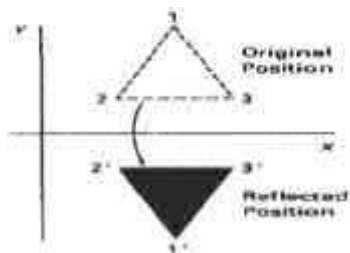
## 5.Reflection

A reflection is a transformation that produces a mirror image of an object.

The mirror image for a two- dimensional reflection is generated relative to an axis of reflection by rotating the object 180° about the reflection axis.

We can choose an axis of reflection in the xy plane or perpendicular to the xy plane or coordinate origin

### Reflection of an object about the x axis



### Video Content/ Details of website for further learning (if any):

[https://www.tutorialspoint.com/computer\\_graphics/2d\\_transformation.htm](https://www.tutorialspoint.com/computer_graphics/2d_transformation.htm)

[http://www.miet.edu/course/wp-content/uploads/2019/07/3.5-CG-cse\\_Optimized.pdf](http://www.miet.edu/course/wp-content/uploads/2019/07/3.5-CG-cse_Optimized.pdf)

### Important Books/Journals for further learning including the page nos.:

Donald Hearn and M. Pauline Baker, "Computer Graphics C Version", Pearson Education, 2003,Page No: 204-227

<https://www.journals.elsevier.com/computers-and-graphics>

<http://airccse.org/journal/ijcga/index.html>

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L-8

## LECTURE HANDOUTS

CSE

III/VI

Course Name with Code : Computer graphics-16CSD13

Course Faculty : M GANTHIMATHI

Unit : I - Introduction

Date of Lecture:

**Topic of Lecture:** Two dimensional Clipping

**Introduction : ( Maximum 5 sentences ) :**

- In two-dimensional graphics, a clip region may be defined so that pixels are only drawn within the boundaries of a window or frame.
- Clip regions can also be used to selectively control pixel rendering for aesthetic or artistic purposes.

**Prerequisite knowledge for Complete understanding and learning of Topic:  
( Max. Four important topics)**

- Line drawing algorithm
- 2D transformations

Detailed content of the Lecture:

**Clipping operation**

- Any procedure that identifies those portions of a picture that are inside or outside of a specified region of space is referred to as **clipping algorithm or clipping**.
- The region against which an object is to be clipped is called **clip window**.

Point clipping -  $xw_{min} \leq x \leq xw_{max}; yw_{min} \leq y \leq yw_{max}$

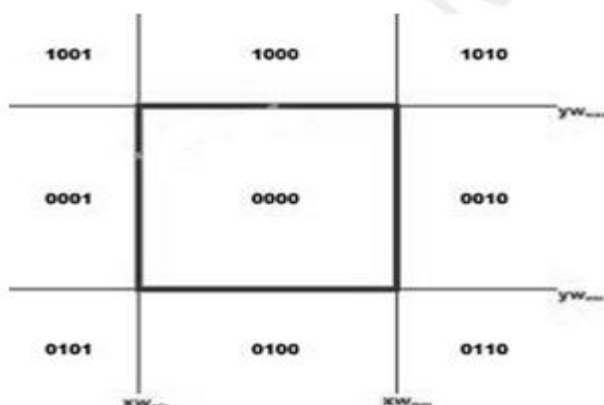
Line clipping

Area clipping

Curve clipping

Text clipping-All or none string clipping & All or none character clipping

**Cohen-Sutherland Line Clipping**



- Set the region code using ABRL .
- Cohen-Sutherland line clipping starting with bottom endpoint left, right , bottom and top boundaries in turn and find that this point is below the clipping rectangle.

Step 1 : Assign a region code for two endpoints of given line.

Step 2 : If both endpoints have a region code 0000

then given line is completely inside.

Step 3 : Else, perform the logical AND operation for both region codes.

Step 3.1 : If the result is not 0000, then given line is completely outside.

Step 3.2 : Else line is partially inside.

Step 3.2.1 : Choose an endpoint of the line that is outside the given rectangle.

Step 3.2.2 : Find the intersection point of the rectangular boundary (based on region code).

Step 3.2.3 : Replace endpoint with the intersection point and update the region code.

Step 3.2.4 : Repeat step 2 until we find a clipped line either trivially accepted or trivially rejected.

Step 4 : Repeat step 1 for other lines

For a line with endpoint coordinates  $(x_1, y_1)$  and  $(x_2, y_2)$  and the y coordinate of the intersection point with a vertical boundary can be obtained with the calculation.

$$y = y_1 + m (x - x_1)$$

where x value is set either to  $x_{w_{min}}$  or to  $x_{w_{max}}$  and slope of line is calculated as  $m = (y_2 - y_1)$

$$/ (x_2 - x_1)$$

the intersection with a horizontal boundary the x coordinate can be calculated as  $x = x_1 + (y - y_1) / m$



### Sutherland - Hodgeman polygon clipping:

A polygon can be clipped by processing the polygon boundary as a whole against each window edge. This could be accomplished by processing all polygon vertices against each clip rectangle boundary.

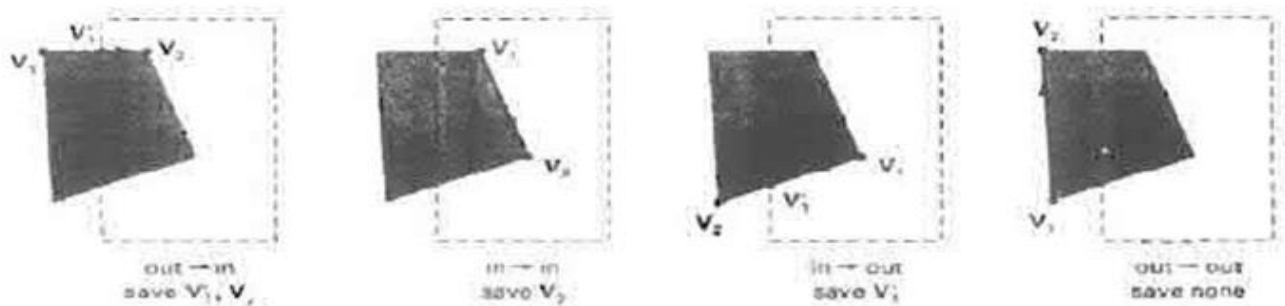
There are four possible cases when processing vertices in sequence around the perimeter of a polygon. As each point of adjacent polygon vertices is passed to a window boundary clipper, make the following tests:

1. If the first vertex is outside the window boundary and second vertex is inside, both the intersection point of the polygon edge with window boundary and second vertex are added to output vertex list.
2. If both input vertices are inside the window boundary, only the second vertex is added to the output vertex list.
3. If first vertex is inside the window boundary and second vertex is outside only the edge intersection with window boundary is added to output vertex list.
4. If both input vertices are outside the window boundary nothing is added to the output list.

**Clipping a polygon against successive window boundaries.**



**Successive processing of pairs of polygon vertices against the left window boundary**



**Video Content / Details of website for further learning (if any):**

<https://www.geeksforgeeks.org/line-clipping-set-1-cohen-sutherland-algorithm/>  
[http://www.miet.edu/course/wp-content/uploads/2019/07/3.5-CG-cse\\_Optimized.pdf](http://www.miet.edu/course/wp-content/uploads/2019/07/3.5-CG-cse_Optimized.pdf)

**Important Books/Journals for further learning including the page nos.:**

Donald Hearn and M. Pauline Baker, "Computer Graphics C Version", Pearson Education, 2003, Page No: 237-256

<https://www.journals.elsevier.com/computers-and-graphics>

<http://airccse.org/journal/ijcga/index.html>

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L-9

## LECTURE HANDOUTS

CSE

III/VI

Course Name with Code : Computer graphics-16CSD13

Course Faculty : M GANTHIMATHI

Unit : I - Introduction

Date of Lecture:

Topic of Lecture: Two dimensional viewing

### Introduction : ( Maximum 5 sentences ) :

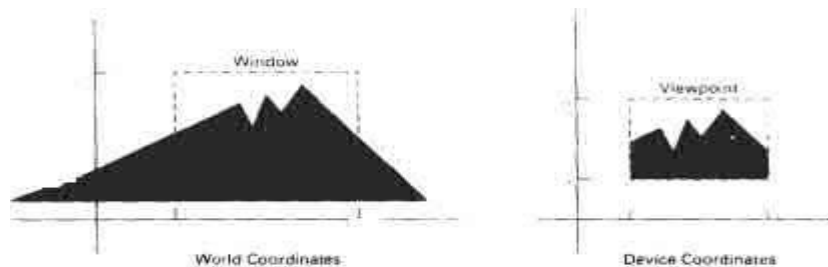
- A world coordinate area selected for display is called a window.
- An area on a display device to which a window is mapped is called a view port.
- The window defines what is to be viewed the view port defines where it is to be displayed.
- The mapping of a part of a world coordinate scene to device coordinate is referred to as viewing transformation.

### Prerequisite knowledge for Complete understanding and learning of Topic: ( Max. Four important topics)

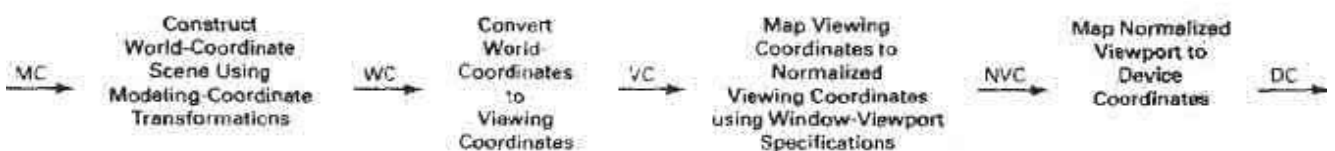
- Display device
- 2D transformations
- 2D clipping

Detailed content of the Lecture:

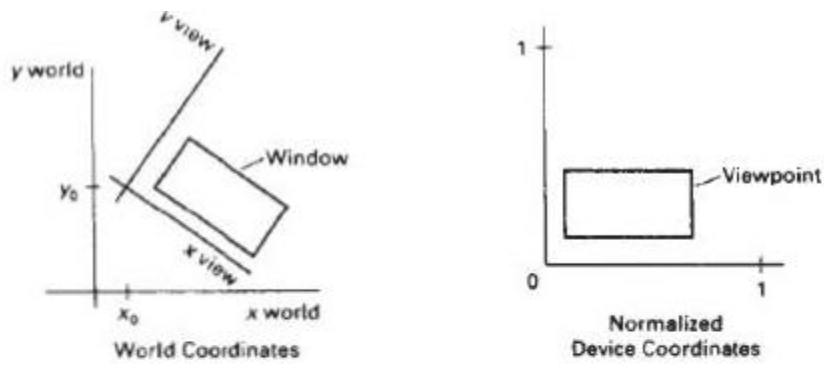
### A viewing transformation using standard rectangles for the window and viewport



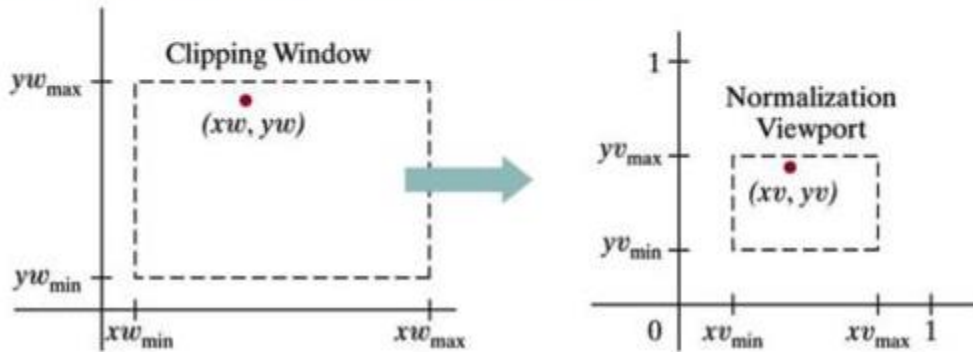
### The two dimensional viewing transformation pipeline







**Window to view port coordinate transformation:**



- A point at position  $(x_w, y_w)$  in a designated window is mapped to viewport coordinates  $(x_v, y_v)$  so that relative positions in the two areas are the same.
- The figure illustrates the window to view port mapping.
- A point at position  $(x_w, y_w)$  in the window is mapped into position  $(x_v, y_v)$  in the associated view port. To maintain the same relative placement in view port as in window

$$\frac{x_v - x_{v_{min}}}{x_{v_{max}} - x_{v_{min}}} = \frac{x_w - x_{w_{min}}}{x_{w_{max}} - x_{w_{min}}}$$

$$\frac{y_v - y_{v_{min}}}{y_{v_{max}} - y_{v_{min}}} = \frac{y_w - y_{w_{min}}}{y_{w_{max}} - y_{w_{min}}}$$

solving these expressions for view port position  $(x_v, y_v)$

$$x_v = x_{v_{min}} + (x_w - x_{w_{min}}) \left( \frac{x_{v_{max}} - x_{v_{min}}}{x_{w_{max}} - x_{w_{min}}} \right)$$

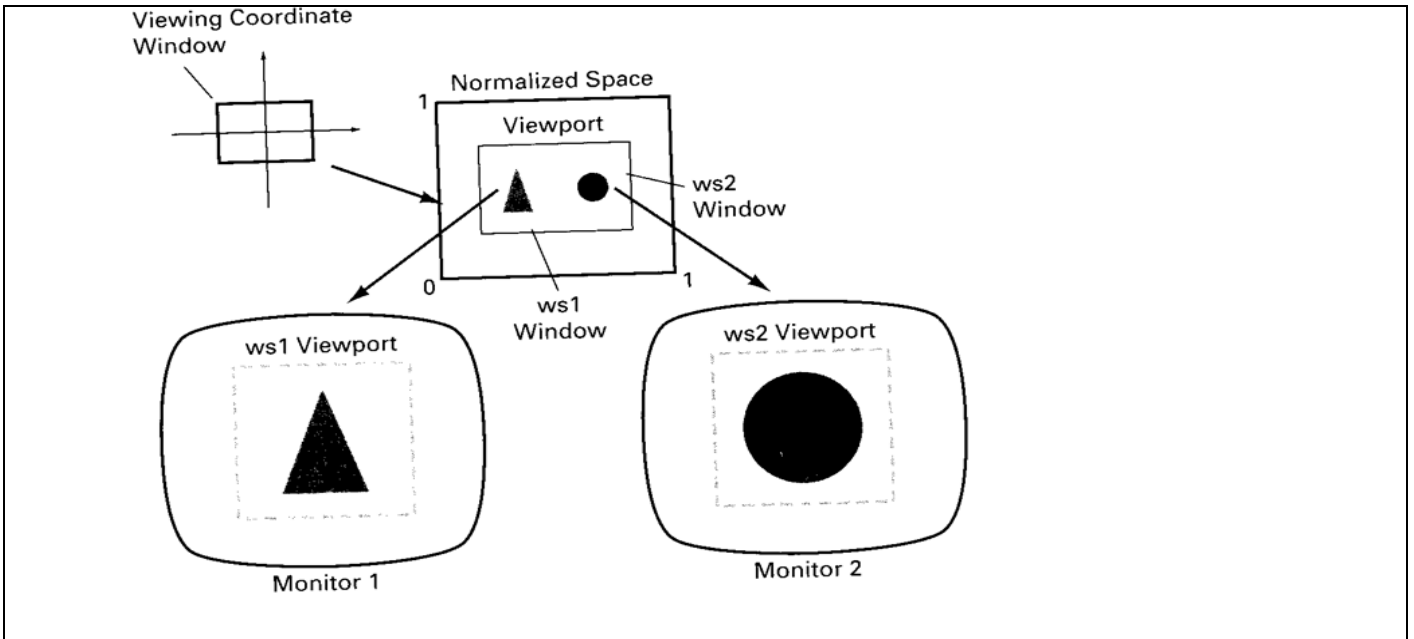
$$y_v = y_{v_{min}} + (y_w - y_{w_{min}}) \left( \frac{y_{v_{max}} - y_{v_{min}}}{y_{w_{max}} - y_{w_{min}}} \right)$$

where scaling factors are

$$S_x = \frac{X_{V_{max}} - X_{V_{min}}}{X_{W_{max}} - X_{W_{min}}}$$

$$S_y = \frac{Y_{V_{max}} - Y_{V_{min}}}{Y_{W_{max}} - Y_{W_{min}}}$$

Mapping selected parts of a scene in normalized coordinate to different video monitors with work station transformation.



**Video Content / Details of website for further learning (if any):**

[http://www.eenadupratibha.net/pratibha/engineering-colleges/engineering-jobs/cse\\_sem\\_two\\_dim\\_vie\\_un4.html](http://www.eenadupratibha.net/pratibha/engineering-colleges/engineering-jobs/cse_sem_two_dim_vie_un4.html)

[http://www.miet.edu/course/wp-content/uploads/2019/07/3.5-CG-cse\\_Optimized.pdf](http://www.miet.edu/course/wp-content/uploads/2019/07/3.5-CG-cse_Optimized.pdf)

**Important Books/Journals for further learning including the page nos.:**

Donald Hearn and M. Pauline Baker, "Computer Graphics C Version", Pearson Education, 2003,Page No: 257-266

<https://www.journals.elsevier.com/computers-and-graphics>

<http://airccse.org/journal/ijcga/index.html>

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## LECTURE HANDOUTS

L-10

CSE

III/VI

Course Name with Code : 16CSD13- Computer Graphics

Course Faculty : M GANTHIMATHI

Unit : II - Two Dimensional Graphics Date of Lecture:

**Topic of Lecture:** Three-dimensional object representations

**Introduction :** Three-dimensional object have three dimensions (such as height, width and depth), which represent by 3 axis x,y,z. eg: object in the real world, A cube, rectangular, prism, sphere, cone and cylinder ect.. This topic discusses how to represent Three-dimensional object.

**Prerequisite knowledge for Complete understanding and learning of Topic:**

Knowledge about 2D object and its Representation (Algorithm to draw 2D object)

**Detailed content of the Lecture:**

### Three Dimensional Object Representations

Representation schemes for solid objects are divided into two categories as follows:

#### Boundary Representation ( B-reps)

It describes a three dimensional object as a set of surfaces that separate the object interior from the environment. Examples are polygon facets and spline patches.

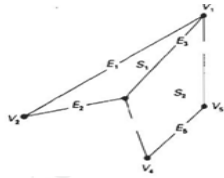
#### Space Partitioning representation

It describes the interior properties, by partitioning the spatial region containing an object into a set of small, nonoverlapping, contiguous solids(usually cubes). Eg: Octree Representation

**Polygon Surfaces** :Polygon surfaces are boundary representations for a 3D graphics object.

**Polygon Tables:** Polygon data tables can be organized into two groups: Geometric tables and attribute tables. **Geometric Tables:** It contains:

- 1.Vertex Table : Stores Coordinate values for each vertex in the object.
- 2.Edge Table: identify the vertices for each polygon edge.
- 3.Polygon Table: identify the edges of each polygon surface.



Vertex table	Edge Table	Polygon surface table
V <sub>1</sub> : X <sub>1</sub> , Y <sub>1</sub> , Z <sub>1</sub>	E <sub>1</sub> : V <sub>1</sub> , V <sub>2</sub>	S <sub>1</sub> : E <sub>1</sub> , E <sub>2</sub> , E <sub>3</sub>
V <sub>2</sub> : X <sub>2</sub> , Y <sub>2</sub> , Z <sub>2</sub>	E <sub>2</sub> : V <sub>2</sub> , V <sub>3</sub>	S <sub>2</sub> : E <sub>3</sub> , E <sub>4</sub> , E <sub>5</sub> , E <sub>6</sub>
V <sub>3</sub> : X <sub>3</sub> , Y <sub>3</sub> , Z <sub>3</sub>	E <sub>3</sub> : V <sub>3</sub> , V <sub>1</sub>	
V <sub>4</sub> : X <sub>4</sub> , Y <sub>4</sub> , Z <sub>4</sub>	E <sub>4</sub> : V <sub>3</sub> , V <sub>4</sub>	
V <sub>5</sub> : X <sub>5</sub> , Y <sub>5</sub> , Z <sub>5</sub>	E <sub>5</sub> : V <sub>4</sub> , V <sub>5</sub>	
	E <sub>6</sub> : V <sub>5</sub> , V <sub>1</sub>	

**Attribute tables:** Contain attribute information for an object such as parameters specifying the degree of transparency of the object and its surface reflectivity and texture characteristics.

**Plane Equations:** The equation for a plane surface is  $Ax + By + Cz + D = 0 \dots\dots 1$

By dividing D in equation 1

$$(A/D)x_k + (B/D)y_k + (C/D)z_k = -1$$

$$A = \begin{vmatrix} 1 & y_1 & z_1 \\ 1 & y_2 & z_2 \\ 1 & y_3 & z_3 \end{vmatrix} \quad B = \begin{vmatrix} x_1 & 1 & z_1 \\ x_2 & 1 & z_2 \\ x_3 & 1 & z_3 \end{vmatrix}$$

$$C = \begin{vmatrix} x_1 & y_1 & 1 \\ x_2 & y_2 & 1 \\ x_3 & y_3 & 1 \end{vmatrix} \quad D = - \begin{vmatrix} x_1 & y_1 & z_1 \\ x_2 & y_2 & z_2 \\ x_3 & y_3 & z_3 \end{vmatrix}$$

Expanding the determinants:

$$A = y_1(z_2 - z_3) + y_2(z_3 - z_1) + y_3(z_1 - z_2)$$

$$B = z_1(x_2 - x_3) + z_2(x_3 - x_1) + z_3(x_1 - x_2)$$

$$C = x_1(y_2 - y_3) + x_2(y_3 - y_1) + x_3(y_1 - y_2)$$

$$D = -x_1(y_2 z_3 - y_3 z_2) - x_2(y_3 z_1 - y_1 z_3) - x_3(y_1 z_2 - y_2 z_1)$$

If  $Ax + By + Cz + D < 0$ , the point (x, y, z) is inside the surface.

If  $Ax + By + Cz + D > 0$ , the point (x, y, z) is outside the surface.

**Polygon Meshes :** One type of polygon mesh is the **triangle strip**. This function produces n-2 connected triangles given the coordinates for n vertices.



**Quadrilateral mesh**, which generates a mesh of (n-1) by (m-1) quadrilaterals, given the coordinates for an n by m array of vertices.



**Quadric Surfaces :** The quadric surfaces are described with second degree equations (quadratics).

They include spheres, ellipsoids, tori, paraboloids, and hyperboloids

**Sphere:** Cartesian coordinates, a spherical surface with radius r centered on the coordinates origin is defined as the set of points (x, y, z) that satisfy the equation.

$$x^2 + y^2 + z^2 = r^2 \dots\dots\dots(1)$$

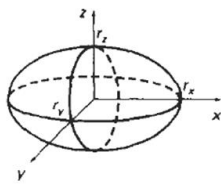
- The spherical surface can be represented in parametric form by using latitude and longitude angles

$$\begin{aligned}x &= r \cos\varphi \cos\theta, & -\Lambda/2 \leq \varphi \leq \Lambda/2 \\y &= r \cos\varphi \sin\theta, & -\Lambda \leq \varphi \leq \Lambda \\z &= r \sin\varphi\end{aligned}$$

**Ellipsoid:** The Cartesian representation for points over the surface of an ellipsoid is

$$\left(\frac{x}{r_x}\right)^2 + \left(\frac{y}{r_y}\right)^2 + \left(\frac{z}{r_z}\right)^2 = 1$$

The parametric representation for the ellipsoid in terms of the latitude angle  $\varphi$  and the longitude angle  $\theta$  is



$$\begin{aligned}x &= r_x \cos\varphi \cos\theta, & -\Lambda/2 \leq \varphi \leq \Lambda/2 \\y &= r_y \cos\varphi \sin\theta, & -\Lambda \leq \varphi \leq \Lambda \\z &= r_z \sin\varphi\end{aligned}$$

**Torus:** Torus is a doughnut shaped object. The Cartesian representation for points over the surface of a torus can be written in the form

$$\left[r - \sqrt{\left(\frac{x}{r_x}\right)^2 + \left(\frac{y}{r_y}\right)^2}\right]^2 + \left(\frac{z}{r_z}\right)^2 = 1$$

$$\begin{aligned}x &= r_x (r + \cos\varphi) \cos\theta, & -\Lambda \leq \varphi \leq \Lambda \\y &= r_y (r + \cos\varphi) \sin\theta, & -\Lambda \leq \varphi \leq \Lambda \\z &= r_z \sin\varphi\end{aligned}$$

### Spline Representations

\*A Spline is a flexible strip used to produce a smooth curve through a designated set of points.

\*Spline curve can be specified by a set of coordinate positions called **control points** which indicates the general shape of the curve.

- When polynomial sections are fitted so that the curve passes through each control point the resulting curve is said to **interpolate** the set of control points

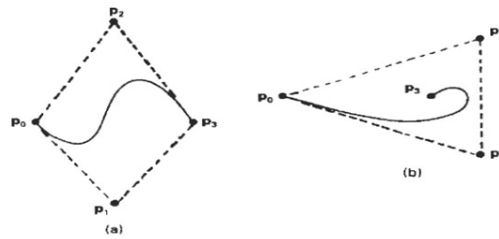


- When the polynomials are fitted to the general control point path without necessarily passing through any control points, the resulting curve is said to **approximate** control points.

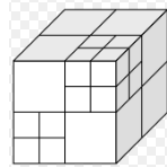


- The convex polygon boundary that encloses a set of control points is called the **convex hull**.

Convex hull shapes (dashed lines) for two sets of control points



**Octree representation:** Octrees are most often used to partition a three-dimensional space by recursively subdividing it into eight octants. Octrees are the three-dimensional analog of quadtrees



**Fractals :** A fractal is a never-ending pattern. Fractals are infinitely complex patterns that are self-similar across different scales



**Bloby objects :** Bloby objects are the objects which are non-rigid and do not retain their fixed size  
Eg : Raindrops, Clouds, Grass.

**Video Content / Details of website for further learning (if any):**

<https://www.youtube.com/watch?v=7FfVWVUKK8M>

<https://www.youtube.com/watch?v=sNWfczFSWoc>

[https://www.tutorialspoint.com/computer\\_graphics/computer\\_graphics\\_surfaces.htm](https://www.tutorialspoint.com/computer_graphics/computer_graphics_surfaces.htm)

[https://www.brainkart.com/article/Three-Dimensional-Object-Representations\\_10217/](https://www.brainkart.com/article/Three-Dimensional-Object-Representations_10217/)

**Important Books/Journals for further learning including the page nos.:**

- ✓ Donald Hearn and M. Pauline Baker, “Computer Graphics C Version”, Pearson Education, 2003.pg.No: 325-422
- ✓ <https://ieeexplore.ieee.org/document/554198>- Three-dimensional object representation and invariant recognition using continuous distance transform
- ✓ <http://ieeexplore.ieee.org/document/1213556/>- Representation and classification of 3-D objects

Course Faculty

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# MUTHAYAMMAL ENGINEERING COLLEGE

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Rasipuram - 637 408, Namakkal Dist., Tamil Nadu



## LECTURE HANDOUTS

L-11

CSE

III/VI

Course Name with Code : 16CSD13- Computer Graphics

Course Faculty : M GANTHIMATHI

Unit : II - Two Dimensional Graphics Date of Lecture:

<b>Topic of Lecture:</b> Three-Dimensional Geometric and Modelling
<b>Introduction :</b> The geometric transformations play a vital role in generating images of three Dimensional objects with the help of these transformations. The location of objects relative to others can be easily expressed. Sometimes viewpoint changes rapidly, or sometimes objects move in relation to each other. For this number of transformation can be carried out repeatedly.
<b>Prerequisite knowledge for Complete understanding and learning of Topic:</b>  Knowledge about 3D object and Representation of 3D object.
<b>Detailed content of the Lecture:</b>  <b><u>3D Transformations:</u></b> <ul style="list-style-type: none"><li>Transformation means changing some graphics into something else by applying rules. We can have various types of transformations such as translation, scaling up or down, rotation, shearing, etc. When a transformation takes place on a 3D plane, it is called 3D transformation.</li><li>Basic geometric transformations are:</li></ul> <b><i>Translation:</i></b> <ul style="list-style-type: none"><li>It is the movement of an object from one position to another position. Translation is done using translation vectors. There are three vectors in 3D instead of two. These vectors are in x, y, and z directions. Translation in the x-direction is represented using <math>T_x</math>. The translation in the y-direction is represented using <math>T_y</math>. The translation in the z- direction is represented using <math>T_z</math>.</li><li>If P is a point having co-ordinates in three directions (x, y, z) is translated, then after translation its coordinates will be (x1 y1 z1) after translation. <math>T_x T_y T_z</math> are translation vectors in x, y, and z directions respectively.</li></ul> <b><i>Rotation:</i></b> <ul style="list-style-type: none"><li>In rotation, we rotate the object at particular angle <math>\theta</math> from its origin. From the following figure, we can see that the point P(x, y, z) is located at angle <math>\phi</math> from the horizontal X coordinate with distance r from the origin.</li></ul> <b><i>Scaling:</i></b>

- To change the size of an object, scaling transformation is used. In the scaling process, you either expand or compress the dimensions of the object. Scaling can be achieved by multiplying the original coordinates of the object with the scaling factor to get the desired result.
- Let us assume that the original coordinates are  $X, Y, X', Y'$ , the scaling factors are  $(SX, SY)$ , and the produced coordinates are  $X', Y', X', Y'$ . This can be mathematically represented as shown below –
  - $X' = X \cdot SX$  and  $Y' = Y \cdot SY$
- The scaling factor  $SX, SY$  scales the object in  $X$  and  $Y$  direction respectively

**Reflection:**

- Reflection is the mirror image of original object. In other words, we can say that it is a rotation operation with  $180^\circ$ . In reflection transformation, the size of the object does not change.

**Shear:**

- A transformation that slants the shape of an object is called the shear transformation. There are two shear transformations X-Shear and Y-Shear. One shifts  $X$  coordinates values and other shifts  $Y$  coordinate values.
- However; in both the cases only one coordinate changes its coordinates and other preserves its values. Shearing is also termed as Skewing.

**composite Transformation:**

- If a transformation of the plane  $T1$  is followed by a second plane transformation  $T2$ , then the result itself may be represented by a single transformation  $T$  which is the composition of  $T1$  and  $T2$  taken in that order. This is written as  $T = T1 \cdot T2$ .
- Composite transformation can be achieved by concatenation of transformation matrices to obtain a combined transformation matrix.
- A combined matrix –

$$[T][X] = [X] [T1] [T2] [T3] [T4] \dots [Tn]$$

**Video Content / Details of website for further learning (if any):**

<https://www.youtube.com/watch?v=yuYcrIbAdfl>

<https://slideplayer.com/slide/9310809/>

**Important Books/Journals for further learning including the page nos.:**

Donald Hearn and M. Pauline Baker, “Computer Graphics C Version”, Pearson Education, 2003.pg.No: 427-439

<https://unacademy.com/course/3d-geometric-transformations/AJ0P8WQX>

<http://ieeexplore.ieee.org/document/1624309/>

Course Faculty

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## LECTURE HANDOUTS

L-12

CSE

III/VI

Course Name with Code : 16CSD13- Computer Graphics

Course Faculty : M GANTHIMATHI

Unit : II - Two Dimensional Graphics Date of Lecture:

**Topic of Lecture:** 3D Transformations (Scaling, Translation, Rotation)

**Introduction :** Transformation means changing the position, size and shape of 3D objects. In this session we discuss about the basic transformation scaling, Translation and Rotation.

**Prerequisite knowledge for Complete understanding and learning of Topic:**

- Knowledge about 3D object and its representation.
- Should know the concept of 2D Transformation.

**Detailed content of the Lecture:**

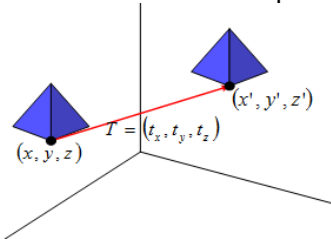
**3D Transformations:**

Basic geometric transformations are: Translation, Rotation, Scaling.

**Translation :** Moving 3D object from one position to other point by adding translation distances, tx, ty, and tz to the original coordinate position (x,y,z):

$$x' = x + t_x, y' = y + t_y, z' = z + t_z$$

translation can also be specified by the transformation matrix in the following formula:

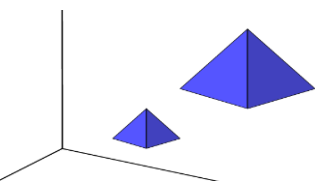


$$\begin{bmatrix} x' \\ y' \\ z' \\ 1 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & t_x \\ 0 & 1 & 0 & t_y \\ 0 & 0 & 1 & t_z \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \\ 1 \end{bmatrix}$$

**Scaling:** Increase size of 3D object with respect to the origin by setting the scaling factors sx, sy and sz, which are multiplied to the original vertex coordinate positions (x,y,z):

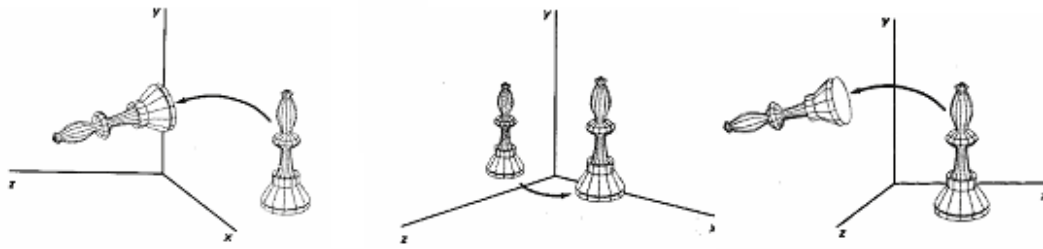
$$x' = x * s_x, y' = y * s_y, z' = z * s_z$$

scaling can also be specified by the transformation matrix in the following formula



$$\begin{bmatrix} x' \\ y' \\ z' \\ 1 \end{bmatrix} = \begin{bmatrix} s_x & 0 & 0 & 0 \\ 0 & s_y & 0 & 0 \\ 0 & 0 & s_z & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \\ 1 \end{bmatrix}$$

Rotations: A 3D rotation can be specified around any line in space



**Linear Representation of rotation**

$$y' = y \cos \theta - z \sin \theta,$$

$$z' = y \sin \theta + z \cos \theta, \text{ and}$$

$$x' = x$$

$$z' = z \cos \theta - x \sin \theta,$$

$$x' = z \sin \theta + x \cos \theta, \text{ and}$$

$$y' = y$$

$$x' = x \cos \theta - y \sin \theta,$$

$$y' = x \sin \theta + y \cos \theta, \text{ and}$$

$$z' = z$$

**Matrix representation of rotation**

$$\begin{bmatrix} x' \\ y' \\ z' \\ 1 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & \cos \theta & -\sin \theta \\ 0 & \sin \theta & \cos \theta \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \\ 1 \end{bmatrix}$$

**X-Axis Rotation**

$$\begin{bmatrix} x' \\ y' \\ z' \\ 1 \end{bmatrix} = \begin{bmatrix} \cos \theta & \sin \theta & 0 \\ -\sin \theta & \cos \theta & 0 \\ 0 & 0 & 1 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \\ 1 \end{bmatrix}$$

**Y -Axis Rotation**

$$\begin{bmatrix} x' \\ y' \\ z' \\ 1 \end{bmatrix} = \begin{bmatrix} \cos \theta & -\sin \theta & 0 & 0 \\ \sin \theta & \cos \theta & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \\ 1 \end{bmatrix}$$

**Z -Axis Rotation**

**Video Content / Details of website for further learning (if any):**

<https://www.youtube.com/watch?v=yuYcrIbAdfI>

<https://slideplayer.com/slide/9310809/>

**Important Books/Journals for further learning including the page nos.:**

Donald Hearn and M. Pauline Baker, "Computer Graphics C Version", Pearson Education, 2003.pg.No: 440-452

<https://unacademy.com/course/3d-geometric-transformations/AJ0P8WQX>

<http://ieeexplore.ieee.org/document/1624309/>

**Course Faculty**

**Verified by HOD**



L-13

LECTURE HANDOUTS

CSE

III/VI

Course Name with Code : 16CSD13- COMPUTER GRAPHICS

Course Faculty : M GANTHIMATHI

Unit : II Date of Lecture:

**Topic of Lecture:** 3D Transformations (Shearing, Reflection)

**Introduction :** Transformation means changing the position, size and shape of 3D objects. In this session we discuss about the other transformation shearing and Reflection.

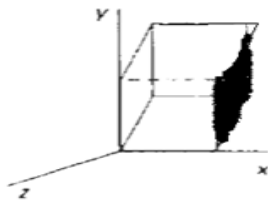
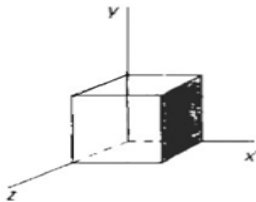
- Prerequisite knowledge for Complete understanding and learning of Topic:**
- Knowledge about 3D object and its representation.
  - Should know the concept of 2D Transformation.
  - Basic transformation scaling, Translation and Rotation.

**Detailed content of the Lecture:**

**3D Transformations:**

Other transformations are :

3D Shearing: Modify object shapes called shearing.



$$\begin{aligned} X' &= X \\ Y' &= Sh_y \cdot X + Y \\ Z' &= Sh_z \cdot X + Z \end{aligned}$$

$$\begin{aligned} X' &= X + Sh_x \cdot Y \\ Y' &= Y \\ Z' &= Sh_z \cdot Y + Z \end{aligned}$$

$$\begin{aligned} X' &= X + Sh_x \cdot Z \\ Y' &= Y + Sh_y \cdot Z \\ Z' &= Z \end{aligned}$$

$$\begin{bmatrix} x' \\ y' \\ z' \\ 1 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 \\ Sh_y & 1 & 0 & 0 \\ Sh_z & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \\ 1 \end{bmatrix}$$

X- Shearing

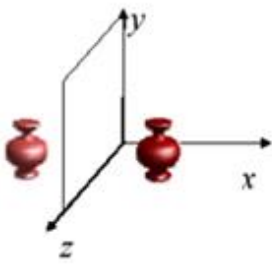
$$\begin{bmatrix} x' \\ y' \\ z' \\ 1 \end{bmatrix} = \begin{bmatrix} 1 & Sh_x & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & Sh_z & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \\ 1 \end{bmatrix}$$

Y -Shearing

$$\begin{bmatrix} x' \\ y' \\ z' \\ 1 \end{bmatrix} = \begin{bmatrix} 1 & 0 & Sh_x & 0 \\ 0 & 1 & Sh_y & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \\ 1 \end{bmatrix}$$

Z- Shearing

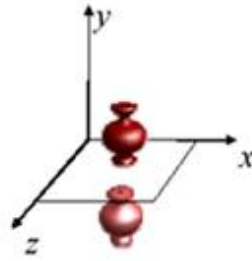
3D Reflection: Producing Mirror image of an object is called reflection.



$$\begin{aligned} X' &= -X \\ Y' &= Y \\ Z' &= Z \end{aligned}$$

$$\begin{bmatrix} x' \\ y' \\ z' \\ 1 \end{bmatrix} = \begin{bmatrix} -1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \\ 1 \end{bmatrix}$$

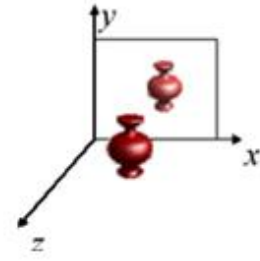
X-Reflection



$$\begin{aligned} X' &= X \\ Y' &= -Y \\ Z' &= Z \end{aligned}$$

$$\begin{bmatrix} x' \\ y' \\ z' \\ 1 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & -1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \\ 1 \end{bmatrix}$$

Y -Reflection



$$\begin{aligned} X' &= -X \\ Y' &= Y \\ Z' &= -Z \end{aligned}$$

$$\begin{bmatrix} x' \\ y' \\ z' \\ 1 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & -1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \\ 1 \end{bmatrix}$$

Z-Reflection

**Video Content / Details of website for further learning (if any):**

<https://www.youtube.com/watch?v=yuYcrIbAdfI>

<https://slideplayer.com/slide/9310809/>

**Important Books/Journals for further learning including the page nos.:**

Donald Hearn and M. Pauline Baker, "Computer Graphics C Version", Pearson Education, 2003.pg.No: 453-449

<https://unacademy.com/course/3d-geometric-transformations/AJ0P8WQX>

<http://ieeexplore.ieee.org/document/1624309/>

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L-14

III/VI

L-14

CSE

Course Name with Code : 16CSD13- Computer Graphics

Course Faculty : M GANTHIMATHI

Unit : II - Two Dimensional Graphics Date of Lecture:

Topic of Lecture: Three Dimensional viewing

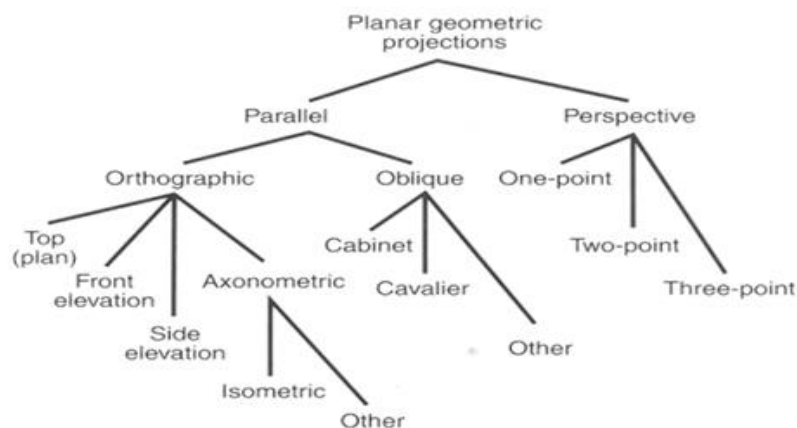
**Introduction :** Projection is just one part of the process of converting from 3-D world coordinates to a 2-D image.

**Prerequisite knowledge for Complete understanding and learning of Topic:**

- Knowledge about 3D object and its representation
- Basic concept of viewing

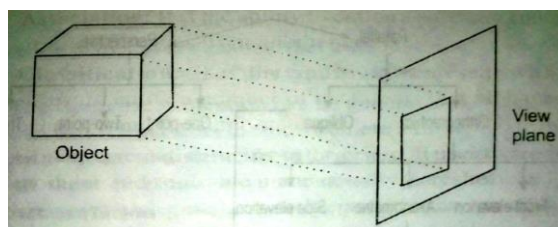
**Detailed content of the Lecture:**

**Three Dimensional viewing is a Projection:** Projection is just one part of the process of converting from 3-D world coordinates to a 2-D image.



**Parallel Projection :** transforms object positions to the view plane along parallel lines.

A parallel projection preserves relative proportions of objects. Accurate views of the various sides of an object are obtained with a parallel projection. But not a realistic representation.

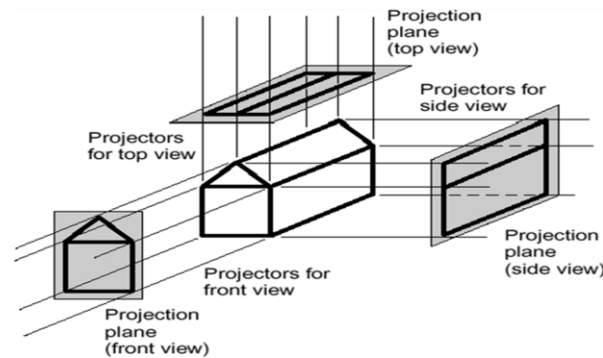


**Orthographic Projections:** Orthographic parallel projections are done by projecting points along

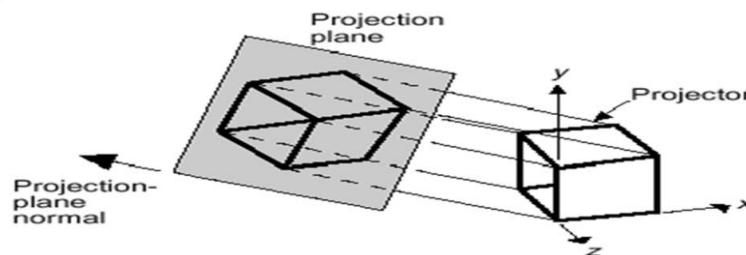
parallel lines that are perpendicular to the projection plane.

Some special Orthographic Parallel Projections involve Plan View (front Elevation ,Top projection), Side Elevations and Isometric Projection

Eg: they are used in Engineering drawing, like machine parts ,buildings etc

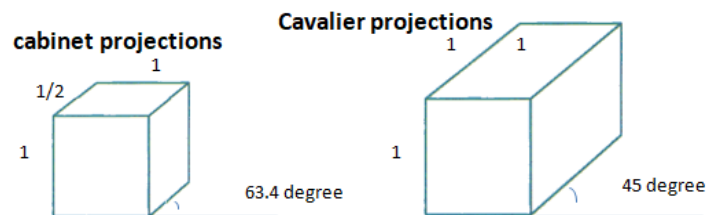


**axonometric projection:** Orthographic projection can display more than one face of an object called axonometric orthographic projection. Eg :isometric projection

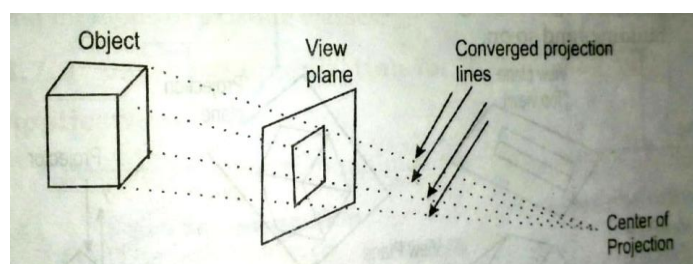


**Oblique projection:** Oblique projections are obtained by projecting along parallel lines that are NOT perpendicular to the projection plane

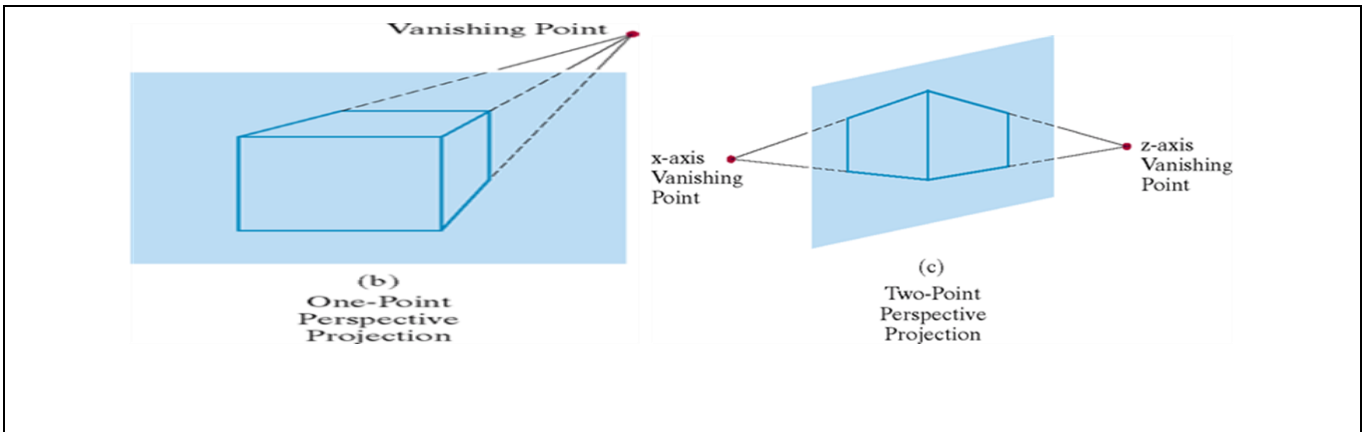
- cavalier projections (direction of projection makes a 45 degree angle with view plane. thus the line perpendicular to view plane has same length as line itself) and
- cabinet projections (direction of projection makes a angle of  $\arctan(2)=63.4$  with view plane. thus the line perpendicular to view plane projected one  $\frac{1}{2}$  their actual length.



**Perspective Projection:** Perspective projection produces realistic views but does not preserve relative proportions. Projections of distant objects are smaller than the projections of objects of the same size that are closer to the projection plane.



**Types of Perspective Projections:** There are a number of different kinds of perspective views The most common are one-point and two point perspectives and three point projection point



**Video Content / Details of website for further learning (if any):**

<https://www.youtube.com/watch?v=x2TY95ZS-OQ>

<https://www.youtube.com/watch?v=VQgowR3uEQg>

<https://www.youtube.com/watch?v=k2ajK9uM0Co>

<https://www.cs.cmu.edu/afs/cs/academic/class/15462-s09/www/lec/06/lec06.pdf>

<http://www.cs.cityu.edu.hk/~helena/cs31622000B/Chap8Notes.pdf>

**Important Books/Journals for further learning including the page nos.:**

Donald Hearn and M. Pauline Baker, "Computer Graphics C Version", Pearson Education, 2003.pg.No: 452-487

<http://ieeexplore.ieee.org/document/4056965>

<https://dl.acm.org/citation.cfm?id=618448>

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## LECTURE HANDOUTS

L-15

CSE

III/VI

Course Name with Code : 16CSD13- Computer Graphics

Course Faculty : M GANTHIMATHI

Unit : II - Two Dimensional Graphics Date of Lecture:

<b>Topic of Lecture:</b> Color Models
<b>Introduction :</b> A color model is a system that uses three primary colors to create a larger range of colors. There are different kinds of color models used for different purposes, and each has a slightly different range of colors they can produce.
<b>Prerequisite knowledge for Complete understanding and learning of Topic:</b> <ul style="list-style-type: none"><li>• Knowledge about Colors</li><li>• Properties or behavior of color</li></ul>
<b>Detailed content of the Lecture:</b> <p>A color model :Method for explaining the properties or behavior of color within some particular Context.</p> <p><u>Properties of Light and Colors:</u></p> <ul style="list-style-type: none"><li>• <b>Light or colors</b> :Form a narrow frequency band within the electromagnetic spectrum</li><li>• <b>Hue (Color):</b> The dominant frequency reflected by the object</li><li>• <b>Brightness:</b> The perceived intensity of the light. This is related to the luminance of the source.</li><li>• <b>Purity (Saturation):</b> How pure the color of the light appears.</li><li>• <b>Chromaticity:</b> collectively refer to purity and hue.</li><li>• <b>Complementary colors:</b> eg. Red and Cyan, Green and Magenta, Blue and Yellow, which combine and form white light.</li><li>• <b>Primary colors:</b> eg. r,g,b - starting from these colors, a wide range of other colors can be formed.</li><li>• <b>Shades of a color:</b> created by adding black pigment to the color.</li><li>• <b>Tints of a color:</b> created by adding white pigment to the color.</li><li>• <b>Tones of a color:</b> created by adding black or white pigments to the color</li></ul>
<p><u>RGB Model</u></p> <p>Used by RGB monitors which separate signals for the red, green, blue components of an image.</p> <p>Based on the vision system of our eyes, that we have 3 visual pigments in the cones of the retina, for red, green, and blue</p>



YIQ Model

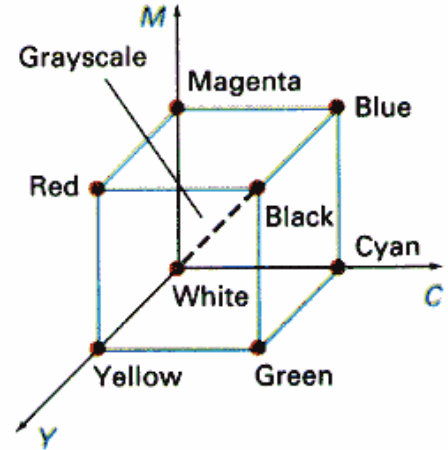
Used by the NTSC television monitors:

Y - Contain the luminance (brightness) information , I - Contain the orange-cyan hue information

Q - Contain the green-magenta hue information

CMY Model

- Useful for describing color output to hard-copy devices.
- These devices produce a color picture by coating a paper with color pigments. We see the colors by reflected light, which is a subtractive process.
- **CMYK** means using the ink of Cyan, Magenta, Yellow, and Black.
- Consider that, Magenta ink indeeds subtracts the green component from incident light, so the remaining red and blue components are seen by us, as a resultant color of magenta.
- Cyan ink indeeds subtracts the red component from incident light, so the remaining green and blue components are seen by us, as a resultant color of cyan.
- If we mix the ink of magenta and cyan, then, this ink subtracts the green and red component from the incident light, and the remaining blue component is seen by us, as a resultant color of blue.

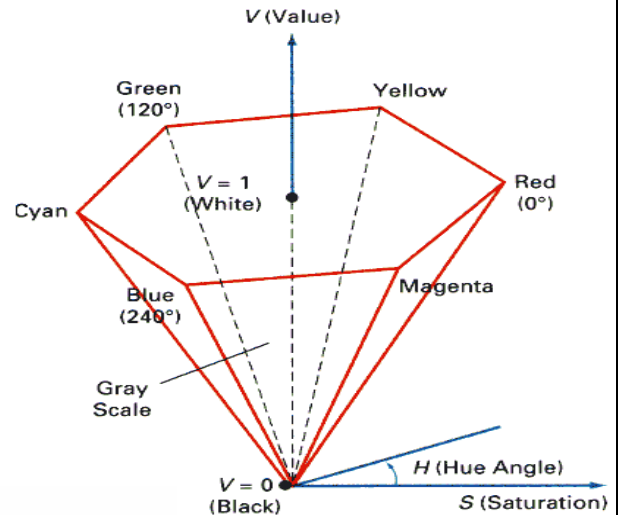


HSV Model:

In this model, users select a spectral color and apply the amounts of white or black that are to be added to obtain different shades, tints, and tones.

HSV model is derived from the RGB cube.

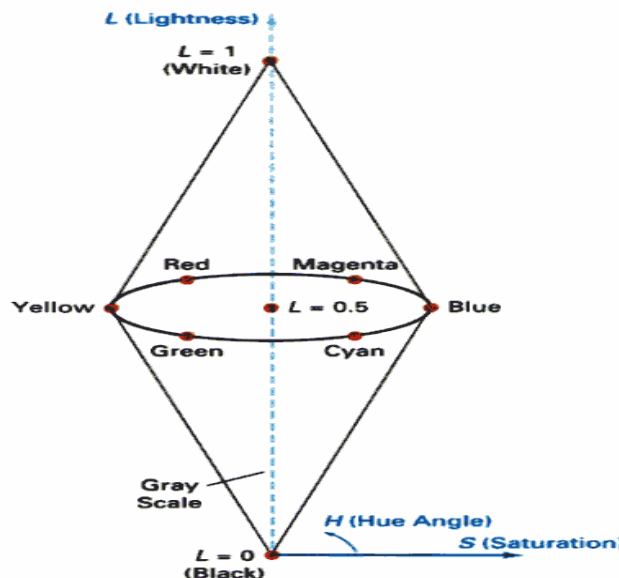
- H: Hue
- S: Saturation
- V: Value



The HSV hexcone.

vertical axes. And a degree (0 - the hue. Complementary colors apart.

Saturation and value are measured as the Horizontal and 360) describes are 180 degrees



HLS Model:

Used by Tektronix.

H: Hue

L: Lightness

S: Saturation

**Video Content / Details of website for further learning (if any):**

<https://www.youtube.com/watch?v=BqC1fkjiISo>

<https://study.com/academy/lesson/what-is-a-color-model-uses-definition.html>

[https://www.youtube.com/watch?v=eQ\\_uHw15Z4w](https://www.youtube.com/watch?v=eQ_uHw15Z4w)

**Important Books/Journals for further learning including the page nos.:**

Donald Hearn and M. Pauline Baker, "Computer Graphics C Version", Pearson Education, 2003.pg.No: 585-601

<https://dl.acm.org/doi/10.1145/800250.807502>

<https://www.journals.elsevier.com/graphical-models>

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LECTURE HANDOUTS

L-16

CSE

III/VI

Course Name with Code : 16CSD13- Computer Graphics

Course Faculty : M GANTHIMATHI

Unit : II - Two Dimensional Graphics Date of Lecture:

## Topic of Lecture: Animation

### Introduction :

Computer animation is the art of creating moving images via the use of computers. It is a subfield of computer graphics and animation. Increasingly it is created by means of 3D computer graphics, though 2D computer graphics are still widely used for low bandwidth and faster real-time rendering needs.

### Prerequisite knowledge for Complete understanding and learning of Topic:

- Knowledge about basic concepts of animation
- Know the concepts of 3D object representation and projection

### Detailed content of the Lecture:

Computer Animation is the process used for generating animated images using computer graphics

Animators are artists who specialize in the creation of animation.

From Latin amatio, “the act of bringing to life”; from animo (“to animate” or “give life to”) and -atio (“the act of”).

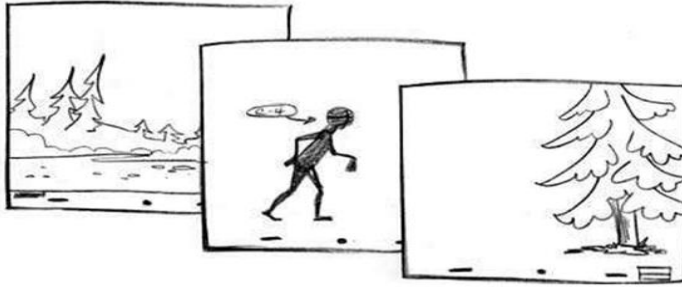
APPLICATIONS: Video Games, Cartoon, Mobile Phones

### DESIGN OF ANIMATION SEQUENCE

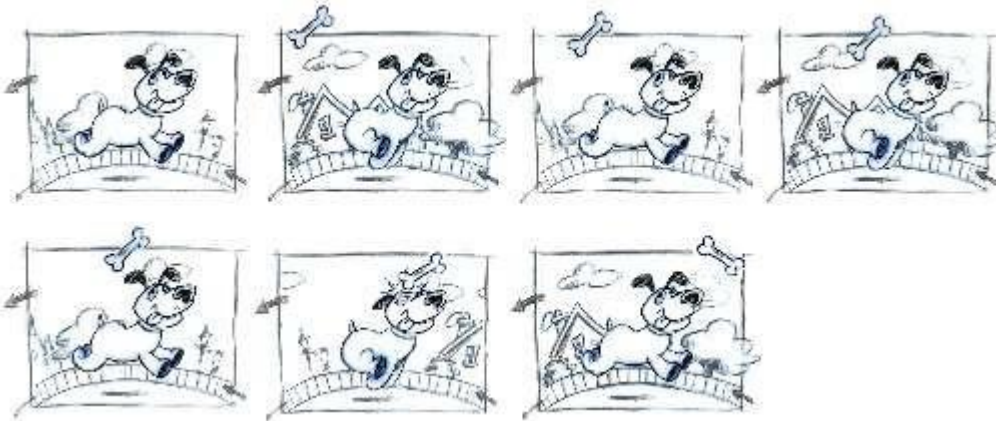
Steps for designing animation sequence

1. Storyboard Layout
2. Object Definitions
3. Key frame specifications
4. Generation of in-between frames

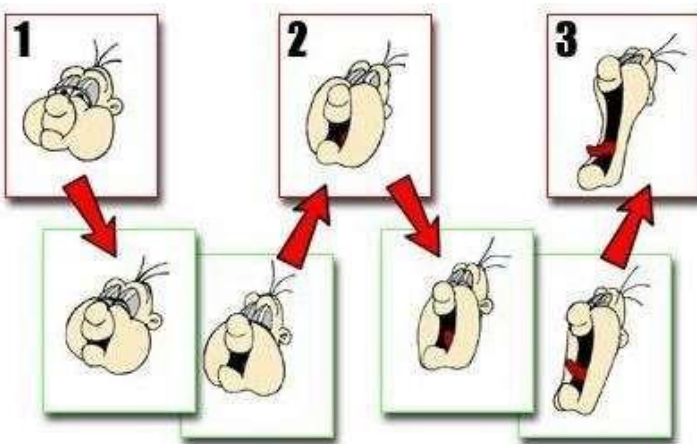
STORYBOARD LAYOUT : It is the outline of a action. It defines the motion sequences as a set of basic that are to take place. Depending on the type of animation to be produced, the storyboard could be consist of a set of rough sketches or it could be a list of basis ideas for motion.



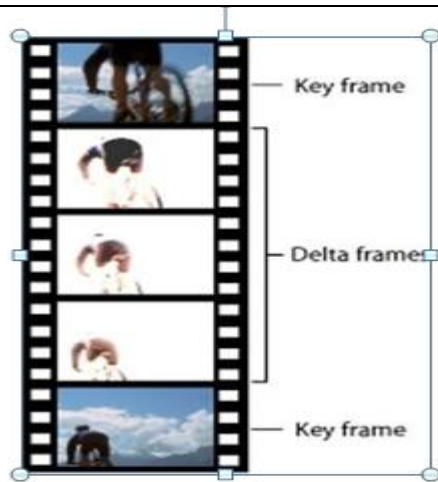
**OBJECT DEFINITIONS:** Each object participating in the action is given object definition, such as terms of basic shapes, such as polygons or splines.



**FRAMES:** It is one of the many single photographic images in a motionpicture. The individual frames are separated by frame lines. Normally, are needed for one second of flim.



**KEY FRAMES :**A key frame in animation and filmmaking is a drawing that defines the starting and ending points of any smooth transition. A sequence of key frames which movement the spectator will see, but the position of the key frames on the film, defines the timing of the movement. 2 or 3 can be present for a span of asecond.



**IN BETWEEN:** It is a process of generating intermediate frames between 2 images to give appearance that the 1<sup>st</sup> image evolves smoothly into the second image. In-betweens are the drawing between the key frames which help to create the illusion of motion. Film requires 24 frames per second and graphics terminals are refreshed at a rate of 30 to 60 frames per second.

### RASTER ANIMATION

1. On raster systems, we generate real-time animation in limited application using raster operation.
2. Such as 2D or 3D transformations on objects.
3. We can also animate objects along 2D motion paths using the color table transformation.

Apart from above 4, the other tasks required are:

- Motion verification
- Editing
- Production and synchronization of sound track.

**Video Content / Details of website for further learning (if any):**

<https://www.youtube.com/watch?v=5X0kTrbfFA0>

<https://www.youtube.com/watch?v=h3Tr4jvw23k>

<http://cs.wellesley.edu/~cs110/lectures/M01-color/graphics.pdf>

<https://www.docsity.com/en/computer-graphics-animation/5090744/>

**Important Books/Journals for further learning including the page nos.:**

Donald Hearn and M. Pauline Baker, "Computer Graphics C Version", Pearson Education, 2003.pg.No: 604-616

<https://www.journals.elsevier.com/computers-and-graphics>

<https://dl.acm.org/citation.cfm?id=1016004>

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LECTURE HANDOUTS

L-17

CSE

III/VI

Course Name with Code : 16CSD13- Computer Graphics

Course Faculty : M GANTHIMATHI

Unit : II - Two Dimensional Graphics Date of Lecture:

**Topic of Lecture:** Multimedia Applications

## **Introduction :**

A Multimedia Application is an Application which uses a collection of multiple media sources e.g. text, graphics, images, sound/audio, animation and/or video

## **Prerequisite knowledge for Complete understanding and learning of Topic:**

- Knowledge about graphics
- Basic concepts of text, image, animation and audio/video

## **Detailed content of the Lecture**

Categorization of multimedia Applications.

### **Entertainment**

The entertainment industry has used this technology the most to create real life like Games. Several developers have used graphics, sound, animation of multimedia to Create variety of games. The special technologies such as virtual reality have made These games just like experiences of real life.

### **Edutainment**

Edutainment is nothing but educational entertainment. Many computer games with, Focus on education are now available. A simple example, in this case is an educational game, which plays various rhymes for little kids. in addition to playing rhymes, the child can paint the pictures, increase reduce size of various objects etc.

### **Business Communications**

Multimedia is a very powerful tool for enhancing the quality of business Communications. The business communications such as employee related communications, product promotions, customer information, and reports for investor of the presentation types are:

- Keyboard Interactive Station
- Interactive Touch screen Kiosk
- Sequential Playback
- Continuous Loop Playback

### **Public Access**

Public Access is an area of application where many multimedia applications will soon be available. One such application may be the tourist information system, where a person who wants to go for a sight seminary may have the glimpse of places he has R L selected for visiting, Eg: Railway Time table enquiry.

## COMMUNICATION TECHNOLOGY AND MULTIMEDIA SERVICES

The advances of computing, communication and creation of relevant standards have led to the beginning of an era where people get multimedia facilities at home. May be in the form of an Interactive T.V or through the World Wide Web.

These services may include:

- Basic Television Services
- Interactive entertainment
- Digital Audio
- Video on demand
- Home shopping through e-mail
- Financial transactions using ecommerce
- Interactive single and multiuser games
- Digital multimedia libraries
- Electronic versions of newspapers, magazines etc.

## MULTIMEDIA IN BUSINESS

Multimedia can be used in many applications in a business

**Voice Mail :** Voice mail is a tool, which communicates voice over a line. A recorded voice is better than having no voice. A voice mail based system is not person dependent.

**Electronic Mail:** Electronic mail is preferred than the voice mail to exchange information for the Cases,' which require wider distribution of complex information.

**Multimedia based FAX:**

- FAX, in general, is better accepted than electronic mail because:
- it can be used to send detailed information
- is easier to use
- handles graphic information
- Provides a printed copy of information.

**Office Needs:**

The activities in an office such as meetings, group discussions, trainings are some areas where we need the concepts such as brainstorming, sharing of idea, problem solving etc. For real-time meetings that involve geographically dispersed group of people we can avail the choices as:

- Audio conferencing
- Video conferencing, or
- Document conferencing.

## MULTIMEDIA PEDAGOGUES: INTERACTIVE SYSTEMS FOR TEACHING AND LEARNING

Pedagogues are useful teaching aids only if they stimulate and motivate the students. The audio- visual support to a pedagogue can actually help in doing so.

**Simulations**

This is an important area of pedagogy where a student is engaged in situations of Problem solving. Simulations are mainly categorized in two main forms:

- Scenarios based simulations
- Knowledge based simulations.

## MEDICAL APPLICATION: MEDNET-A MEDICAL COLLABORATION AND CONSULTATION SYSTEM

Since a medical consultation system is extremely critical as decision taken by doctors are life critical, therefore, the data manipulations and user interaction in such a system are extremely broad and quite demanding.

Mednet provides the Following services:

- A real-time monitoring and multiparty consultation
- Collaboration during brain surgery.

**Video Content / Details of website for further learning (if any):**

<https://www.ques10.com/p/31904/the-applications-of-multimedia-system-1/>

<https://www.omicsonline.org/conferences-list/multimedia-tools-and-applications>

[https://www.youtube.com/watch?v=Syeu\\_l3sAJE](https://www.youtube.com/watch?v=Syeu_l3sAJE)

**Important Books/Journals for further learning including the page nos.:**

Andleigh, P. K and Kiran Thakrar, "Multimedia Systems and Design", PHI, 2003. Pg No :8-11

<https://www.springer.com/journal/11042>

<https://ieeexplore.ieee.org/document/269141>

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LECTURE HANDOUTS

L-18

CSE

III/VI

Course Name with Code : 16CSD13- Computer Graphics

Course Faculty : M GANTHIMATHI

Unit : II - Two Dimensional Graphics Date of Lecture:

**Topic of Lecture:** Multimedia Real Time Applications

## Introduction :

A Multimedia Application is an Application which uses a collection of multiple media sources e.g. text, graphics, images, sound/audio, animation and/or video

## Prerequisite knowledge for Complete understanding and learning of Topic:

- Knowledge about graphics
- Basic concepts of text, image, animation and audio/video

## Detailed content of the Lecture

### 1.Document Imaging

- Concepts of storage, compression and decompression, and display technologies used for multimedia systems were developed for document image management.
- Organizations such as insurance agencies, law offices, country and state governments, and the federal government manage large volumes of documents.

### 2.Image processing and Image Recognition

- **Image processing** involves image recognition, Image enhancement, image synthesis, and image reconstruction.(alter the contents of the image itself).
- **Image enhancement:** (image adjustment) Increasing the sensitivity and contrast makes the picture darker by making border line pixels black or increasing the gray-scale level of pixels.It includes the following:
- **Image calibration:** Overall image density is calibrated, and the image pixels are adjusted to a predefined level.
- **Real time alignment:** The image is aligned in real-time for skewing caused by improper feeding of paper.

### Image Animation

- Computers-created or scanned images can be displayed sequentially at controlled display speeds to provide image animation that simulates real processes.
- The basic concept of displaying successive images at short intervals to give motion eg: designing moving parts such as automobile engines.

### Image annotation

Image annotation can be performed in one of two ways:

1. Text file stored along with the image or
2. Small image stored with the original image.

The annotation is overlaid over the original image for display purposes. It requires tracking multiple image components associated with a single page

### **Optical Character Recognition**

- Optical Character Recognition (OCR) technology is used for data entry by scanning typed or printed words in a form.
- Initially, people used dedicated OCR scanners. Now, OCR s/w is available used for capturing entire paragraphs of text and entered as a field in a database or in an editable document

### **Handwriting recognition**

- Research for Handwriting recognition was performed for *CADI* CAM systems for command recognition.
- Pen-based systems are designed to allow the user to write commands on an electronic tablet. Handwriting recognition engines use complex algorithms designed to capture data in real time .

### **3.Full motion Digital video Applications**

- Full motion video has applications in the games industry and training, as well as the business world.
- Full motion video is the most complex and most demanding component of multimedia applications.

For business applications, some core requirements are needed.

- (i) Full-motion video clips should be sharable but should have only one sharable copy.
- (ii) It should be possible to attach full-motion video clips to other documents such as chapter text, presentation, and so on

### **4.Electronic Messaging**

Mail system provided a basic text link between users and provided a valuable communications medium for users within a department or enterprise.

- It is first alternative to paper .
- Second generation of electronic mail system was providing cross-platform and cross-network electronic mail with a capability to attach other files like graphics and program executables.

### **Video Content / Details of website for further learning (if any):**

<https://www.ques10.com/p/31904/the-applications-of-multimedia-system-1/>  
<https://www.omicsonline.org/conferences-list/multimedia-tools-and-applications>  
[https://www.youtube.com/watch?v=Syeu\\_13sAJE](https://www.youtube.com/watch?v=Syeu_13sAJE)

### **Important Books/Journals for further learning including the page nos.:**

Andleigh, P. K and Kiran Thakrar, "Multimedia Systems and Design", PHI, 2003. Pg No :12-19  
<https://www.springer.com/journal/11042>  
<https://ieeexplore.ieee.org/document/269141>

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L-19

## LECTURE HANDOUTS

CSE

III/VI

Course Name with Code : Computer Graphics-16CSD13

Course Faculty : M GANTHIMATHI

Unit : III - Multimedia

Date of Lecture:

**Topic of Lecture:** Multimedia basics

**Introduction : ( Maximum 5 sentences) :** Multimedia is the field concerned with the computer controlled integration of text, graphics, drawings, still and moving images (Video), animation, audio, and any other media where every type of information can be represented, stored, transmitted and processed digitally.

**Prerequisite knowledge for Complete understanding and learning of Topic:**  
( Max. Four important topics)

Basic concepts of Audio  
video and animation

**Detailed content of the Lecture:**

- Multimedia is a combination of text, graphic art, and sound, animation and video elements.
- Any system that is capable of presenting multimedia, is called a multimedia system".
- A multimedia application accepts input from the user by means of a keyboard, voice or pointing device.
- Multimedia applications involve using multimedia technology for business, education and entertainment.
- Multimedia is now available on standard computer platforms. It is the best way to gain attention of users and is widely used in many fields as follows:
  - \* Business
  - \* Schools
  - \* Public places
  - \* Home PCs equipped with CD-ROMs and game machines
  - \* Virtual Reality (VR)

### MULTIMEDIA ELEMENTS

#### \*Facsimile

Facsimile transmissions were the first practical means of transmitting document images over telephone lines.

#### \*Document images

Document images are used for storing business documents that must be retained for long periods of time or may need to be accessed by a large number of people.

#### \*Photographic images

Photographic images are used for employee records for instant identification at a security desk, real estates systems with photographs of houses in the database containing the description of houses, medical case histories, and so on.

**\*Geographic information systems map (GIS)**

Map created in a GIS system are being used widely for natural resources and wild life management as well as urban planning.

**\*Voice commands and voice synthesis**

Voice commands and voice synthesis are used for hands-free operations of a computer program. Voice synthesis is used for presenting the results of an action to the user in a synthesized voice.

**\*Audio message**

Annotated voice mail already uses audio or voice message as attachments to memos and documents such as maintenance manuals.

**\*Video messages**

Video messages are being used in a manner similar to annotated voice mail.

**\*Holographic images**

All of the technologies so far essentially present a flat view of information.

Holographic images extend the concept of virtual reality by allowing the user to get "inside" a part, such as, an engine and view its operation from the inside.

**\*Fractals**

Fractals started as a technology in the early 1980s but have received serious attention only recently.

This technology is based on synthesizing and storing algorithms that describes the information.

**Video Content / Details of website for further learning (if any):**

<https://en.wikipedia.org/wiki/Multimedia>

[http://www.miet.edu/course/wp-content/uploads/2019/07/3.5-CG-cse\\_Optimized.pdf](http://www.miet.edu/course/wp-content/uploads/2019/07/3.5-CG-cse_Optimized.pdf)

**Important Books/Journals for further learning including the page nos.:**

Andleigh, P. K and Kiran Thakrar, "Multimedia Systems and Design", PHI, 2003,Page no : 53-106

<https://www.igi-global.com/journal/international-journal-mobile-computing-multimedia>

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## LECTURE HANDOUTS

L-20

CSE

III/VI

Course Name with Code : Computer Graphics-16CSD13

Course Faculty : M GANTHIMATHI

Unit : III - Multimedia

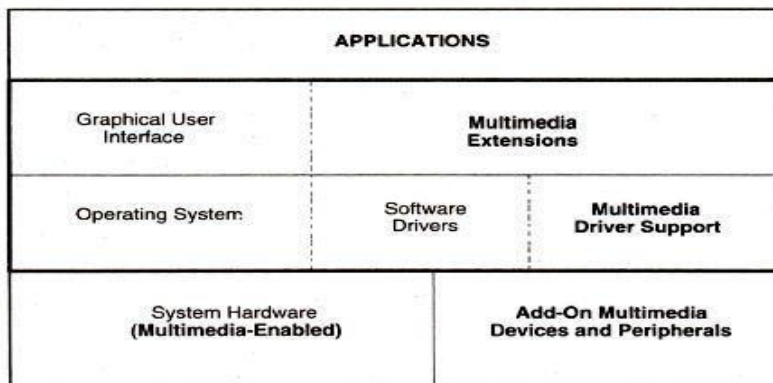
Date of Lecture:

**Topic of Lecture:** Multimedia system architecture

**Introduction : ( Maximum 5 sentences) :** Multimedia is the field concerned with the computer controlled integration of text, graphics, drawings, still and moving images (Video), animation, audio, and any other media where every type of information can be represented, stored, transmitted and processed digitally

**Prerequisite knowledge for Complete understanding and learning of Topic:**  
( Max. Four important topics)  
Multimedia Basics  
Multimedia Elements  
Multimedia applications

**Detailed content of the Lecture:**  
➤ Multimedia encompasses a large variety of technologies and integration of multiple architectures interacting in real time.  
All of these multimedia capabilities must integrate with the standard user interfaces such as Microsoft Windows.  
The following figure describes the architecture of a multimedia workstation environment. In this diagram.



The right side shows the new architectural entities required for supporting multimedia applications.

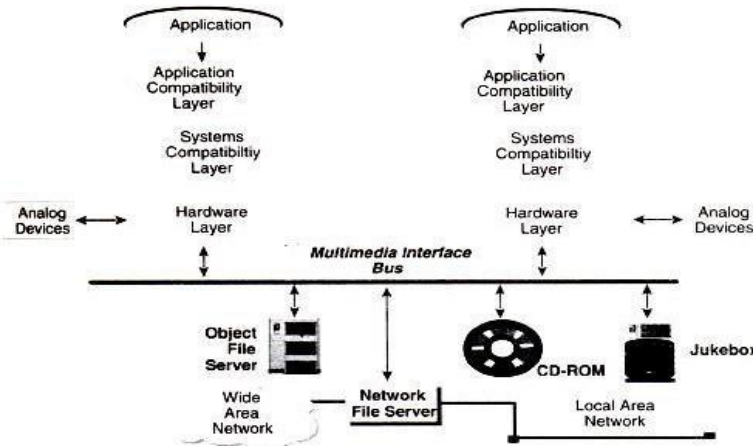
- (i) **VGA mixing:** In VGA mixing, the image acquisition memory serves as the display source memory, thereby fixing its position and size on screen:
- (ii) **VGA mixing with scaling:** Use of scalar ICs allows sizing and positioning of images in pre-defined windows.

Resizing the window causes the things to be retrieved again.

- (iii) **Dual-buffered VGA/Mixing/Scaling:** Double buffer schemes maintain the original images in a decompression buffer and the resized image in a display buffer.

### The IMA Architectural Framework

- The Interactive Multimedia Association has a task group to define the architectural framework for multimedia to provide interoperability.
- The task group has concentrated on the desktops and the servers.
- Desktop focus is to define the interchange formats.
- This format allows multimedia objects to be displayed on any work station.



### Network Architecture for Multimedia Systems:

- Multimedia systems need special networks. Because large volumes of images and video messages are being transmitted.
- Asynchronous Transfer Mode technology (ATM) simplifies transfers across LANs and WANs.

### Networking Standards:

The two well-known networking standards are

1. Ethernet
2. token ring.

ATM and FDDI are the two technologies which are going to be discussed in detail.

#### ATM:

- ATM is a acronym for Asynchronous Transfer Mode. It's topology was originally designed for broadband applications in public networks.
- ATM is a method of multiplexing and relaying (cell-switching) 53 byte cells. (48 bytes of user information and 5 bits of header information).
- It has been increasingly used for transferring real time multimedia data in local network at a speed higher than 100Mbits/sec. ANSI has adopted ATM as the cell switching standard.
- **Cell Switching:** It is a form of fast packet switching based on the use of cells. **Cells:** Short, fixed length packets are called cells.
- The ANSI standard for FDDI allows large-distance networking. It can be used as high-performance backbone networks to complement and extend current LANs.
- ATM provides high capacity, low-latency switching fabric for data. It is independent of protocol and distances. ATM effectively manage a mix of data types, including text data, voice, images and full motion video. ATM was proposed as a means of transmitting multimedia applications over asynchronous networks.

#### FDDI:

- FDDI is an acronym of Fiber Distributed Data Interface. This FDDI network is an excellent candidate to act as the hub in a network configuration, or as a backbone that interconnects different types of LANs.
- FDDI presents a potential for standardization for high speed networks.
- The ANSI (American National Standard Institute) standard for FDDI allows for single-

mode fiber supporting up to 40 km between stations.

- It extends the current LAN speed from 100 Mbits/sec to several Gigabits per seconds, and large-distance networking.

<b>ATM</b>	<b>FDDI II</b>
ATM pushes network speed as high as 622Mbits/sec	FDDI II pushes network speed as high as 100 Mbits /sec
ATM is capable of lower speeds at the workstations. It reduces number of devices protocol translation require for communication between local and wide area network	FDDI II does not allow a user to connect to the network at the speed required by the user, rather it requires the user to be capable of supporting the network speed.

**Video Content / Details of website for further learning (if any):**

<https://en.wikipedia.org/wiki/Multimedia>

[http://www.miet.edu/course/wp-content/uploads/2019/07/3.5-CG-cse\\_Optimized.pdf](http://www.miet.edu/course/wp-content/uploads/2019/07/3.5-CG-cse_Optimized.pdf)

**Important Books/Journals for further learning including the page nos.:**

Andleigh, P. K and Kiran Thakrar, "Multimedia Systems and Design", PHI, 2003, Page no : 19-25

<https://www.igi-global.com/journal/international-journal-mobile-computing-multimedia>

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## LECTURE HANDOUTS

L-21

CSE

III / VI

Course Name with Code : Computer Graphics-16CSD13

Course Faculty : M GANTHIMATHI

Unit : III - Multimedia Date of Lecture:

<b>Topic of Lecture:</b> Evolving technologies for multimedia
<b>Introduction : ( Maximum 5 sentences) :</b> Multimedia applications use a number of technologies generated for both commercial business application as well as the video game industry.
<b>Prerequisite knowledge for Complete understanding and learning of Topic:</b> ( Max. Four important topics) Multimedia Basics Multimedia Elements Multimedia architecture
<b>Detailed content of the Lecture:</b> <b>1. Hypermedia documents</b> *Hypermedia documents are documents which have text, embedded or linked multimedia objects such as image, audio, hologram, or full-motion video. *The network speed and computing efficiency with which these hypermedia documents can manipulated has special implications for multimedia application such as messaging. *Hypermedia has its roots in hypertext. <b>Hypertext</b> *Hypertext systems allow authors to link information together, create information paths through a large volume of related text in documents. *It also allows to annotate existing text, and append notes. *It allows fast and easy searching and reading of selected excerpts. <b>Hypermedia</b> *It is an extension of hypertext. *In that, we can include texts, any kind of information that can be stored in electronic storage, such as audio, animated video, graphics or full-motion video. *Hypermedia documents used for electronic mail and work flow applications provide a rich functionality for exchanging a variety of information types. *The hypermedia document is a definition of a document and a set of pointers to help locate the various elements of the document on the network. <b>Hyper Speech</b> *Multimedia stimulated the development of general-purpose speech interfaces. * Speech synthesis and speech recognition are fundamental requirement for hyperspeech systems. *Speech recognition is nothing but converting the analog speech into a computer action and



into ASCII text.

\*Speech- recognition systems cannot segment a stream of sounds without breaks into meaningful units.

\*The user must speak in a stilted fashion. He should make sure to interpose silence between each word.

\*Speech synthesis and speech recognition requires substantial processing power.

\*High performance microprocessors, such as main CPU in workstations, and Digital Signal Processing and codecs supporting encoding and decoding of sound based on emerging standards can handle speech recognition and speech synthesis.

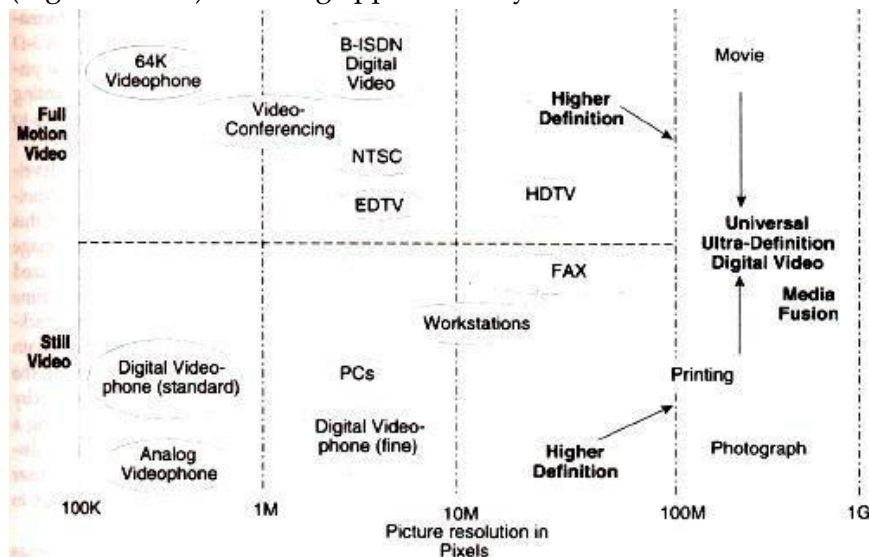
## 2. HDTV AND UDTV

\*HDTV is an acronym of High-Definition Television.

\*The broadcasting standards such as NTSC, PAL, SECAM, NHK have an idea of bringing the world together on a single high-definition Television broadcasting standard.

\*The Japanese broadcasting services developed a 1125-line, along MUSE system. A competing standard in the U.S. changed direction from analog to digital technology: A 1125-line digital HDTV has been developed and is being commercialized.

\*NHK of Japan is trying to leapfrog the digital technology to develop ultra definition television (digital UDTV) featuring approximately 3000 lines



**Video Content / Details of website for further learning (if any):**

[https://www.brainkart.com/article/Evolving-Technologies-for-Multimedia-Systems\\_10191/](https://www.brainkart.com/article/Evolving-Technologies-for-Multimedia-Systems_10191/)  
[http://www.miet.edu/course/wp-content/uploads/2019/07/3.5-CG-cse\\_Optimized.pdf](http://www.miet.edu/course/wp-content/uploads/2019/07/3.5-CG-cse_Optimized.pdf)

**Important Books/Journals for further learning including the page nos.:**

Andleigh, P. K and Kiran Thakrar, "Multimedia Systems and Design", PHI, 2003, Page no : 26-32  
<https://www.igi-global.com/journal/international-journal-mobile-computing-multimedia>

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L-22

## LECTURE HANDOUTS

CSE

III/VI

Course Name with Code : Computer Graphics-16CSD13

Course Faculty : M GANTHIMATHI

Unit : III - Multimedia

Date of Lecture:

**Topic of Lecture:** Evolving technologies for multimedia

**Introduction : ( Maximum 5 sentences ) :** Multimedia applications use a number of technologies generated for both commercial business application as well as the video game industry.

**Prerequisite knowledge for Complete understanding and learning of Topic:**  
( Max. Four important topics)

Multimedia Basics

Multimedia Elements

Multimedia architecture

**Detailed content of the Lecture:**

### 3.3D Technologies And Holography

Three-dimensional technologies are concerned with two areas: pointing devices and displays.

3-D pointing devices are essential to manipulate object in a 3-D display system. 3-D displays are achieved using holography techniques.

### 4. Fuzzy Logic

Fuzzy logic is logic which is used for low-level process controllers.

Use of fuzzy logic in multimedia chips is the key to the emerging graphical interfaces of the future. It is expected to become an integral part of multimedia hardware.

Fuzzy logic has mathematical principles. Hence, the application of multimedia can benefit those principles.

Like Digital Signal Processing(DSP) the Fuzzy Logic Signal Processing(FLSPs) provide interesting applications for multimedia systems.

Fuzzy logic is a integral part of multimedia hardware and it is the key for emerging graphical interface.

### 5. Digital Signal Processing

Digital Signal Processing are used in applications such as digital servos in hard disk drives, and fax/modems.

**Memory Management:** DSP architectures provide dynamic allocation of arrays from multiple segments, including RAM, SRAM and DRAM.

**Hardware-Interrupt handling:** A DSP operating system must be designed to minimize hardware-interrupt latency to ensure fast response to real time events for applications, such as servo systems.

**Multitasking:** DSPs need real-time kernels that provide pre-emptive multitasking and user-defined and dynamic task prioritization.

## **6. Intertask Synchronization And Communication**

Mechanisms for intertask communication include message queues, semaphores, shared memory, and quick response event flags.

Device-Independent I/O: DSP operating system should supports

(i) Asynchronous data stream

(ii) Synchronous message passing.

### **Video Content / Details of website for further learning (if any):**

[https://www.brainkart.com/article/Evolving-Technologies-for-Multimedia-Systems\\_10191/](https://www.brainkart.com/article/Evolving-Technologies-for-Multimedia-Systems_10191/)

[http://www.miet.edu/course/wp-content/uploads/2019/07/3.5-CG-cse\\_Optimized.pdf](http://www.miet.edu/course/wp-content/uploads/2019/07/3.5-CG-cse_Optimized.pdf)

### **Important Books/Journals for further learning including the page nos.:**

Andleigh, P. K and Kiran Thakrar, "Multimedia Systems and Design", PHI, 2003, Page no : 26-32

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L-23

## LECTURE HANDOUTS

CSE

III / VI

Course Name with Code : Computer Graphics-16CSD13

Course Faculty : M GANTHIMATHI

Unit : III - Multimedia

Date of Lecture:

**Topic of Lecture:** Defining objects for multimedia systems

**Introduction : ( Maximum 5 sentences) :** The basic data types of object using in multimedia include text, image, audio, holograms and full- motion video.

**Prerequisite knowledge for Complete understanding and learning of Topic:**  
( Max. Four important topics)

Multimedia Basics

Multimedia Elements

Multimedia architecture

**Detailed content of the Lecture:**

### TEXT

\*It is the simplest of data types and requires the least amount of storage. Text is the base element of a relational database.

\*It is also the basic building of a document.

\* The major attributes of text include paragraph styling, character styling, font families and sizes, and relative location in a document

### HYPertext

\*It is an application of indexing text to provide a rapid search of specific text strings in one or more documents. It is an integral component of hypermedia documents

\*Sub-objects include images, sound and full motion video.

\*A hypermedia document always has text and has one or more other types of sub-objects

### IMAGES

\* Image object is an object that is represented in graphics or encoded form. Image object is a subobject of the hypermedia document object.

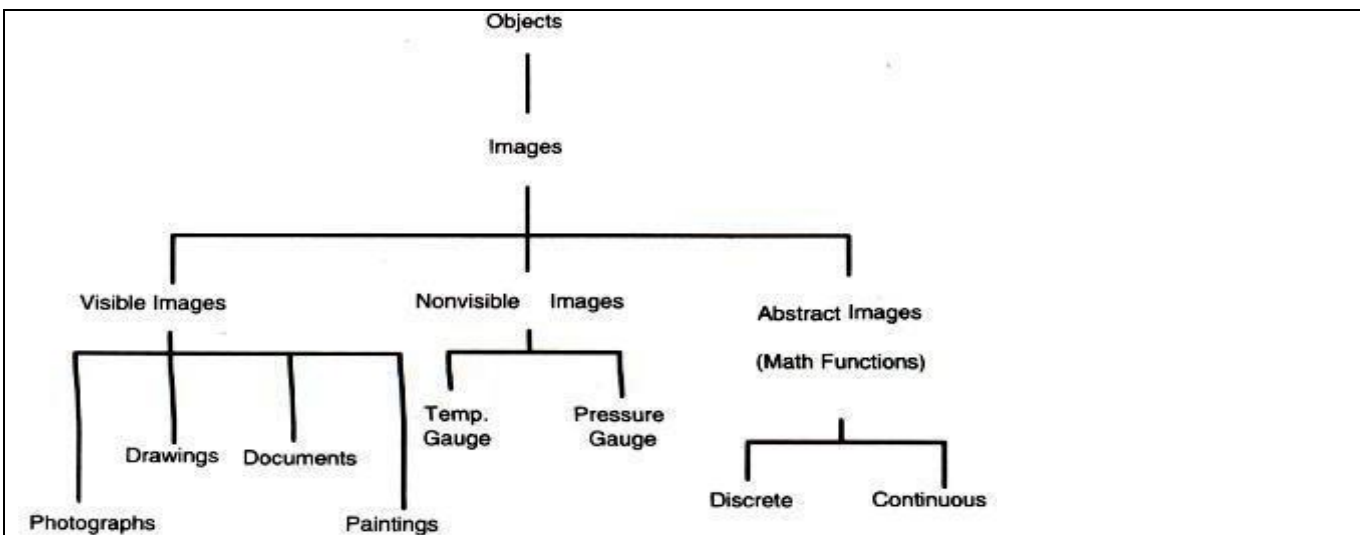
\*In this object, there is no direct relationship between successive representations in time.

The image object includes all data types that are not coded text.

\*It do not have a temporal property associated with them.

\*The data types such as document images, facsimile systems, fractals, bitmaps, meta files, and still pictures or still video frames are grouped together.

Figure describes a hierarchy of the object classes



**Non-Visible:** This type of images are not stored as images. But they are displayed as images. Example: Pressure gauges, and temperature gauges.

**Abstract:** Abstract images are computer-generated images based on some arithmetic calculations. They are really not images that ever existed as real-world objects. Example of these images is fractals.

#### AUDIO AND VOICE

\*Stored-Audio and Video objects contain compressed audio information. This can consist of music, speech, telephone conversation and voice commands.

\*An Audio object needs to store information about the sound clip.

\*Information here means length of the sound clip, its compression algorithm, playback characteristics, and any annotations associated with the original clip.

#### FULL MOTION AND LIVE VIDEO

\*Full motion video refers to pre-stored video clips. Live video refers to live and it must be processed while it is being captured by the camera.

\*From a storage perspective, we should have the information about the coding algorithm used for compression. It need decoding also.

\*From a processing perspective, video should be presented to user with smooth and there should not be any unexpected breaks.

\* Hence, video object and its associated audio object must be transferred over the network to the decompression unit.

\*For successful playback of compressed video, there are number of technologies.

They are database storage, network media and protocols, decompression engines and display engines.

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[http://www.brainkart.com/article/Defining-Objects-for-Multimedia-Systems\\_10192/](http://www.brainkart.com/article/Defining-Objects-for-Multimedia-Systems_10192/)

[http://www.miet.edu/course/wp-content/uploads/2019/07/3.5-CG-cse\\_Optimized.pdf](http://www.miet.edu/course/wp-content/uploads/2019/07/3.5-CG-cse_Optimized.pdf)

#### Important Books/Journals for further learning including the page nos.:

Andleigh, P. K and Kiran Thakrar, "Multimedia Systems and Design", PHI, 2003, Page no : 33-35

<https://www.igi-global.com/journal/international-journal-mobile-computing-multimedia>

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L-24

## LECTURE HANDOUTS

CSE

III / VI

Course Name with Code : Computer Graphics-16CSD13

Course Faculty : M GANTHIMATHI

Unit : III - Multimedia

Date of Lecture:

**Topic of Lecture:** Multimedia data interface Standards

**Introduction : ( Maximum 5 sentences) :** A file format is a standard way that information is encoded for storage in a computer file.

It specifies how bits are used to encode information in a digital storage medium. File formats may be either proprietary or free and may be either unpublished or open.

Some file formats are designed for very particular types of data: PNG files, for example, store bitmapped images using lossless data compression.

**Prerequisite knowledge for Complete understanding and learning of Topic:**  
( Max. Four important topics)

Multimedia Basics

Multimedia architecture

**Detailed content of the Lecture:**

**File Formats for Multimedia Systems:**

(i) **Device-independent Bitmap (DIB):** This file format contains bit map, color, and color palette information.

(ii) **RIFF device Independent Bitmap (RDIB):** Resource Interchange File Format (RIFF) is the standard file format defined for Microsoft Windows and OS/2.

(iii) **Musical Instrument Digital interface (MIDI):** This is the interface standard for file transfer between a computer and a musical instrument such as a digital piano. It is also, used for full-motion video and voice-mail messaging systems.

**RIFF Musical Instrument Digital Interface**

A MIDI format within a RIFF envelope provides a more complex interface.

**Palette File Format (PAL)** An interface that allows defining a palette of 1 to 256 colours in a representation as RGB values.

**Rich Text Format (RTF)** This file format allows embedding graphics and other file formats within a document. This format is used by products such as Lotus Notes. This format is also the basis for the use of OLE.

**Waveform Audio File Format (WAVE)** A digital file representation of digital audio.

**Windows Metafile Format (WMF)** This is a vector graphic format used by Microsoft Windows as an interchange format.

**Multimedia Movie Format (MMM)** This is a format used for digital video animation.

**Apple's Movie Format** This format was defined as the standard for file exchange by Quick Time enabled systems.

**Digital Video Command Set (DVCS)** This is the set of digital video commands simulating VCR controls.

**Digital Video Media Control Interface** Microsoft's high level control interface for VCR controls, including play, rewind, record and so on.

**Vendor - Independent Messaging (VIM)** Developed by a consortium of Vendors providing a standardized format for cross-product messages.

**Apple's Audio Interchange File Format** Apple's standard file format for compressed audio and voice data.

**SDTS GIS Standard** The Spatial Data Transfer Standard (SDTS) is designed to provide a common storage format for geographic and cartographic data.

**Video Content / Details of website for further learning (if any):**

[http://www.brainkart.com/article/Defining-Objects-for-Multimedia-Systems\\_10192/](http://www.brainkart.com/article/Defining-Objects-for-Multimedia-Systems_10192/)

[http://www.miet.edu/course/wp-content/uploads/2019/07/3.5-CG-cse\\_Optimized.pdf](http://www.miet.edu/course/wp-content/uploads/2019/07/3.5-CG-cse_Optimized.pdf)

**Important Books/Journals for further learning including the page nos.:**

Andleigh, P. K and Kiran Thakrar, "Multimedia Systems and Design", PHI, 2003, Page no : 36-37  
<https://www.igi-global.com/journal/international-journal-mobile-computing-multimedia>

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L-25

## LECTURE HANDOUTS

CSE

III/VI

Course Name with Code: Computer graphics-16CSD13

Course Faculty : M GANTHIMATHI

Unit : III

Date of Lecture:

**Topic of Lecture:** Multimedia data interface Standards

**Introduction : ( Maximum 5 sentences ) :**

- A file format is a standard way that information is encoded for storage in a computer file.
- It specifies how bits are used to encode information in a digital storage medium. File formats may be either proprietary or free and may be either unpublished or open.
- Some file formats are designed for very particular types of data: PNG files, for example, store bitmapped images using lossless data compression.

**Prerequisite knowledge for Complete understanding and learning of Topic:**  
( Max. Four important topics)

Multimedia Basics

Multimedia architecture

**Detailed content of the Lecture:**

VIDEO PROCESSING STANDARDS

INTELS DVI

DVI is an acronym of Digital Video Interface.

DVI standard is to provide a processor independent specification for a video interface.

That video interface should accommodate most compression algorithms for fast multimedia displays.

An example of custom-designed chip which supports DVI is Intel's i750 B.

This chip is designed for enhancing low-end, software based PC video.

Advantages of the DVI Chip

- (i) It can operate software video processing real time.
- (ii) It can share the processing with the host CPU.
- (iii) It can handle additional vector-quantization-type algorithms in conjunction with host processing.
- (iv) DVI silicon chip relies on a programmable video processor. It gives potential to DVI chips to run a range of compression algorithms.

**APPLE QUICK TIME**

Quick Time standard is developed by Apple Computer. It is designed to Support multimedia applications.

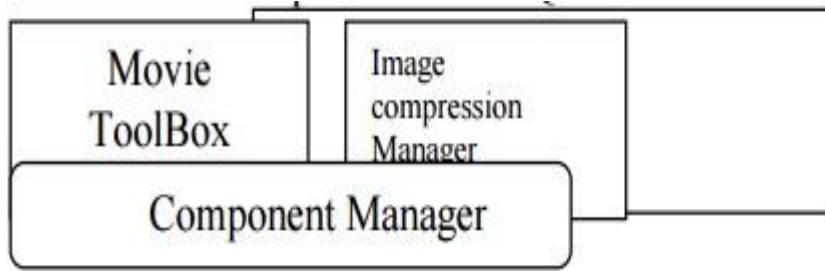
It is integrated with the operating system. Quick time refers to both the extensions to the Mac Operating system and to the compression/decompression functionality Of the environment.

Quick Time is designed to be the graphics standard for timebased graphic data types.



Quick Time's definition has been extended to include (i) System Software, (ii) File Formats, (Hi) Compression! decompression algorithms, (iv) Human Interface Standards.

Figure Shows the components in the Quick Time Architecture.



Quick Time adjust automatically to the hardware being used by the user.

MPEG is another competing standard which is comparatively higher-end, hardware-assisted standard.

It can produce better resolutions at faster rates.

MICROSOFT AVI

A VI is an acronym for Audio Video Interleave Standard. It is similar to Apple's Quick Time.

It offers low-cost, low-resolution video processing for the average desktop user.

It is a layered product. A VI is scalable. It allows users to set parameter such as window size, frame rate, quality and compression algorithm through a number of dialog boxes.

AVI-compatible hardware allows enhancing performance through hardware-accelerated compression algorithms such as DVI and MPEG. AVI supports several compression algorithms.

**Video Content / Details of website for further learning (if any):**

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## LECTURE HANDOUTS

L-26

CSE

III / VI

Course Name with Code : Computer Graphics-16CSD13

Course Faculty : M GANTHIMATHI

Unit : III - Multimedia

Date of Lecture:

**Topic of Lecture:** Multimedia database

**Introduction : ( Maximum 5 sentences ) :** mages, sounds and movies can be stored, retrieved and played by many databases.

In future, multimedia databases will become a main source of interaction between users and multimedia elements.

**Prerequisite knowledge for Complete understanding and learning of Topic:**  
( Max. Four important topics)

Multimedia Basics

Multimedia architecture

Multimedia file formats

**Detailed content of the Lecture:**

Multimedia storage is characterized by a number of considerations. They are:

- (i) massive storage volumes
- (ii) large object sizes
- (iii) multiple related objects
- (iv) temporal requirements for retrieval

### Massive Data Volumes

A single multimedia document may be a combination of different media Hence indexing of documents, films and tapes is more complex.

Locating massive data volumes requires searching through massive storage files.

Locating and indexing systems can be understood only by a few key staff personnel.

Hence it requires a major organizational effort to ensure that they are returned in proper sequence to their original storage location.

### storage technologies

There are two major mass storage technologies used currently for storage of multimedia documents.

- (i) Optical disk storage systems.
- (ii) High-speed magnetic storage.

### Advantages of Optical disk storage systems:

(i) Managing a few optical disk platters in a juke box is much simpler than managing a large magnetic disk farm.

(ii) Optical disk storage is excellent storage system for off line archival of old and infrequently referenced documents for significant periods of time

### **Multimedia object storage**

Multimedia object storage in an optical medium serves its original purpose, only if it can be located fast and automatically.

A key issue here is random keyed Access to various components of hypermedia database record. Optical media provides very dense storage.

Speed of retrieval is another consideration.

Retrieval speed is a direct result of the storage latency, size of the data relative to display resolution, transmission media and speed, and decompression efficiency.

### **Multimedia document retrieval**

The simplest form of identifying a multimedia document is by storage platter identification and its relative position on the platter (file number).

These objects can then be grouped using a database in folders (replicating the concept of paper storage in file folders) or within complex objects representing hypermedia documents.

The capability to access objects using identifiers stored in a database requires capability in the database to perform the required multimedia object directory functions.

Another important application for sound and full motion video is the ability to clip parts of it and combine them with another set.

Indexing of sound and full-motion video is the subject of intense debate and a number of approaches have been used.

### **Database Management Systems for Multimedia Systems**

Since most multimedia applications are based primarily on communications technologies, such as electronic mail, the database system must be fully distributed.

A number of database storage choices are available.

The choices available are:

- \* Extending the existing relational database management systems, (RDBMSs) to support the various objects for multimedia as binary objects.
- \* Extending RDBMSs beyond basis binary objects to the concepts of inheritance and classes. RDBMSs supporting these . features provide extensions for object-programming front ends and/or C++ support.
- \* Converting to a full fledged object oriented database that supports the standard SQL language.
- \* Converting the database and the application to an objectoriented database and using an object-oriented language, or an object-enabled SQL for development.

Multimedia applications combine numerical and textual data, graphics from GUI front-ends, CAD/CAM systems and GIS applications, still video, audio and full-motion video with recorded audio and annotated voice components.

Relational databases, the dominant database paradigm, have lacked the ability to support multimedia databases.

Key limitations of relational database systems for implementing multimedia applications stem from two

areas: the relational data model and the relational computational model.

RDBMSs have been designed to manage only tabular alphanumeric forms of data (along with some additional data types stored in binary form such as dates).

#### **RDBMS EXTENSIONS FOR MULTIMEDIA**

Binary Large Object (BLOB) is a data type which has been adapted by most of the leading relational databases.

BLOBs are used for objects such as images or other binary data types.

The relational database is extended to access these BLOBs to present the user 'with a complete' data set.

Extended relational databases provide a gradual migration path to a more object-oriented environment.

Relational database tables include location information for the BLOBs which may be stored outside the database on separate image or video servers.

Relational databases have the strength of rigorous set management for maintaining the integrity of the database

#### **Video Content / Details of website for further learning (if any):**

[http://www.brainkart.com/article/Defining-Objects-for-Multimedia-Systems\\_10192/](http://www.brainkart.com/article/Defining-Objects-for-Multimedia-Systems_10192/)

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#### **Important Books/Journals for further learning including the page nos.:**

Ardleigh, P. K and Kiran Thakrar, "Multimedia Systems and Design", PHI, 2003,Page no : 44-47  
Practice, 3rd edition,2008.

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L-27

## LECTURE HANDOUTS

CSE

III / VI

Course Name with Code : Computer Graphics-16CSD13

Course Faculty : M GANTHIMATHI

Unit : III - Multimedia

Date of Lecture:

**Topic of Lecture:** Multimedia database

**Introduction : ( Maximum 5 sentences) :** mages, sounds and movies can be stored, retrieved and played by many databases. In future, multimedia databases will become a main source of interaction between users and multimedia elements.

**Prerequisite knowledge for Complete understanding and learning of Topic:**  
( Max. Four important topics)

Multimedia Basics

Multimedia architecture

Multimedia file formats

**Detailed content of the Lecture:**

**Object-Oriented Databases for Multimedia**

- In object databases, data remains in RMS or flat files. Object databases can provide the fastest route to multimedia support.
- Object programming embodies the principles of reusable code and modularity. This will ease future maintenance of these databases.
- Object database capabilities such as message passing, extensibility, and the support of hierarchical structures, are important for multimedia systems.
- We can develop the application fastest class definitions. ODBMSs are extensible. They allow incremental changes to the database applications.

**Extensibility:** Extensibility .means that the set of operations, structures and constraints that are available to operations are not fixed, and developers can define new operations, which can then be added as needed to their application.

- Object-oriented software technology has three important concepts. They are:

**Encapsulation:** It is the ability to deal with software entities as units that interact in pre-defined and controllable manner, and where the control routines are integral with entity.

**Association:** It is the ability to define a software entity in terms of its differences from another entity.

**Classification:** It is the ability to represent with a single software entity a number of data items that all have the same behavior and the same state attributes.

Object orientation helps to organize the software in a more, modular and re-usable manner.

Encapsulation allows for the development of open systems where one part of the application does not need to know the functioning of other part.

It also provides autonomy;

**Autonomy** means we can interface to a variety of external programs can be built in one class of objects and the storage of the data in another class of objects.

### Database Organization for Multimedia Applications

Data organization for multimedia systems has some key issues. They are:

- (1) Data independence
- (2) Common distributed database architecture
- (3) Distributed database servers ·
- (4) Multimedia object management.

#### **Data Independence**

Flexible access by a number of databases requires that the data be independent from the application so that future applications can access the data without constraints related to a previous application.

Key features of data independent designs are:

- 1.Storage design in independent of specific applications.
- 2.Explicit data definitions are independent of application program.
- 3.Users need not know data formats or physical storage structures.
- 4.Integrity assurance in independent of application programs.
- 5.Recovery in independent of application programs.

#### **Distributed Data servers**

Distributed database servers are a dedicated resource on a network accessible to a number of applications.

The database server is built for growth and enhancement, and the network provides the opportunity for the growth of applications and distributed access to the data.

#### **Multimedia Object Management**

The object management system must be capable of indexing, grouping and storing multimedia objects in distributed hierarchical optional storage systems, and accessing these objects on or keyed basis.

The design of the object management system should be capable indexing objects in such a manner that there is no need to maintain multiple storage copies.

Multimedia transactions are very complex transactions.

We define a multimedia transaction as the sequence of events that starts when a user makes a request to display, edit, or print a hyper media document.

The transaction is complete when the user releases the hypermedia document and stores back the edited versions or discards the copy in memory (including virtual memory) or local storage .

**Video Content / Details of website for further learning (if any):**

[http://www.brainkart.com/article/Defining-Objects-for-Multimedia-Systems\\_10192/](http://www.brainkart.com/article/Defining-Objects-for-Multimedia-Systems_10192/)

[http://www.miet.edu/course/wp-content/uploads/2019/07/3.5-CG-cse\\_Optimized.pdf](http://www.miet.edu/course/wp-content/uploads/2019/07/3.5-CG-cse_Optimized.pdf)

**Important Books/Journals for further learning including the page nos.:**

Andleigh, P. K and Kiran Thakrar, "Multimedia Systems and Design", PHI, 2003,Page no : 48-50

<https://www.igi-global.com/journal/international-journal-mobile-computing-multimedia>

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# MUTHAYAMMAL ENGINEERING COLLEGE

(An Autonomous Institution)

(Approved by AICTE, New Delhi, Accredited by NAAC & Affiliated to Anna University)

Rasipuram - 637 408, Namakkal Dist., Tamil Nadu



L-28

## LECTURE HANDOUTS

CSE

III / VI

**Course Name with Code** : Computer Graphics-16CSD13

**Course Faculty** : M GANTHIMATHI

**Unit** : IV -: Network Security In Multimedia **Date of Lecture:**

**Topic of Lecture:** Introduction to Compression

**Introduction :** ( Maximum 5 sentences) : Compression is the way of making files to take up less space.

In multimedia systems, in order to manage large multimedia data objects efficiently, these data objects need to be compressed to reduce the file size for storage of these objects.

Compression tries to eliminate redundancies in the pattern of data.

**Prerequisite knowledge for Complete understanding and learning of Topic:**  
( Max. Four important topics)

Multimedia file formats

Multimedia databases

**Detailed content of the Lecture:**

TYPES OF COMPRESSION

- Compression and decompression techniques are utilized for a number of applications, such as facsimile system, printer systems, document storage and retrieval systems, video conferencing systems, and electronic multimedia messaging systems.
- An important standardization of compression algorithm was achieved by the CCITT when it specified Group 2 compression for facsimile system.
- In lossless compression, data is not altered or lost in the process of compression or decompression.

Lossy compression is that some loss would occur while compressing information objects.

**Binary Image compression schemes**

Binary Image Compression Scheme is a scheme by which a binary image containing black and white pixel is generated when a document is scanned in a binary mode.

**1 .Packpits Encoding( Run-Length Encoding)**

It is a scheme in which a consecutive repeated string of characters is replaced by two bytes.

- It is the simple, earliest of the data compression scheme developed. It need not to have a standard.
- It is used to compress black and white (binary) images.



- Among two bytes which are being replaced, the first byte contains a number representing the number of times the character is repeated, and the second byte contains the character itself.
- In some cases, one byte is used to represent the pixel value, and the other seven bits to represents the run length.

## 2. CCITT Group 3 1-D Compression

- This scheme is based on run-length encoding and assumes that a typical scanline has long runs of the same color.
- This scheme was designed for black and white images only, not for gray scale or color images.
- The primary application of this scheme is in facsimile and early document imaging system.
- A modified version of run-length encoding is Huffman encoding.
- It is used for many software based document imaging systems. It is used for encoding the pixel run length in CCITT Group 3 1-dGroup 4.
- It is variable-length encoding. It generates the shortest code for frequently occurring run lengths and longer code for less frequently occurring run lengths.
- It is also known as modified run length encoding. It is used for software based imaging system and facsimile.
- It is easier to decompress in software than CCITT Group 4. The CCITT Group 3 2D scheme uses a "k" factor where the image is divided into several group of k lines. This scheme is based on the statistical nature of images; the image data across the adjacent scanline is redundant.
- If black and white transition occurs on a given scanline, chances are the same transition will occur within + or - 3 pixels in the next scanline.

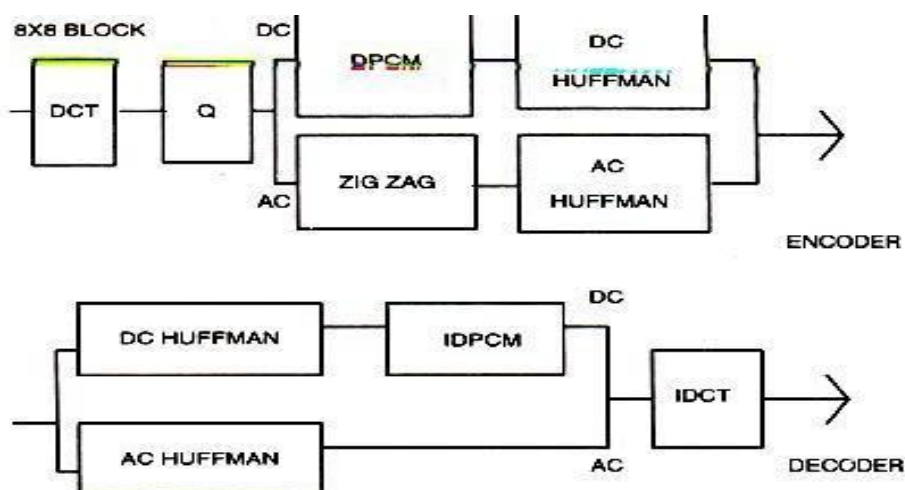
## JOINT PHOTOGRAPHIC EXPERTS GROUP COMPRES5ION (JPEG)

JPEG is a compression standard for still color images and grayscale images, otherwise known as continuous tone images.

**JPEG Components** JPEG Standard components are:

- (i) Baseline Sequential Codec
- (ii) OCT Progressive Mode
- (iii) Predictive Lossless Encoding
- (iv) Hierarchical Mode.

**Figure** below shows the components and sequence of quantization 5 \* 8 Image blocks



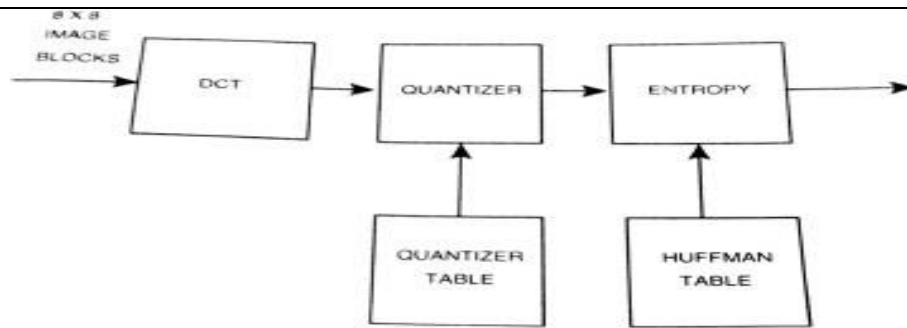


Fig. 2-4 Codec Components.

### The Discrete Cosine Transform(DCT)

DCT is closely related to Fourier transforms. Fourier transforms are used to represent a two dimensional sound signal.

The benefits provided by DCT transformations are as follows

- DCT is proven to be the optimal transform for large classes of images.
- DCT is an orthogonal transform; it allows converting the spatial representation of an 8x8 image to the frequency domain where only a few data points are required to represent the image.
- DCT generates coefficients that are easily quantized to achieve good compression of the block.
- The DCT algorithm is well-behaved and can be computed efficiently by making it easy to implement in both hardware and software.

The DCT algorithm is symmetrical, and an inverse DCT algorithm can be used to decompress an image.

### Quantization

Quantization is a process of reducing the precision of an integer, thereby reducing the number of bits required to store the integer, thereby reducing the number of bits required to store the integer.

$$\text{Quantized Co-efficient (i, j)} = \frac{DCT(i, j)}{Quantum(i, j)}$$

### ZigZag Sequence

Run-length encoding generates a code to represent the Count of zero-value OCT co-efficients. This process of run-length encoding gives an excellent compression of the block consisting mostly of zero values.

Further empirical work proved that the length of zero values in a run can be increased to give a further increase in compression by reordering the runs. JPEG came up with ordering the quantized OCT co-efficients in a ZigZag sequence

### Entropy Encoding

Entropy is a term used in thermodynamics for the study of heat and work. Entropy, as used in data compression, is the measure of the information content of a message in number of bits. It is represented as

$$\text{Entropy in number of bits} = \log_2(\text{probability of Object})$$

**Video Content / Details of website for further learning (if any):**

[http://www.brainkart.com/article/Compression-and-Decompression\\_10195/](http://www.brainkart.com/article/Compression-and-Decompression_10195/)

[http://www.miet.edu/course/wp-content/uploads/2019/07/3.5-CG-cse\\_Optimized.pdf](http://www.miet.edu/course/wp-content/uploads/2019/07/3.5-CG-cse_Optimized.pdf)

**Important Books/Journals for further learning including the page nos.:**

Andleigh, P. K and Kiran Thakrar, "Multimedia Systems and Design", PHI, 2003,Page No:53-106

<https://www.igi-global.com/journal/international-journal-mobile-computing-multimedia>

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Course Name with Code : Computer Graphics-16CSD13

Course Faculty : M GANTHIMATHI

Unit : IV -: Network Security In Multimedia Date of Lecture:

**Topic of Lecture:** Decompression

**Introduction : ( Maximum 5 sentences ) :** Decompression is the process of restoring compressed data to its original form.  
Data decompression is required in almost all cases of compressed data, including lossy and lossless compression.  
Similar to compression of data, decompression of data is also based on different algorithms.

**Prerequisite knowledge for Complete understanding and learning of Topic:**  
( Max. Four important topics)  
Multimedia file formats  
Compression techniques

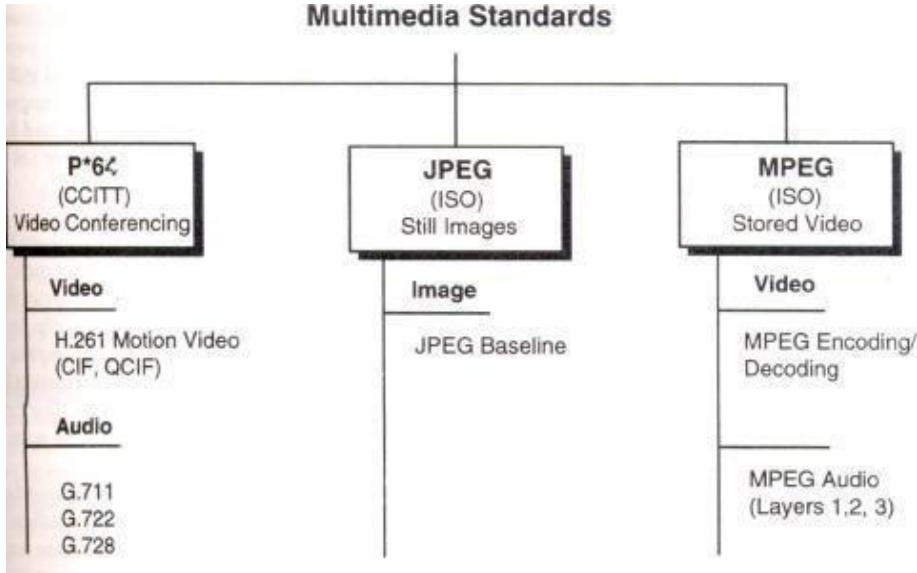
**Detailed content of the Lecture:**

## VIDEO IMAGE COMPRESSION

The development of digital video technology has made it possible to use digital video compression for a variety of telecommunications applications.

Standardization of compression algorithms for video was first initiated by CCITT for teleconferencing and video telephony

Multimedia standards for Video:



### Requirements for full-motion Video Compression

Applications using MPEG standards can be symmetric or asymmetric. Symmetric applications are applications that require essentially equal use of compression and decompression. Asymmetric applications require frequent decompression.

Symmetric applications require on-line input devices such as video cameras, scanners and microphones for digitized sound.

The MPEG standard has identified a number of such issues that have been addressed by the standards activity. Let us review these Issues.

### **Random Access**

The expectations generated for multimedia systems are the ability to play a sound or video clip from any frame with that clip, irrespective of on what kind-of media the information is stored

### **VCR paradigm**

The VCR paradigm consists of the control functions typically found on a VCR such as play, fast forward, rewind, search forward and rewind search.

### **Multiplexing Multiple Compressed Audio and Video Bit Streams**

It is a special requirement retrieved from different storage centers on a network. It may be received from different storage centers on a network.

It may have to be achieved in a smooth manner to avoid the appearance of a jumpy screen.

#### **Editability**

#### **Playback Device Flexibility**

#### **CCITT H.261 Video Coding Algorithms (P x 64)**

### **Moving Picture Experts Group Compression**

The MPEG 2 suite of standards consist of standards for MPEG2 Video, MPEG - 2 Audio and MPEG - 2 systems. It is also defined at different levels, called profiles.

### **MPEG Coding Methodology**

The MPEG algorithm for spatial reduction is lossy and is defined as a hybrid which employs motion compensation, forward discrete cosine transform (DCF), a uniform quantizer, and Huffman coding. Block- based motion compensation is *utilized* for *reducing temporal* redundancy (i.e. to reduce the amount of data needed to represent each picture in a video sequence). Motion-compensated reduction is a key feature of MPEG.

### **Moving Picture Types**

Moving pictures consist of sequences of video pictures or frames that are played back a fixed number of frames per second. To achieve the requirement of random access, a set of pictures can be defined to form a group of pictures (GOP) consisting of one or more of the following three types of pictures.

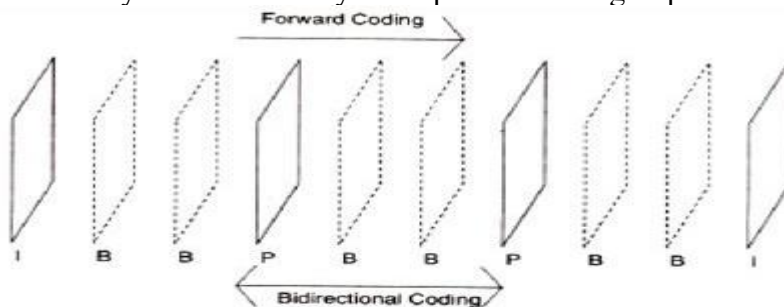
#### **Intra pictures (I)**

#### **Unidirectionally predicted**

#### **pictures (U) Bidirectionally**

#### **predicted pictures (B)**

A Group consists of consecutive pictures that begin with an intrapicture. The intrapicture is coded without any reference to any other picture in the group.



### **MACRO BLOCKS**

For the video coding algorithm recommended by CCITT, CIF and QCIF are divided into a hierarchical block structure consisting of pictures, groups of blocks (GOBs), Macro Blocks(MBs), and blocks.

Each picture frame is divided into 16 x 16 blocks. Each Macroblock is composed of four 8 x 8 (Y) luminance blocks and two 8 x 8 (Cb and Cn) chrominance blocks.

This set of six blocks, called a macroblock; is the basic hierarchical component used for achieved a high level of compression.

### **Motion compensation**

Motion compensation is the basis for most compression algorithms for visual telephony and full-

motion video.

It assumes that the current picture is some translation of a previous picture.

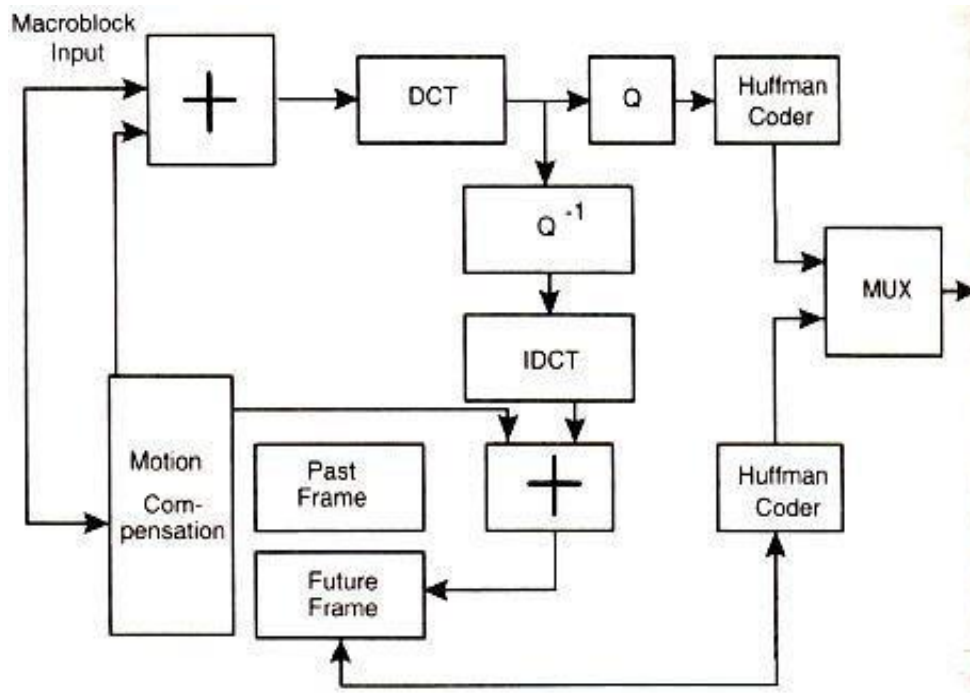
This creates the opportunity for using prediction and interpolation.

Prediction requires only the current frame and the reference frame.

### MPEG Encoder

**Figure** below shows the architecture of an MPEG encoder. It contains DCT quantizer, Huffman coder and Motion compensation. These represent the key modules in the encoder.

#### Architecture of MPEG Encoder:



First an image is converted to the YUV color space.

The pixel data is then fed into a DCT, which creates a scalar quantization of the pixel data.

Following quantization, a number of compression algorithms are applied, including run-length and Huffman encoding.

For full-motion video, several more levels of motion compensation compression and coding are applied.

#### Video Content / Details of website for further learning (if any):

[http://www.brainkart.com/article/Compression-and-Decompression\\_10195/](http://www.brainkart.com/article/Compression-and-Decompression_10195/)

<https://www.techopedia.com/definition/14330/decompression>

#### Important Books/Journals for further learning including the page nos.:

Andleigh, P. K and Kiran Thakrar, "Multimedia Systems and Design", PHI, 2003,Page No:107-123  
Foley, van Dam, Feiner, and Hughes, Computer Graphics: Principles and Practice, 3rd edition,2008.

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## LECTURE HANDOUTS

L-30

CSE

III /VI

**Course Name with Code** : Computer Graphics-16CSD13

**Course Faculty** : M GANTHIMATHI

**Unit** : IV -: Network Security In Multimedia **Date of Lecture:**

<b>Topic of Lecture:</b> Data and file format standards
<b>Introduction : ( Maximum 5 sentences) :</b> File format is a standard way that information is encoded for storage in a computer file. It specifies how bits are used to encode information in a digital storage medium. There are large number of formats and standards available for multimedia system.
<b>Prerequisite knowledge for Complete understanding and learning of Topic:</b> ( Max. Four important topics) Multimedia file formats Compression and Decompression techniques
<b>Detailed content of the Lecture:</b> <ul style="list-style-type: none"> <li>➤ Rich-Text Format (RTF)</li> <li>➤ Tagged Image file Format (TIFF)</li> <li>➤ Resource Image File Format (RIFF)</li> <li>➤ Musical Instrument Digital Interface (MIDI)</li> <li>➤ Joint Photographic Experts Group (JPEG)</li> <li>➤ Audio Video Interleaved (AVI) Indeo file format</li> <li>➤ TWAIN.</li> </ul> <p><b>Rich Text Format</b></p> <p>This format extends the range of information from one word processor application or DTP system to another.</p> <p>The key format information carried across in RTF documents are given below: Character Set: It determines the characters that supports in a particular implementation.</p> <p>Font Table,Color table,Document Formatting,Section formatting,general formatting,character formatting,special character.</p> <p><b>TIFF File Format</b></p> <p>TIFF is an industry-standard file format designed to represent raster image data generated by scanners,</p>

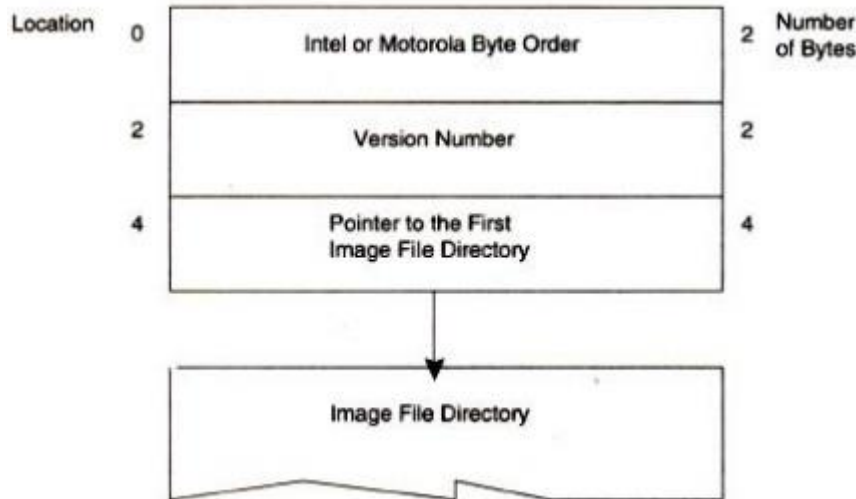
frame grabbers, and paint/ photo retouching applications.

### TIFF Structure

TIFF files consists of a header. The header consists of byteordering flag, TIFF file format version number, and a pointer to a table.

The pointer points image file directory. This directory contains table of entries of various tags and their information.

TIFF file format Header:



### TIFF Tags

The first two bytes of each directory entry contain a field called the Tag ID.

Tag IDs are grouped into several categories. They are Basic, Informational, Facsimile, Document storage and Retrieval.

### TIFF Classes: (Version 5.0)

1. Class B for binary images
2. Class F for Fax
3. Class G for gray-scale images
4. Class P for palette color images
5. Class R for RGB full-color images.

### Resource Interchange File Format (RIFF)

The RIFF file formats consist of blocks of data called chunks. They are RIFF Chunk - defines the content of the RIFF file.

List Chunk - allows to embed archival location copy right information and creating date. Subchunk - allow additional information to a primary chunk

The first chunk in a RIFF file must be a RIFF chunk and it may contain one or more sub chunk

The first four bytes of the RIFF chunk data field are allocated for the form type field containing four characters to identify the format of the data stored in the file: AVI, WAV, RMI, PAL and so

### MIDI File Format

The MIDI file format follows music recording metaphor to provide the means of storing separate tracks of music for each instrument so that they can be read and syn-hronized when they are played.

The MIDI file format also contains chunks (i.e., blocks) of data. There are two types of chunks: (i) header chunks (ii) track chunks.

## Header Chunk

It is made up of 14 bytes .

The first four-character string is the identifier string, "MThd" .

The second four bytes contain the data size for the header chunk. It is set to a fixed value of six bytes .

The last six bytes contain data for header chunk.

## Track chunk

The Track chunk is organized as follows:

--The first 4-character string is the identifier.

--The second 4 bytes contain track length.

## MIDI Communication Protocol

The number of bytes depends on the types of message. There are two types of messages:

- (i) Channel messages and (ii) System messages.

## JPEG Motion Image:

JPEG Motion image will be embedded in A VI RIFF file format. There are two standards available:

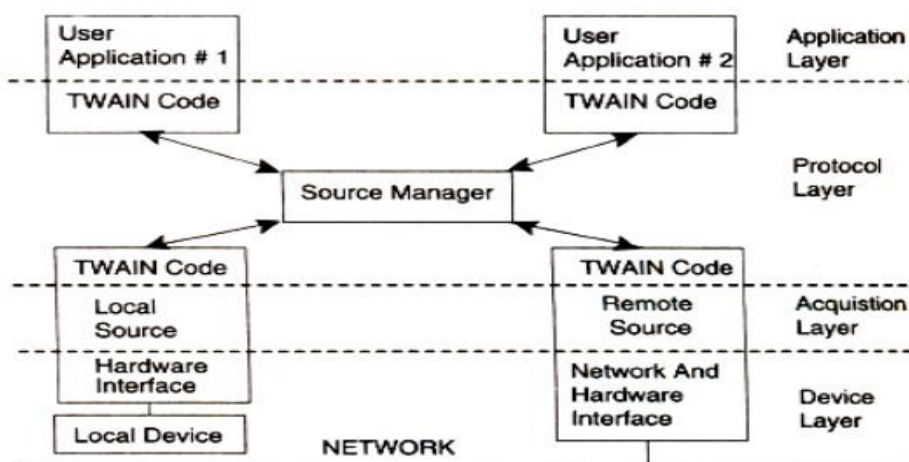
(i) MPEG ~ In this, patent and copyright issues are there.

(ii) MPEG 2 ~ It provide better resolution and picture quality.

## TWAIN

To address the problem of custom interfaces, the TWAIN working group was formed to define an open industry standard interface for input devices. They designed a standard interface called a generic TWAIN . interface. It allows applications to interface scanners, digital still cameras, video cameras.

## TWAIN ARCHITECHTURE:



- The Twain architecture defines a set of application programming interfaces (APIs) and a protocol to acquire data from input devices.
- It is a layered architecture.
- It has application layer, the protocol layer, the acquisition layer and device layer.
- Application Layer: This layer sets up a logical connection with a device. The application layer interfaces with protocol layer.



- Protocol Layer: This layer is responsible for communications between the application and acquisition layers.
- The main part of the protocol layer is the source Manager.
- Source manager manages all sessions between an application and the sources, and monitors data acquisition transactions. The protocol layer is a complex layer.

**Video Content / Details of website for further learning (if any):**

[https://www.brainkart.com/article/Data-and-File-Formats-Standards\\_10196/](https://www.brainkart.com/article/Data-and-File-Formats-Standards_10196/)

<https://www.dpconline.org/handbook/technical-solutions-and-tools/file-formats-and-standards>

**Important Books/Journals for further learning including the page nos.:**

Andleigh, P. K and Kiran Thakrar, "Multimedia Systems and Design", PHI, 2003,Page No:124-187

<https://www.springer.com/journal/11042>

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L-31

## LECTURE HANDOUTS

CSE

III /VI

Course Name with Code : Computer Graphics-16CSD13

Course Faculty : M GANTHIMATHI

Unit : IV -: Network Security In Multimedia Date of Lecture:

Topic of Lecture: Multimedia I/O technologies

Introduction : ( Maximum 5 sentences) :

Wide ranges of Input and output devices are available for multimedia.

Prerequisite knowledge for Complete understanding and learning of Topic:

( Max. Four important topics)

Introduction to Multimedia

Input and output devices

Detailed content of the Lecture:

**Image Scanners:** Image scanners are the scanners by which documents or a manufactured part are scanned. The scanner acts as the camera eye and take a photograph of the document.

**Sound and Voice:** When voice or music is captured by a microphone, it generates an electrical signal.

**Full-Motion Video:** It is the most important and most complex component of Multimedia System. Video Cameras are the primary source of input for full-motion video.

**Pen Driver:** It is a pen device driver that interacts with the digitizer to receive all digitized information about the pen location and builds pen packets for the recognition context manager.

**Recognizor:** It recognizes hand written characters and converts them to ASCII.

**Dictionary:** A dictionary is a dynamic link library (DLL); The windows form pen computing system uses this dictionary to validate the recognition results.

**Display Driver:** It interacts with the graphics device interface' and display hardware.

**Video and Image Display Systems Display System Technologies**

**VGA mixing:** Images from multiple sources are mixed in the image acquisition memory.

**VGA mixing with scaling:** Scalar ICs are used to sizing and positioning of images in predefined windows.

**Dual buffered VGA mixing/Scaling:** If we provide dual buffering, the original image is prevented from loss. In this technology, a separate buffer is used to maintain the original image.

**Visual Display Technology Standards**

**MDA: Monochrome Display Adapter:**It was introduced by IBM . It displays 80 x 25 rows and columns . It could not display bitmap graphics .

**CGA: Color Graphics Adapter :** It was introduced in 1981. It was designed to display both text and bitmap graphicsi

**MGA: Monochrome Gr.aphics Adapter :** It was introduced in 1982 . It could display both text and graphics

It could display at a resolution 720 x 350 for text and 720 x 338 for Graphics . MDA is compatible mode for this standard.

**EGA: Enhanced Graphics Adapter :** introduced in 1984 .It emulated both *MDt.* and CGA standards and displayed of both text and graphics in 16 colors at a resolution of 640 x · 350 pixels.

**PGA: Professional Graphics Adapter.**

- It was introduced in 1985

- It could display bit map graphics at 640 x 480 resolution and 256 colors .

-Compatible mode of this standard is CGA.

**VGA: Video Graphics Array . . :** It was introduced by IBM in 1988 .

- It offers CGA and EGA compatibility .
- It display both text and graphics .
- It generates analog RGB signals to display 256 colors .
- It remains the basic standard for most video display systems.

**SVGA: Super Video Graphics Adapter.** It is developed by VESA (Video Electronics Standard Association) . It's goal is to display with higher resolution than the VGA with higher refresh rates with minimize flicker.

**XGA: Extended Graphics Array**

It is developed by IBM . It offers VGA compatible mode . Resolution of 1024 x 768 pixels in 256 colors is offered by it. XGA utilizes an interlace scheme for refresh rates.

**Flat Panel Display system**

Flat panel displays use a fluorescent tube for backlighting to give the display a sufficient level of brightness. The four basic technologies used for flat panel display are:

1. Passive-matrix monochrome
2. Active-matrix monochrome
3. Passive-matrix color
4. Active-matrix color.

**LCD (Liquid Crystal Display)**

Construction: Two glass plates each containing a light polarizer at right angles to the other plate, sandwich the nematic (thread like) liquid crystal material.

Liquid crystal is the compounds having a crystalline arrangement of molecules. But it flow like a liquid.

Nematic liquid crystal compounds are tend to keep the long axes of rod-shaped molecules aligned.

**Passive Matrix LCD**

**Working:** Normally, the molecules are aligned in the 'ON' state.

Polarized light passing through the materials is twisted so that it will pass through the opposite polarizer. The light is then reflected back to the viewer. To turn off the pixel, we have to apply a voltage to the two intersecting conductors to align molecules so that the light is not twisted.

**ACTIVE Matrix LCD**

In this device, a transistor is placed at each pixel position, using thin-film transistor technology.

The transistors are used to control the voltage at pixel locations and to prevent charge from gradually leaking out of the liquid crystal cells.

**PRINT OUTPUT TECHNOLOGIES**

To explain this technology, let us take Hewlett Packard Laser jet-III laser printer as an example. The basic components of the laser printer are

- Paper feed mechanism
- Paper guide
- Laser assembly
- Fuser
- Toner cartridge.

**Working:** The paper feed mechanism moves the paper from a paper tray through the paper path in the printer. The paper passes over a set of corona wires that induce a change in the paper .

## IMAGE SCANNERS

In a document imaging system, documents are scanned using a scanner.

### Types of Scanners

A and B size Scanners, large form factor scanners, flat bed scanners, Rotary drum scanners and hand held scanners are the examples of scanners.

**Charge-Coupled Devices** All scanners use charge-coupled devices as their photosensors. CCDs consists of cells arranged in a fixed array on a small square or rectangular solid state surface. Light source moves across a document.

### Image Enhancement Techniques

**HalfTones** In a half-tone process, patterns of dots used to build scanned or printed image create the illusion of continuous shades of gray or continuous shades of color..

#### Dithering

Dithering is a process in which group of pixels in different patterns are used to approximate halftone patterns by the scanners.

### Image Manipulation

It includes scaling, cropping and rotation.

**Scaling:** Scaling can be up or down, the scaling software is available to reduce or enlarge. This software uses algorithms.

**Cropping:** To remove some parts of the image and to put the rest of the image as the subset of the old image.

**Rotation:** Image could be rotated at any degree for displaying it in different angles.

### Video Content / Details of website for further learning (if any):

[https://www.brainkart.com/article/Multimedia-Input-Output-Technologies\\_10197/](https://www.brainkart.com/article/Multimedia-Input-Output-Technologies_10197/)

<https://www.dpconline.org/handbook/technical-solutions-and-tools/file-formats-and-standards>

### Important Books/Journals for further learning including the page nos.:

Andleigh, P. K and Kiran Thakrar, "Multimedia Systems and Design", PHI, 2003,Page No:188-224

<https://www.springer.com/journal/11042>

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L-32

## LECTURE HANDOUTS

CSE

III / VI

Course Name with Code : Computer Graphics-16CSD13

Course Faculty : M GANTHIMATHI

Unit : IV -: Network Security In Multimedia Date of Lecture:

**Topic of Lecture:** Digital voice and audio

**Introduction : ( Maximum 5 sentences ) :**  
Sound is made up of continuous analog sine waves that tend to repeat depending on the music or voice.  
The analog waveforms are converted into digital format by analog-to-digital converter (ADC) using sampling process.

**Prerequisite knowledge for Complete understanding and learning of Topic:**  
( Max. Four important topics)  
Input and output technologies  
Multimedia fileformats

**Detailed content of the Lecture:**  
**Sampling process**  
 Sampling is a process where the analog signal is sampled over time at regular intervals to obtain the amplitude of the analog signal at the sampling time.  
**Sampling rate:**The regular interval at which the sampling occurs is called the sampling rate.

```

graph TD
    A[Analog-to-Digital Converter  
Amplitude and Noise  
Normalization] --> B[Parametric Analysis]
    B --> C{Train of  
Recognize}
    C -- Train --> D[Add New  
Reference  
Pattern to  
the List]
    C -- Recognize --> E[Dynamic  
Time Trap]
    E --> F[Compare Unknown  
with  
Reference Pattern]
    F --> G[Output the  
matched reference  
pattern]
  
```

Digital Voice

Speech is analog in nature and is converted to digital form by an analog-to-digital converter (ADC). An ADC takes an input signal from a microphone and converts the amplitude of the sampled analog signal to an 8, 16 or 32 bit digital value.

The four important factors governing the ADC process are **sampling rate resolution linearity and conversion speed.**

**Sampling Rate:** The rate at which the ADC takes a sample of an analog signal. **Resolution:** The number of bits utilized for conversion determines the resolution of ADC.

**Linearity:** Linearity implies that the sampling is linear at all frequencies and that the amplitude truly represents the signal.

**Conversion Speed:** It is a speed of ADC to convert the analog signal into Digital signals. It must be fast enough.

### VOICE Recognition System

Voice Recognition Systems can be classified into three types. 1. Isolated-word Speech Recognition.

2. Connected-word Speech Recognition. 3. Continuous Speech Recognition.

### Voice Recognition performance

#### 1. Voice Recognition Accuracy

$$\text{Voice Recognition Accuracy} = \frac{\text{Number of correctly recognized words}}{\text{Number of test words}} \times 100$$

#### 2. Substitution Error

$$\text{Substitution error} = \frac{\text{Number of substituted words}}{\text{Number of test words}} \times 100$$

#### 3. No Response Error

$$\frac{\text{Number of no responses}}{\text{Number of test words}} \times 100$$

#### 4. Insertion Error

$$\text{Insertion error} = \frac{\text{Number of insertion error}}{\text{Number of test words}} \times 100$$

### Musical Instrument Digital Interface (MIDI)

MIDI interface is developed by Dave Smith of sequential circuits, inc in 1982. It is an universal synthesizer interface

#### MIDI Specification 1.0

MIDI is a system specification consisting of both hardware and software components which define inter-connectivity and a communication protocol for electronic synthesizers, sequencers, rhythm machines, personal computers, and other electronic musical instruments.

#### MIDI Hardware Specification

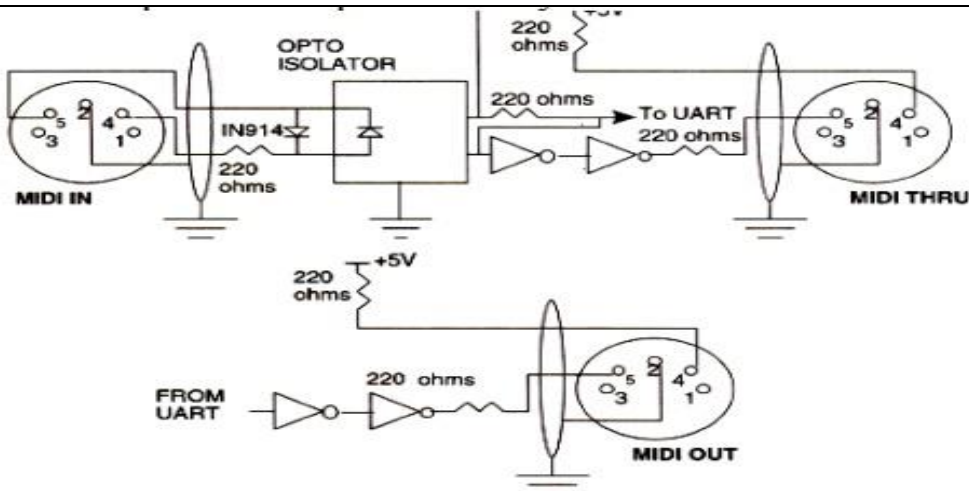
The MIDI hardware specification requires five pin panel mount receptacle DIN connectors for MIDI IN, MIDI OUT and MIDI THRU signals

#### MIDI Interconnections

The MIDI IN port of an instrument receives MIDI messages to play the instrument's internal synthesizer.

The MIDI OUT port sends MIDI messages to play these messages to an external synthesizer. The MIDI THRU port outputs MIDI messages received by the MIDI IN port for daisy-chaining external synthesizers.

MIDI Input and output circuitry:



## Communication Protocol

The MIDI communication protocol uses multibyte messages; There are two types of messages:

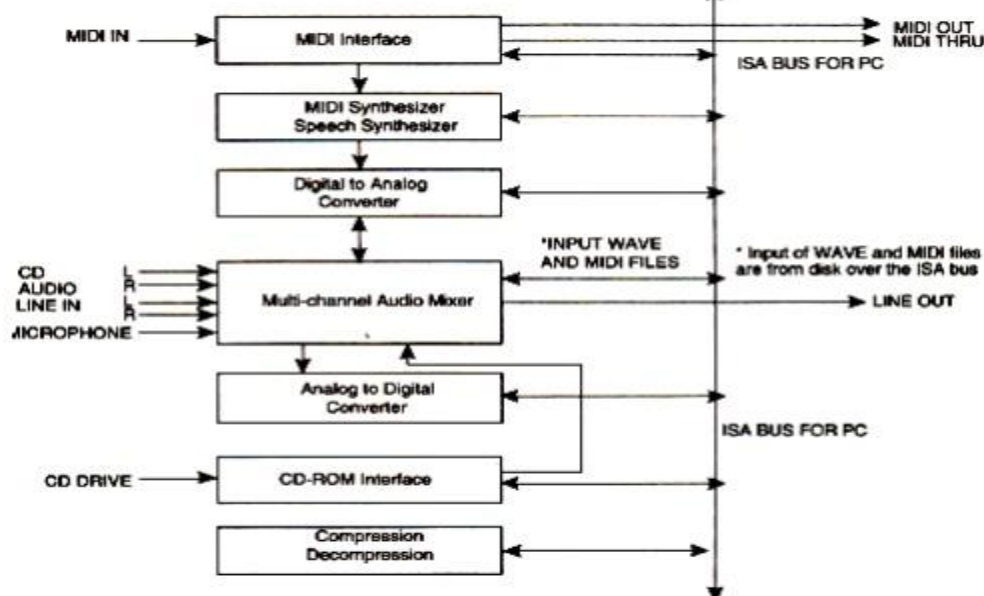
(i) Channel messages

(ii) System messages.

## SOUND BOARD ARCHITECTURE

A sound card consist of the following components:

MIDI Input/Output Circuitry, MIDI Synthesizer Chip, input mixture circuitry to mix CD audio input with LINE IN input and microphone input, analog-to-digital converter with a pulse code modulation circuit to convert analog signals to digital to create WAVfiles.



LINEOUT.

Video Content / Details of website for further learning (if any):

[http://www.brainkart.com/article/Digital-Voice-and-Audio\\_10198/](http://www.brainkart.com/article/Digital-Voice-and-Audio_10198/)

<https://www.dpconline.org/handbook/technical-solutions-and-tools/file-formats-and-standards>

Important Books/Journals for further learning including the page nos.:

Andleigh, P. K and Kiran Thakrar, "Multimedia Systems and Design", PHI, 2003,Page No:224-246

<https://www.springer.com/journal/11042>.

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LECTURE HANDOUTS

L-33

CSE

III / VI

Course Name with Code : Computer Graphics-16CSD13

Course Faculty : M GANTHIMATHI

Unit : IV -: Network Security In Multimedia Date of Lecture:

**Topic of Lecture:** Video image and animation

**Introduction : ( Maximum 5 sentences) :**

A video frame grabber is used to capture, manipulate and enhance video images.

A video frame grabber card consists of video channel multiplexer, Video ADC, Input look-up table with arithmetic logic unit, image frame buffer, compression-decompression circuitry, output color look-up table, video DAC and synchronizing circuitry.

**Prerequisite knowledge for Complete understanding and learning of Topic:**

**( Max. Four important topics)**

Input and output technologies

Digital audio and video

**Detailed content of the Lecture:**

**Video Channel Multiplexer:**

A video channel multiplexer has multiple inputs for different video inputs.

The video channel multiplexer allows the video channel to be selected under program control and switches to the control circuitry appropriate for the selected channel in a TV with multi - system inputs.

**Analog to Digital Converter:** The ADC takes inputs from video multiplexer and converts the amplitude of a sampled analog signal to either an 8-bit digital value for monochrome or a 24 bit digital value for colour.

**Input lookup table:** The input lookup table along with the arithmetic logic unit (ALU) allows performing image processing functions on a pixel basis and an image frame basis.

**Image Frame Buffer Memory:** The image frame buffer is organized as a 1024 x 1024 x 24 storage buffer to store image for image processing and display.

**Video Compression-Decompression:** The video compression-decompression processor is used to compress and decompress still image data and video data.

**Frame Buffer Output Lookup Table:** The frame buffer data represents the pixel data and is used to index into the output look up table.

**SVGA Interface:** This is an optional interface for the frame grabber. The frame grabber can be designed to include an SVGA frame buffer with its own output lookup table and digital-to-



analog converter.

**Analog Output Mixer:** The output from the SVGA DAC and the output from image frame buffer DAC is mixed to generate overlay output signals.

### **Video and Still Image Processing**

Video image processing is defined as the process of manipulating a bit map image so that the image can be enhanced, restored, distorted, or analyzed.

**Pixel point to point processing:** In pixel point-to-point processing, operations are carried out on individual pixels one at a time.

**Histogram Sliding:** It is used to change the overall visible effect of brightening or darkening of the image.

**Histogram Stretching and Shrinking:** It is to increase or decrease the contrast.

In histogram shrinking, the brighter pixels are made less bright and the darker pixels are made less dark.

**Pixel Threshold:** Setting pixel threshold levels set a limit on the bright or dark areas of a picture. Pixel threshold setting is also achieved through the input lookup table.

### **Inter- frame image processing**

Inter- frame image processing is the same as point-to-point image processing, except that the image processor operates on two images at the same time. The equation of the image operations is as follows: Pixel output  $(x, y) = (\text{Image 1}(x, y)$

Operator  $(\text{Image 2}(x, y)$

**Image Averaging:** Image averaging minimizes or cancels the effects of random noise.

**Image Subtraction:** Image subtraction is used to determine the change from one frame to the next for image comparisons for key frame detection or motion detection.

**Logical Image Operation:** Logical image processing operations are useful for comparing image frames and masking a block in an image frame.

**Spatial Filter Processing** The rate of change of shades of gray or colors is called spatial frequency.

**Low Pass Filter:** A low pass filter causes blurring of the image and appears to cause a reduction in noise.

**High Pass Filter:** The high-pass filter causes edges to be emphasized. The high-pass filter attenuates low-spatial frequency components, thereby enhancing edges and sharpening the image.

**Laplacian Filter:** This filter sharply attenuates low-spatial-frequency components without affecting and high-spatial frequency components, thereby enhancing edges sharply.

**Frame Processing** Frame processing operations are most commonly for geometric operations, image transformation, and image data compression and decompression. Frame processing operations are very compute intensive many multiply and add operations, similar to spatial filter convolution operations.

**Image scaling:** Image scaling allows enlarging or shrinking the whole or part of an image.

**Image rotation:** Image rotation allows the image to be rotated about a center point.

pixel output  $(x, y) = \text{pixel input } (x \cos Q + y \sin Q, -x \sin Q + Y \cos Q)$  where,  $Q$  is the orientation angle  $x, y$  are the spatial co-ordinates of the original pixel.

**Image translation:** Image translation allows the image to be moved up and down or side to side. Again, this function can be used for animation.

**The translation formula is:**

Pixel output  $(x, y) = \text{Pixel Input } (x + Tx, y + Ty)$  where

**Image transformation:** An image contains varying degrees of brightness or colors defined by the spatial frequency. **Image Animation Techniques**

**Animation:** Animation is an illusion of movement created by sequentially playing still image frames at the rate of 15-20 frames per second.

**Toggling between image frames:** We can create simple animation by changing images at display time. The simplest way is to toggle between two different images. This approach is good to indicate a "Yes" or "No" type situation.

**Rotating through several image frames:** The animation contains several frames displayed in a loop. Since the animation consists of individual frames, the playback can be paused and resumed at any time.

**Video Content / Details of website for further learning (if any):**

[http://www.brainkart.com/article/Digital-Voice-and-Audio\\_10198/](http://www.brainkart.com/article/Digital-Voice-and-Audio_10198/)

<https://www.dpconline.org/handbook/technical-solutions-and-tools/file-formats-and-standards>

**Important Books/Journals for further learning including the page nos.:**

Andleigh, P. K and Kiran Thakrar, "Multimedia Systems and Design", PHI, 2003,Page No:247-260  
<https://www.springer.com/journal/11042>.

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L-34

LECTURE HANDOUTS

CSE

III /VI

Course Name with Code : Computer Graphics-16CSD13

Course Faculty : M GANTHIMATHI

Unit : IV -: Network Security In Multimedia Date of Lecture:

**Topic of Lecture:** Full motion video

**Introduction : ( Maximum 5 sentences ) :**

Most modern cameras use a CCD for capturing the image.

HDTV video cameras will be all-digital, and the capture method will be significantly different based on the new NTSC HDTV Standard.

**Prerequisite knowledge for Complete understanding and learning of Topic:  
( Max. Four important topics)**

Input and output technologies

Digital audio and video

Video image and animation

**Detailed content of the Lecture:**

### Full-Motion Video Controller Requirements

**Video Capture Board Architecture:** A full-motion video capture board is a circuit card in the computer that consists of the following components:

- (i) Video input to accept video input signals.
- (ii) S- Video input to accept RS 170 input.
- (iii) Video compression-decompression processor to handle different video compression-decompression algorithms for video data.
- (iv) Audio compression-decompression processor to compress and decompress audio data.
- (v) Analog to digital converter.
- (vi) Digital to analog converter.
- (vii) Audio input for stereo audio LINE IN, CD IN.
- (viii) Microphone.

A video capture board can handle a variety of different audio and video input signals and convert them from analog to digital or digital to analog.

**Video Channel Multiplexer:** It is similar to the video grabber's video channel multiplexer.

**Video Compression and Decompression:** A video compression and decompression processor is used to compress and decompress video data.

The video compression and decompression processor contains multiple stages for compression and decompression.

The stages include forward discrete cosine transformation and inverse discrete cosine transformation, quantization and inverse quantization, ZigZag and Zero run-length encoding and decoding, and motion estimation and compensation.

**Audio Compression:** MPEG-2 uses adaptive pulse code modulation (ADPCM) to sample the audio signal.

The method takes a difference between the actual sample value and predicted sample value.

The difference is then encoded by a 4-bit value or 8-bit value depending upon the sample rate

**Analog to Digital Converter:** The ADC takes inputs from the video switch and converts the amplitude of a sampled analog signal to either an 8-bit or 16-bit digital value.

**Video Content / Details of website for further learning (if any):**

[http://www.brainkart.com/article/Full-Motion-Video\\_10199/](http://www.brainkart.com/article/Full-Motion-Video_10199/)

<https://www.dpconline.org/handbook/technical-solutions-and-tools/file-formats-and-standards>

**Important Books/Journals for further learning including the page nos.:**

Andleigh, P. K and Kiran Thakrar, "Multimedia Systems and Design", PHI, 2003,Page No:260-264.

<https://www.springer.com/journal/11042>.

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L-35

## LECTURE HANDOUTS

CSE

III /VI

**Course Name with Code** : Computer Graphics-16CSD13

**Course Faculty** : M GANTHIMATHI

**Unit** : IV -: Network Security In Multimedia **Date of Lecture:**

**Topic of Lecture:** storage and retrieval technologies

**Introduction : ( Maximum 5 sentences) :**

Multimedia systems require storage for large capacity objects such as video, audio and images.

Another requirement is delivery of audio and video objects.

Storage technologies include battery powered RAM, Nonvolatile flash, rotating magnetic disk drives, and rotating optical disk drives

**Prerequisite knowledge for Complete understanding and learning of Topic:**

**( Max. Four important topics)**

Input and output technologies

Digital audio and video

Video image and animation

Full motion video

**Detailed content of the Lecture:**

**MAGNETIC MEDIA TECHNOLOGY**

Magnetic hard disk drive storage is a mass storage medium.

It has advantages of its continual reduction in the price per mega byte of high-capacity storage. It has high capacity and is available at low cost.

**HARD DISK TECHNOLOGY**

Magnetic hard disk storage remains a much faster mass storage to play an important role in multimedia systems.

It remains a much faster mass storage medium than any other mass storage medium.

**ST506 and MFM Hard drives:** ST506 is an interface that defines the signals and the operation of signals between a hard disk controller and the hard disk. It is developed by Seagate. It is used to control platter speed and the movement of heads for a drive.

**ESDI Hard Drive:** ESDI (Enhanced Small Device Interface) was developed by a consortium of several manufacturers. It converts the data into serial bit streams.

**IDE:** Integrated Device Electronics (IDE) contains an integrated controller with drive.

The interface is a 16-bit parallel data interface. The IDE interface supports two IDE drives. One is master drive and the other is slave drive. Here, jumper setting is required. The transfer rate is 8 MHz at bus speed.

**New Enhanced IDE Interface**

This new interface has a transfer rate of 9-13 M Bytes/Sec with maximum capacity around 8 GB. It supports up to four drives CD ROM and tape drives.

## SCSI (Small Computer System Interface)

It is an ANSI X3T9.2 standard which supports SCSI and SCSI2 Standards. The Standard defines both software and hardware.

**SCSI-I:** It defines an 8-bit parallel data path between host adapter and device.

## RAID (Redundant Array of Inexpensive Disks)

It is an alternative to mass storage for multimedia systems that combines throughput speed and reliability improvements.

RAID is an array of multiple disks. In RAID the data is spread across the drives. It achieves fault tolerance, large storage capacity and performance improvement.

### RAID Level 0 Disk Striping

It spreads data across drives. Data is striped to spread segments of data across multiple drives. Data striping provides high transfer rate. Mainly, it is used for database applications.

RAID level 0 provides performance improvement. It is achieved by overlapping disk reads and writes. Overlapping here means, while segment 1 is being written to drive 1, segment 2 writes can be initiated for drive 2.

### RAID Level 1 Disk Mirroring

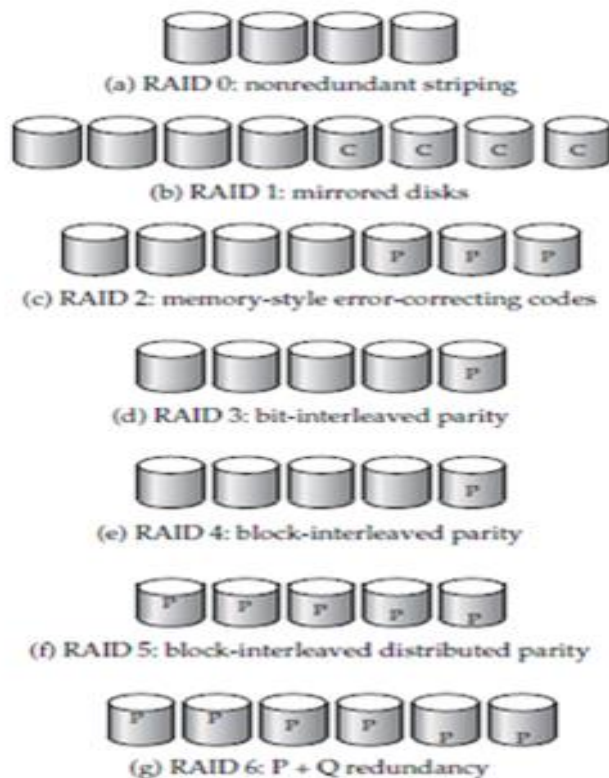
The Disk mirroring causes two copies of every file to be written on two separate drives. (Data redundancy is achieved).

**RAID Level 2, - Bit interleaving of Data:** It contains arrays of multiple drives connected-to a disk array controller.

**RAID Level-3 Parallel Disk Array:** RAID 3 subsystem contains an array of multiple data drives and one parity drive, connected to a disk array controller.

**RAID Level-4 Sector Interleaving:** Sector interleaving means writing successive sectors of data on different drives.

**RAID Level-5 Block Interleaving:** In RAID Level5, as in all the other RAID systems, multiple drives are connected to a disk array controller.



**Figure 11.4** RAID levels.

## Optical Media

CD ROM, WORM (Write once, Read many) and rewritable optical systems are optical drives. CD-ROMs have become the primary media of choice for music due to the quality of sound. WORMs and erasable optical drives both use lasers to pack information densely on a removable disk.

Optical Media can be classified by technology as follows:

CD-ROM - Compact Disc Read Only Memory

WORM - Write Once Read Many

Rewritable - Erasable

Multifunction - WORM and Erasable.

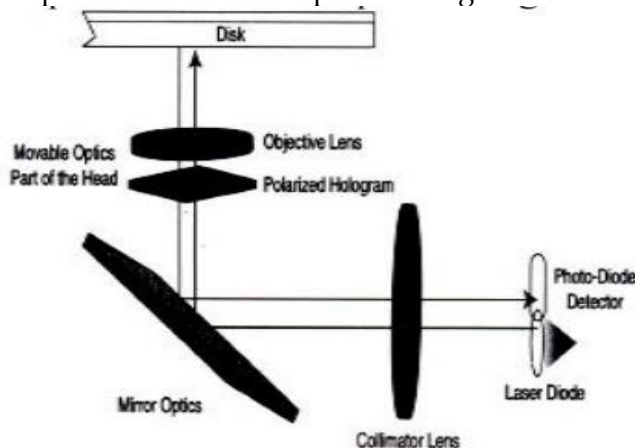
## CD-ROM

### Physical Construction of CD ROMs:

- It consists of a polycarbonate disk. It has 15 mm spindle hole in the center. The polycarbonate substrate contains lands and pits.
- The space between two adjacent pits is called a land. Pits, represent binary zero, and the transition from land to pits and from pits to land is represented by binary one.
- The polycarbonate substrate is covered by reflective aluminium or aluminium alloy or gold to increase the reflectivity of the recorded surface.
- The reflective surface is protected by a coat of lacquer to prevent oxidation. A CD-ROM consists of a single track which starts at the center from inside and spirals outwards.
- The data is encoded on this track in the form of lands and pits. A single track is divided into equal length sectors and blocks.

**Magnetic Disk Organization:** Magnetic disks are organized by CYlinder, track and sector. Magnetic hard disks contain concentric circular tracks. They are divided into sector.

Component of rewritable phase change cd-rom



### Video Content / Details of website for further learning (if any):

[http://www.brainkart.com/article/Storage-and-Retrival-Technology\\_10200/](http://www.brainkart.com/article/Storage-and-Retrival-Technology_10200/)

<https://www.dpconline.org/handbook/technical-solutions-and-tools/file-formats-and-standards>

### Important Books/Journals for further learning including the page nos.:

Andleigh, P. K and Kiran Thakrar, "Multimedia Systems and Design", PHI, 2003,Page no : 266-321

<https://www.springer.com/journal/11042>.

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**LECTURE HANDOUTS**

L-36

**CSE**

**III / VI**

**Course Name with Code : Computer Graphics-16CSD13**  
**Course Faculty : M GANTHIMATHI**  
**Unit : IV -: Network Security In Multimedia Date of Lecture:**

<p><b>Topic of Lecture:</b> Multimedia authoring and user interface</p>
<p><b>Introduction : ( Maximum 5 sentences) :</b>          Multimedia authoring systems are designed with two primary target users: They are          (i) Professionals who prepare documents, audio or sound tracks, and full motion video clips for wide distribution.          (ii) Average business users preparing documents, audio recordings, or full motion video clips for stored messages' or presentations.</p>
<p><b>Prerequisite knowledge for Complete understanding and learning of Topic:</b>  <b>( Max. Four important topics)</b></p> <ul style="list-style-type: none"> <li>➤ Input and output technologies</li> <li>➤ Digital audio and video</li> <li>➤ Video image and animation</li> <li>➤ Full motion video</li> </ul>
<p><b>Detailed content of the Lecture:</b>  <b>Design Issues for Multimedia Authoring</b>          Enterprise wide standards should be set up to ensure that the user requirements are fulfilled with good quality and made the objects transferable from one system to another.          Set for a number of design issues</p> <ol style="list-style-type: none"> <li>1. Display resolution</li> <li>2. Data formula for capturing data</li> <li>3. Compression algorithms</li> <li>4. Network interfaces</li> <li>5. Storage formats.</li> </ol> <p><b>Display resolution:</b>A number of design issues must be considered for handling different display outputs. They are:          (a) Level of standardization on display resolutions.          (b) Display protocol standardization.          (c) Corporate norms for service degradations          (d) Corporate norms for network traffic degradations</p> <p><b>File Format and Data Compression Issues</b>          There are variety of data formats available for image, audio, and full motion video objects. Since the varieties are so large, controlling them becomes difficult. So we should not standardize on a single format. Instead, we should select a set for which reliable conversion application tools are available.</p> <ol style="list-style-type: none"> <li>(i) Compression type (ii) Size of the object</li> <li>(iii) Object orientation (iv)Data and time of creation</li> <li>(v) Source file name (vi)Version number (if any)</li> <li>(vii) Required software application to display or playback the object.</li> </ol> <p><b>Service degradation policies:</b> Setting up Corporate norms for network traffic degradation is difficult as they relate to resolution Issues:</p>



To address these design issues, several policies are possible. They are:

1. Decline further requests with a message to try later.
2. Provide the playback server but at a lower resolution.
3. Provide the playback service at full resolution but, in the case of sound and full motion video, drop intermediate frames.

### **Design Approach to Authoring**

Designing an authoring system spans a number of design issues. They include:

Hypermedia application design specifics, User Interface aspects, Embedding/Linking streams of objects to a main document or presentation, Storage of and access to multimedia objects. Playing back combined streams in a synchronized manner.

A good user interface design is more important to the success of hypermedia applications.

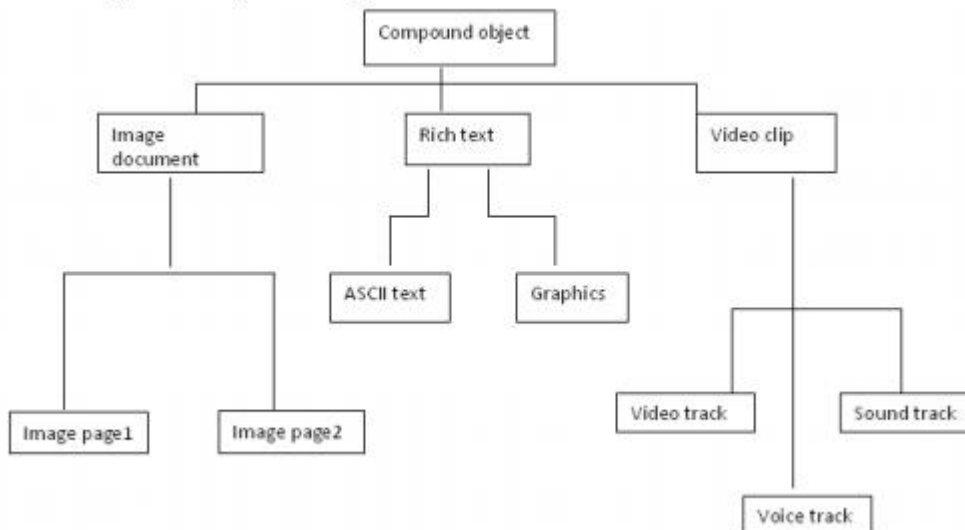
### **Types of Multimedia Authoring Systems**

- Dedicated Authority Systems
- TimeLine -based authoring
- Structured Multimedia Authoring
- Programmable Authoring Systems
- Multisource Multi-user Authoring Systems
- Telephone Authoring systems

### **Types and Object Hierarchies**

Object types are related with various attributes and representations of the objects. The nature of the information structure determines the functions that can be performed on that information set. The object hierarchy defines a contained-in relationship between objects. The manner in which this hierarchy is approached depends on whether the document is being created or played back.

**Example of an Object Hierarchy**



Users need the ability to search for an object knowing very little about the object. Hypermedia application design should allow for such searches.

The user interface with the application depends on the design of the application, particularly the navigation options provided for the user.

### **Designing user Interfaces**

User Interface should be designed by structured following design guidelines as follows:

- 1.Planning the overall structure of the application
- 2.Planning the content of the application
- 3.Planning the interactive behavior
- 4.Planning the look and feel of the application

### **Three Dimensional Object Display and VR(Virtual Reality)**

Number of 3D effects are used in home entertainment a advanced systems used for specialized applications to achieve find the results.

Let us review the approaches in use to determine the impact 0 multimedia display system design due to these advanced systems.

**Planar Imaging Technique:** The planar imaging technique, used in computer-aided tomography (CAT Scan) systems, displays a two dimensional cut of X-ray images through multidimensional data specialized display techniques try to project a 3D image constructed from the 2D data.

An important design issue is the volume of data being displayed (based on the image resolution and sampling rate) and the rate at which 3D renderings need to be constructed to ensure a proper time sequence for the changes in the data.

Computed tomography has a high range of pixel density and can be used for a variety of applications. Magnetic resonance imaging, on the other hand, is not as fast, nor does it provide as high a pixel density as CT. Ultrasound is the third technique used for 3D imaging in the medical and other fields. .

**Video Content / Details of website for further learning (if any):**

[http://www.brainkart.com/article/Storage-and-Retrival-Technology\\_10200/](http://www.brainkart.com/article/Storage-and-Retrival-Technology_10200/)

<https://www.dpconline.org/handbook/technical-solutions-and-tools/file-formats-and-standards>

**Important Books/Journals for further learning including the page nos.:**

Judith Jeffcoate, Multimedia in practice technology and Applications, PHI, 2007,Page no:433-450

<https://www.springer.com/journal/11042>.

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L-37

## LECTURE HANDOUTS

CSE

IV/VIII

Course Name with Code :16CSD13- Computer Graphics

Course Faculty :M GANTHIMATHI

Unit : V - Real World Applications In Multimedia Date of Lecture:

**Topic of Lecture:** Hypermedia messaging

**Introduction :** It is an next version of hypertext which contains different forms of media like, graphics, text, audio, video and moving graphics

**Prerequisite knowledge for Complete understanding and learning of Topic:**

To know about the concepts of hypertext and multimedia.

**Detailed content of the Lecture:**

Messaging is one of the major multimedia applications. Messaging started out as a simple text based electronic mail application. Multimedia components have made messaging much more Complex.

**Text with links**

Concept for manipulating computer-based documents:

- Presentation, access, and structuring
  - not strictly sequential
  - anchors and links allowing jumps to internal parts as well as to external documents  
*made possible by computers and networks*
- Storing
  - physically distributed (geography independence)

**Hypermedia messaging**

- Vendor-independent messaging (VIM) standard
  - providing seamless interface between applications
  - defining data exchange format (message headers)
  - providing address book services
- Internet messaging
  - Simple Mail Transfer Protocol (SMTP)
  - IP domains (addresses) used for user identification
  - Multipurpose Internet Mail Extensions (MIME) for multimedia support

**Hypermedia:**

- It is an next version of hypertext which contains different forms of media like, graphics, text, audio, video and moving graphics etc.
- There is similarity in the structure of both hypermedia and hypertext.
- The common hypermedia link is image link which can take the user to the other page.
- It is used in a variety of applications from problem solving and qualitative research to electronic studying and sophisticated learning.

Components are added to messages.

### **Hypermedia Messaging**

- Mobile messaging represents a major new dimension in the users interaction with the messaging system.
- With the emergence of remote access from users using personal digital assistants and notebook computers, made possible by wireless communications developments supporting wide ranging access using wireless modems and cellular telephone links, mobile messaging has significantly influence messaging paradigms.
- Handheld and desktop devices play an important growth area for messaging,
- Require complementary back-end services to effectively manage communications for large organizations.
- Hypermedia messaging is not restricted to the desktops; it is increasingly being used on the road through mobile communications in metaphors very different from the traditional desktop metaphors.

### **Video Content / Details of website for further learning (if any):**

<https://www.slideshare.net/nirmalbj/hypermedia-messageing>

[https://www.brainkart.com/article/Hyper-Media-Messaging\\_10204/](https://www.brainkart.com/article/Hyper-Media-Messaging_10204/)

### **Important Books/Journals for further learning including the page nos.:**

1. Andleigh, P. K and Kiran Thakrar, "Multimedia Systems and Design", PHI, 2003. PAGE NO: 474-482
2. Judith Jeffcoate, Multimedia in practice technology and Applications, PHI, 2007.

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L-38

## LECTURE HANDOUTS

CSE

IV/VIII

**Course Name with Code :16CSD13- Computer Graphics**

**Course Faculty :M GANTHIMATHI**

**Unit : V - Real World Applications In Multimedia Date of Lecture:**

**Topic of Lecture:** Mobile messaging

**Introduction :** Mobile messaging represents a major new dimension in the users interaction with the messaging system. With the emergence of remote access from users using personal digital assistants and notebook computers, made possible by wireless communications developments supporting wide ranging access using wireless modems and cellular telephone links, mobile messaging has significantly influence messaging paradigms.

**Prerequisite knowledge for Complete understanding and learning of Topic:**

To know about the concepts of messaging and its techniques.

Detailed content of the Lecture:

Messaging is one of the major multimedia applications. Messaging started out as a simple text based electronic mail application. Multimedia components have made messaging much more Complex.

Mobile Messaging:

Mobile Messaging breaks down the communication barrier between businesses and their customers using a centralized, multi-channel platform to deliver messages in real time.

- Supports text messaging (SMS), multimedia messaging (MMS), Facebook Messenger, WeChat, voice calling, push notification, and chatbots
- Proactively validates phone numbers in your contact database to reduce Telephone Consumer Protection Act (TCPA) risk exposure
- Manages customer consent, including opt-in and opt-out tracking
- Offers one-way and two-way capability
- Provides message template customization based on business function
- Translates to local languages
- Features a use-case testing environment to shift ideas from proof-of-concept to production
- Cascades message delivery based on customer responses
- Integrates compliance and security features
- Monitors messaging traffic to provide global, real-time, automated alerting
- Expands into new channels such as Rich Communication Services (RCS)

- Supported by our strategy and professional services teams who can offer customized program implementation
- Complies with financial audit standards

**Advantages :**

Mobile Messaging places the power of multi-channel communication in your hands.

- Mobile messaging represents a major new dimension in the users interaction with the messaging system.
- With the emergence of remote access from users using personal digital assistants and notebook computers, made possible by wireless communications developments supporting wide ranging access using wireless modems and cellular telephone links, mobile messaging has significantly influence messaging paradigms.
- Handheld and desktop devices play an important growth area for messaging,
- Require complementary back-end services to effectively manage communications for large organizations.
- Hypermedia messaging is not restricted to the desktops; it is increasingly being used on the road through mobile communications in metaphors very different from the traditional desktop metaphors.

**Video Content / Details of website for further learning (if any):**

<https://www.syniverse.com/products/mobile-messaging>

<https://journals.sagepub.com/doi/full/10.1177/2050157919852392>

**Important Books/Journals for further learning including the page nos.:**

1. Andleigh, P. K and Kiran Thakrar, "Multimedia Systems and Design", PHI, 2003. PAGE NO: 473-474
2. Sage journals Mobile Media & Communication

**Course Faculty**

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**Course Name with Code :16CSD13- Computer Graphics**

**Course Faculty :M GANTHIMATHI**

**Unit : V - Real World Applications In Multimedia Date of Lecture:**

**Topic of Lecture:** Hypermedia message component

**Introduction :**

hypermedia message may be a simple message in the form of text with an embedded graphics and it consists of following components Text Messages, Typical Electronic mail message, Rich-Text Messages, Voice Messages, Audio' (Music), Full-Motion Video Management, Full-Motion Video Management ect..

**Prerequisite knowledge for Complete understanding and learning of Topic:**

Need Knowledge about Hypermedia and graphics.

**Detailed content of the Lecture:**

- Hypermedia message may be a simple message in the form of text with an embedded graphics, sound track, or video clip, or it may be the result of analysis of material based books, CD ROMs, and other on-line applications.
- An authoring sequence for a message based on such analysis may consist of the following components.

**Text Messages**

In earlier days, messaging systems used a limited subset of plain ASCII text. Later, messaging systems were designed to allow users to communicate using short messages. Then, new messaging standards have added on new capabilities to simple messages. They provide various classes of service and delivery reports.

**Typical Electronic mail message**

Other capabilities of messaging systems includ~ a name and address directory of all users accessible to the messaging system.

**Rich-Text Messages**

- Microsoft defined a standard for exporting and importing text data that included character set, font table, section and paragraph formatting, document formatting, and color information- called Rich Text Format (RTF),
- This standard is used for storage as well as Import and export of text files across a variety of word-processing and messaging systems.
- When sections of this document are cut and pasted into another application, the font and

formatting information is retained.

- This allows the target application to display the text in the nearest equivalent fonts and formats.
- Rich-text messages based on the RTF formats provide the capability to create messages in one word processor and edit in another at the recipient end.

### **Voice Messages**

Voice mail systems answer telephones using recorded messages and direct the caller through a sequence of touch tone key operations until the caller is connected to the desired party or is able to leave a recorded message.

### **Audio (Music)**

The Musical Instrument Digital interface (MIDI) was developed initially by the music industry to allow computer control of and music recordings from musical instruments such as digital pianos and electric keyboards. MIDI interfaces are now being used for a variety of peripherals, including digital pianos, digital organs, video games with high-fidelity sound output, and business presentations.

### **Full-Motion Video Management**

Use of full-motion video for information repositories and memos are more informative. More information can be conveyed and explained in a short full-motion video clip than can be conveyed in a long text document. Because a picture is equivalent to thousand words.

### **Full Motion video Authoring System**

An authoring system is an important component of a multimedia messaging system. A good authoring system must provide a number of tools for the creation and editing of multimedia objects. The subset of tools that are necessary are listed below:

1. A video capture program - to allow fast and simple capture of digital video from analog sources such as a video camera or a video tape.
2. Compression and decompression Interfaces for compressing the captured video as it is being captured.
3. A video editor with the ability to decompress, combine, edit, and compress digital video clips.
4. Video indexing and annotating software for marking sections of a videoclip and recording annotations. Identifying and indexing video clips for storage.

### **Full-Motion Video Playback Systems**

The playback system allows the recipient to detach the embedded video reference object, Interpret its contents and retrieve the actual video clip from a specialized video server and launch the Playback application. A number of factors are involved in playing back the video correctly.

They are:

1. How the compression format used for the storage of the video clip relates to the available hardware and software facilities for decompression.
2. Resolution of the screen and the system facilities available for managing display windows. The display resolution may be higher or lower than the resolution of the source of the video clip.
3. The CPU processing power and the expected level of degradation as well as managing the degraded output on the fly.
4. Ability to determine hardware and software facilities of the recipient's system, and adjusting playback, parameters to provide the best resolution and performance on playback.

The three main technologies for playing full motion video are Microsoft's video for windows, Apple's Quicktime, and Intel's Indeo.

### **Full-Motion Video Management**

- It is the most common environment for multimedia messaging.
- VFW provides capture, edit, and playback tools for full-motion video. The tools provided by VFW are: The VidCap tool, designed for fast digital video capture.
- The VidEdit tool designed for decompression, edition, and compressing full-motion digital video.
- The VFW playback tool.



- The VFW architecture uses OLE. With the development of DDE and OLE, Microsoft introduced in windows the capability to link or multimedia objects in a standardized manner.
- Hence variety; windows based applications can interact with them. We can add full-motion video to any windows-based application with the help of VFW. The VFW playback tool is designed to use a number of codecs (software encoder/decoders) for decompressing and playing video files.

#### **Apple's QuickTime**

An Apple QuickTime product is also an integrated system for playing back video files. The QuickTime product supports four compression methodologies.

#### **Intel's Indeo**

Indeo is a digital video recording format. It is a software technology that reduces the size of un compressed video files through successive compression methodologies, including YUV sub sampling, vector quantization, Huffman's run-length encoding, and variable content encoding. Indeo technology is designed to be scalable for playing back video; It determines the hardware available and optimizes playback for the hardware by controlling the frame rate.

#### **Video Content / Details of website for further learning (if any):**

[https://www.brainkart.com/article/Hypermedia-Message-Components\\_10205/](https://www.brainkart.com/article/Hypermedia-Message-Components_10205/)

<https://www.ewh.ieee.org/soc/es/Nov1998/07/BEGIN.HTM>

#### **Important Books/Journals for further learning including the page nos.:**

1. Andleigh, P. K and Kiran Thakrar, "Multimedia Systems and Design", PHI, 2003. PAGE NO: 480-482
2. Journal of Network and Computer Applications

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LECTURE HANDOUTS

L-40

CSE

IV/VIII

Course Name with Code :16CSD13- Computer Graphics

Course Faculty :M GANTHIMATHI

Unit : V - Real World Applications In Multimedia Date of Lecture:

**Topic of Lecture:** Creating hypermedia message

### Introduction :

Hypermedia message is a complex collection of a variety of objects. A hypermedia report is more complex. It requires the following steps: Planning Creating each component and Integrated multimedia message standards..

### Prerequisite knowledge for Complete understanding and learning of Topic:

Students should have the knowledge about hypermedia, and various message involved in hypermedia and multimedia and various integrating components.

### Detailed content of the Lecture:

Hypermedia message is a complex collection of a variety of objects.

It is an integrated message consisting of text, rich text, binary files, images, bitmaps. voice and sound, and full motion video. Creating of a hypermedia message requires some preparation. A hypermedia report is more complex. It requires the following steps:

1. Planning
2. Creating each component
3. Integrating components

### Planning:

The planning phase for preparing the hypermedia message consists of determining the various sources of input. These can include any of the following:

1. A text report prepared in a word-processing system.
2. A spreadsheet in a spreadsheet program.
3. Some diagrams from a graphics program.
4. Images of documents.
4. Sound clips.
5. Video clips.

We should determine which components are required for the message, in what sequence should they be, and where in the text report they should be referenced. The length of each component should be

determined. Careful planning is necessary to ensure that the capabilities of the messaging system are used appropriately.

Creating each component:

- Each component must be created using the authoring tool provided by the application used for creating it.
- All applications Involved in creating various components must have common formats to allow combining these various components.
- The various components must be authored, reviewed, and edited as needed, checked for smooth flow when the user launches an embedded object and stored in the final format in which it will become a part of the hypermedia message.
- The final step in this process is mailing the hypermedia message.

Integrating components:

- Integrated multimedia message standards: As text-based technologies have progressed and have become increasingly integrated with messaging systems, new standards are being developed to address interoperability of application from different software vendors.
- Finally it integrate all the medias and it visible as asingle image by Integrating components

**Video Content / Details of website for further learning (if any):**

<https://www.infoq.com/presentations/spring-boot-rest-microservices/>

<https://slideplayer.com/slide/2505976/>

[https://www.brainkart.com/article/Creating-Hypermedia-Messages\\_10206](https://www.brainkart.com/article/Creating-Hypermedia-Messages_10206)

**Important Books/Journals for further learning including the page nos.:**

1. Andleigh, P. K and Kiran Thakrar, "Multimedia Systems and Design", PHI, 2003. PAGE NO: 482-483
2. <https://pdfs.semanticscholar.org/8574/153f17154ae96d67a287188511ae72264117.pdf>
3. <https://www.ewh.ieee.org/soc/es/Nov1998/07/BEGIN.HTM>

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L-41

## LECTURE HANDOUTS

CSE

IV/VIII

Course Name with Code :16CSD13- Computer Graphics

Course Faculty :M GANTHIMATHI

Unit : V - Real World Applications In Multimedia Date of Lecture:

**Topic of Lecture:** Integrated multimedia message standards

**Introduction :** An integrated messaging system uses existing messaging equipment to receive, store, retrieve and manage messages in media types and formats appropriate to each existing system using protocols which are specific to that system. Two or more systems are tightly coupled in that a message received in one system can be accessed from all systems.

**Prerequisite knowledge for Complete understanding and learning of Topic:**

To have the knowledge about integrated equipment standards and it working principles

**Detailed content of the Lecture:**

Integrated Multimedia Message Standards are :

**Vendor Independent Messaging (VIM)**

- VIM interface is designed to facilitate messaging between VIM. enabled electronic mail systems as well as other applications.
- The VIM interface makes mail and messages services available through a well defined interface.
- A messaging service enables its clients to communicate with each other in a store-and-forward manner.
- VIM-aware applications may also use one-or-more address books.
- Address books are used to store information about users, groups, applications, and so on.

**VIM Messages:**

- VIM defines messaging as a stored-and-forward method of application-to-application all program to- program data exchange. The objects transported by a messaging system are called messages.
- The message, along with the address is sent to the messaging system. The messaging system providing
- VIM services accept the responsibility for routing and delivering the message to the message container of the recipient.

**Message Definition:**

- Each message has a message type. The message type defines the syntax of the message and the type of information that can be contained in the message.
- A VIM message consists of message header. It may contain one or more message items. The
- message header consists of header attributes: recipient address, originator address, time/date prior
- A message item is a block of arbitrary-sized (means any size) data of a defined type.

- The contents of the data block are defined by the data-item type.
- The actual items in a message and its syntax and semantics are defined by the message type.
- Message may also contain file attachments. VIM allows the nesting of messages; means one message may be enclosed in another message.
- A VIM message can be digitally signed so that we can ensure that the message 'received is without any modification during the transit.

**Mail Message:** It is a message of a well-defined type that must include a message header and may include note parts, attachments, and other application-defined components. End users can see their mail messages through their mail programs.

**Message Delivery:** If message is delivered successfully, a delivery report is generated and send to the sender of the message if the sender requested the delivery report. If a message is not delivered, a non-delivered report is sent to the sender.

A message that delivered will be in a message container will be marked as 'unread', until the recipient open and read it.

**Message Container:** Multiple users or applications can access one message container. Each message in a message container has a reference number associated with it for as long as the message remains stored in the message container.

**VIM Services:** The VIM interface provides a number of services for creating and mailing a message. Some of them are:

- Electronic message composition and submission.
- Electronic message sending and receiving.
- Message extraction from mail system.
- Address book services.

The VIM interface defines two calls for message sending. The SMISendDocuments() call may be used by applications such as spread sheets and word processing to send spreadsheets or word processing documents to one or more users.

The VIM interface also provides more extensive support for programmers to develop mail-aware and messaging applications that use application specific messages containing text graphic, images, audio , video and file attachenments.

#### **MAPI Support (Multimedia Application Programmable Interface)**

MAPI provides a layer of functionality between applications and underlying messaging systems. The primary goals of MAPI are: Separate client applications from the underlying messaging services. Make basic mail enabling a standard feature for all applic ations. Support message-reliant workgroup applications.

#### **Video Content / Details of website for further learning (if any):**

<https://slideplayer.com/slide/2505976/>

<https://www.ukessays.com/essays/information-technology/role-of-multimedia-in-todays= society-information- technology-essay.php>

#### **Important Books/Journals for further learning including the page nos.:**

Andleigh, P. K and Kiran Thakrar, "Multimedia Systems and Design", PHI, 2003. PAGE NO: 483-488

<https://dl.acm.org/citation.cfm?id=331129>

<https://dl.acm.org/doi/10.1145/957013.957114>

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## LECTURE HANDOUTS

L-42

CSE

IV/VIII

Course Name with Code :16CSD13- Computer Graphics

Course Faculty :M GANTHIMATHI

Unit : V - Real World Applications In Multimedia Date of Lecture:

**Topic of Lecture:** Integrated multimedia message standards

**Introduction :** An integrated messaging system uses existing messaging equipment to receive, store, retrieve and manage messages in media types and formats appropriate to each existing system using protocols which are specific to that system. Two or more systems are tightly coupled in that a message received in one system can be accessed from all systems.

**Prerequisite knowledge for Complete understanding and learning of Topic:**

To have the knowledge about integrated equipment standards and it working principles.

**Detailed content of the Lecture:**

**MAPI Support (Multimedia Application Programmable Interface)**

- MAPI provides a layer of functionality between applications and underlying messaging systems.
- The primary goals of MAPI are: Separate client applications from the underlying messaging services. Make basic mail enabling a standard feature for all applications. Support message-reliant workgroup applications.

**MAPI Architecture:** MAPI Architecture provides two perspectives

(i) A client API

(ii) A service provider interface. The Client API provides the link between the client applications And MAPI.

- The service provider interface links MAPI to the messaging system.
- The two interfaces combine to provide an open architecture such that any messaging application can use any messaging service that has a MAPI driver. MAPI drivers are provided by Microsoft or third party developers.

**Telephony API (TAPI)**

TAPI standard has been defined by Microsoft and Intel. The telephone can be used for reading e mail as well as for entering e-mail messages remotely.

**X 400 Message Handling Service**

- The CCITT X 400 series recommendations define the OSI message handling system, (MHS).
- The MHS describes a functional model that provides end users the ability to send and receive electronic messages.

- A Message Transfer Agent (MTA) forwards messages from the originator UA to another MTA.
- A number of MTAs are combine to form Message transfer System (MTS).
- The MTAs in an MTS provide message routing services at intermediate nodes in a WAN.

Figure below shows the overall X 400 architecture and the relationships between the

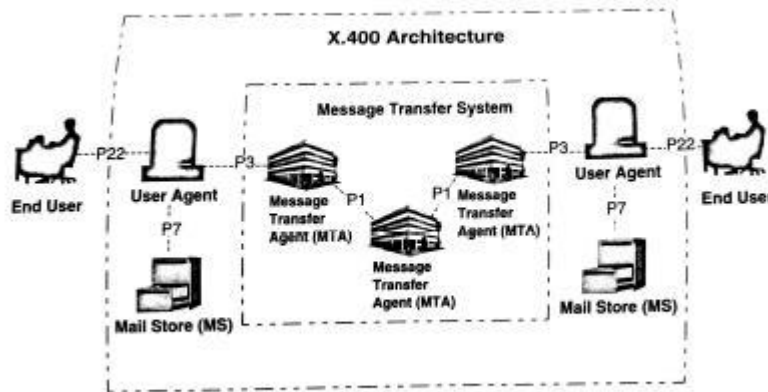


Fig. 9-2 X.400 Architecture

components.

### X 500 Directory System Standards

- The X 500 is the joint International Standard Organization CCITT standard for a distributed directory system that lets users store information such as addresses and databases on a local server and easily query, exchange, and update that information in an interoperable networked environment.
- The X 500 directory structure is described in the CCITT standard known as Data Communications
- Network Directory, Recommendations X 500-X 521, 1988.

### 5 X 500 Directory System Architecture

- Directory System Agents carryout updates and management operations. X 500 defines a structured information model, an objectoriented model and database schema. The X 500 architecture is based on a number of models, as follow

**The information model:** It specifies the contents of directory entries, how they are identified, and the way in which they are organized to form the directory information base.

**The Directory model:** It describes the directory and its users, the functional model for directory operation, and the organization of the directory. .

**The security model:** It specifies the way in which the contents of the directory are protected from unauthorised access and authentication methods for updates.

**X 500 Directory System Components:** All information in an X 500 database is organized as entries in the Directory-Information Base(DIB). The directory system provides agents to manipulate entries in the DIB.

X 500 directories consist of the following basic components:

1. **Directory Information Base (DIB);** The DIB contains information about users, applications, resources and the configuration of the directory that enables servers to locate one another.
2. **Directory User Agents (DUA):** A DUA issues inquiry and update requests, and accesses directory information through the directory access protocol.
3. **Directory Service Agents (DSAs):** DSAs cooperate with one another to resolve user requests over a distributed network. They interact through a specialized protocol called a directory system protocol.

**Video Content / Details of website for further learning (if any):**

<https://slideplayer.com/slide/2505976/>

<https://www.ukessays.com/essays/information-technology/role-of-multimedia-in-todays=society-information-technology-essay.php>

**Important Books/Journals for further learning including the page nos.:**

Andleigh, P. K and Kiran Thakrar, "Multimedia Systems and Design", PHI, 2003. PAGE NO: 488- 492

<https://dl.acm.org/citation.cfm?id=331129>

<https://dl.acm.org/doi/10.1145/957013.957114>

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L-43

## LECTURE HANDOUTS

CSE

IV/VIII

Course Name with Code :16CSD13- Computer Graphics

Course Faculty :M GANTHIMATHI

Unit : V - Real World Applications In Multimedia Date of Lecture:

**Topic of Lecture:** Integrated document management

**Introduction :** A document management system (DMS) is a system used to track, manage and store documents and reduce paper. Most are capable of keeping a record of the various versions created and modified by different users (history tracking). In the case of the management of digital documents such systems are based on computer programs.

**Prerequisite knowledge for Complete understanding and learning of Topic:**

Students should know about various document storing and managing systems for graphics

**Detailed content of the Lecture:**

**Integrated document management :**

- It is for managing integrated documents.
- Integrated document Management for Messaging Specialized messaging system such as Lotus Notes provide Integrated document management for messaging.
- The user can attach embed or link a variety of multimedia objects.
- When document is forwarded to other users, all associated multimedia objects are also forwarded and available to the new receivers of the forward message.

**Integrated Document management for Messaging:**

- Specialized messaging systems such as Lotus Notes provide integrated document management for messaging.
- This means the user can attach , embed, or link a variety of multimedia objects such as graphics, images, audio and video.
- This also implies that when the document is forwarded to other users all associated multimedia objects are also forwarded and available to the new recipients.

**Multimedia Object Server and Mail Server Interactions:**

- The mail server is used to store i'lll e-mail messages.
- It consists of a file server with mail files for each user recipient.
- This file server act as a mail box.
- All received mail is dropped in the user's mail file.
- The user can review or delete these mails.

- When mail messages include references to multimedia objects, mail file contains only link information.

**Video Content / Details of website for further learning (if any):**

<https://www.youtube.com/watch?v=CJM7DZtJlis>

<https://www.youtube.com/watch?v=bnhvMIzMAp8>

**Important Books/Journals for further learning including the page nos.:**

Andleigh, P. K and Kiran Thakrar, "Multimedia Systems and Design", PHI, 2003. PAGE NO: 492-493

<https://www.elsevier.com/journals/isa-transactions/0019-0578/guide-for-authors>

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LECTURE HANDOUTS

L-44

CSE

IV/VIII

Course Name with Code :16CSD13- Computer Graphics

Course Faculty :M GANTHIMATHI

Unit : V - Real World Applications In Multimedia Date of Lecture:

**Topic of Lecture:** Distributed multimedia systems

**Introduction :** A distributed multimedia system (DMS) is an integrated communication, computing, and information system that enables the processing, management, delivery, and presentation of synchronized multimedia information with quality-of-service guarantees

**Prerequisite knowledge for Complete understanding and learning of Topic:**

Student should have an idea about Distributed systems and multimedia system

**Detailed content of the Lecture:**

## DISTRIBUTED MULTIMEDIA SYSTEMS

### Components of a Distributed multimedia systems:

If the multimedia systems are supported by multiuser system, then we call those multimedia systems as distributed multimedia systems.

A multi user system designed to support multimedia applications for a large number of users consists of a number of system components. A typical multimedia application environment consists of the following components:

1. Application software.
2. Container object store.
3. Image and still video store.
4. Audio and video component store.
5. Object directory service agent.
6. component service agent.
7. User interface and service agent.
8. Networks (LAN and WAN).

### Application Software

The application software performs a number of tasks related to a specific business process. A business process consists of a series of actions that may be performed by one or more users. The basic tasks combined to form an application include the following:

**(1) Object Selection** - The user selects a database record or a hypermedia document from a file system, database management system, or document server.

- (2) **Object Retrieval**- The application retrieves the base object.
- (3) **Object Component Display** - Some document components are displayed automatically when the user moves the pointer to the field or button associated with the multimedia object.
- (4) **User Initiated Display** - Some document components require user action before playback/display.
- (5) **Object Display Management and Editing**: Component selection may invoke a component control sub application which allows a user to control playback or edit the component object.

### Document store

A document store is necessary for application that requires storage of large volume of documents. The following describes some characteristics of document stores.

1. **Primary Document Storage**: A file systems or database that contains primary document objects (Container objects). Other attached or embedded documents and multimedia objects may be stored in the document server along with the container object.
2. **Linked Object Storage**: Embedded components, such as text and formatting information, and linked information, and linked components, such as pointers to image, audio, and video. Components contained in a document, may be stored on separate servers.
3. **Linked Object Management**: Link information contains the name of the component, service class or type, general attributes such as size, duration of play for isochronous objects and hardware, and software requirements for rendering.

### Image and still video store

An image and still video is a database system optimized for storage of images. Most systems employ optical disk libraries. Optical disk libraries consist of multiple optical disk platters that are played back by automatically loading the appropriate platter in the drive under device driver control.

The characteristics of image and still video stores are as follows:

- (i) Compressed information
- (ii) Multi-image documents
- (iii) Related annotations
- (iv) Large volumes
- (v) Migration between high-volume such as an optical disk library and high-speed media such as magnetic cache storages
- (vi) Shared access:

### Audio and video Full motion video store

Audio and Video objects are isochronous. The following lists some characteristics of audio and full-motion video object stores:

- (i) Large-capacity file system: A compressed video object can be as large as six to ten M bytes for one minute of video playback.
- (ii) Temporary or permanent Storage: Video objects may be stored temporarily on client workstations, servers Providing disk caches, and multiple audio or video object servers.
- (iii) Migration to high volume/lower-cost media: migration and management of online storage are much of greater importance and more complex than of images.
- (iv) Playback isochronicity: Playing back a video object requires consistent speed without breaks. Multiple shared access objects being played back in a stream mode must be accessible by other users.

### Object Directory Service Agent

The directory service agent is a distributed service that provides a directory of all multimedia objects on the server tracked by that element of the directory service agent.

The following describes various services provided by a directory service Agent.

- (1) Directory Service: It lists all multimedia objects by class and server location.
- (2) Object Assignment: The directory service agent assigns unique identification to each multimedia object.
- (3) Object Status Management: The directory service must track the current usage status of each object.
- (5) Directory Service Domains: The directory service should be modular to allow setting up Directory

Service Server Elements: Each multimedia object server must have directory service element that reside on either server or some other resources.

(6) Network Access: The directory service agent must be accessible from any workstation on the network.

- **Component Service Agent**
- A service is provided to the multimedia used workstation by each multimedia component.
- This service consists of retrieving objects, managing playback of objects, storing objects, and so on.
- The characteristics of services provided by each multimedia component are
  1. **object creating service:** It obtains a identification for creating a new object from the directory service agents and provides user interfaceservice agent access for storing the new object.
  2. **playback service :** It provides services like play, seek,search ,copy, delete and so on.
  3. **component object service agent :**This is the code that provides these services for specific object type such as vide component.
  4. **service agents on servers :** multiple component agents may co resident on a server if the server stores multiple component object.  
and
  5. **multifaceted services** - (multifaceted services component objects may exist in several forms, such as compressed Or uncompressed).
  
- **User Interface Service Agent**
- It resides on each user workstation.
- It provides direct services to the application software for the management of the multimedia object display windows, creation and storage of multimedia objects, and scaling and frame shedding for rendering of multimedia objects.
- The services provided by user interface service agents are
  - **windows management:** creates a new window for multimedia object when invoked and registers it. handles messaes for that window.
  - **object creation and capture:** requests component service agent to set up a new object and captures and stores new object.
  - **object display and playback:** sets up object for decompression, scales and adjusts frame speed for display or playback of object.

Video Content / Details of website for further learning (if any):

<https://www.youtube.com/watch?v=lrYZSqCTnG8>

<https://slideplayer.com/slide/257363/>

Important Books/Journals for further learning including the page nos.:

Andleigh, P. K and Kiran Thakrar, "Multimedia Systems and Design", PHI, 2003. PAGE NO: 495-552

<https://www.igi-global.com/journal/international-journal-mobile-computing-multimedia/1102>

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## LECTURE HANDOUTS

CSE

IV/VIII

Course Name with Code :16CSD13- Computer Graphics

Course Faculty :M GANTHIMATHI

Unit : V - Real World Applications In Multimedia Date of Lecture:

Topic of Lecture: Applications of distributed multimedia system

Introduction : Multimedia applications require functionality beyond the traditional client server architecture.

Prerequisite knowledge for Complete understanding and learning of Topic:  
Student should have an idea about Multimedia system

### Detailed content of the Lecture:

- Multimedia applications require functionality beyond the traditional client server architecture.
- Most client-server systems were designed to connect a client across a network to a server that provided database functions.
- In this case, the client-server link was firmly established over the network. There was only one copy of the object on the specified server. With the development of distributed work group computing, the picture has changed for the clients and servers.
- Actually in this case, there is a provision of custom views in large databases. The advantage of several custom views is the decoupling between the physical data and user.
- The physical organization of the data can be changed without affecting the conceptual schema by changing the distributed data dictionary and the distributed data repository.

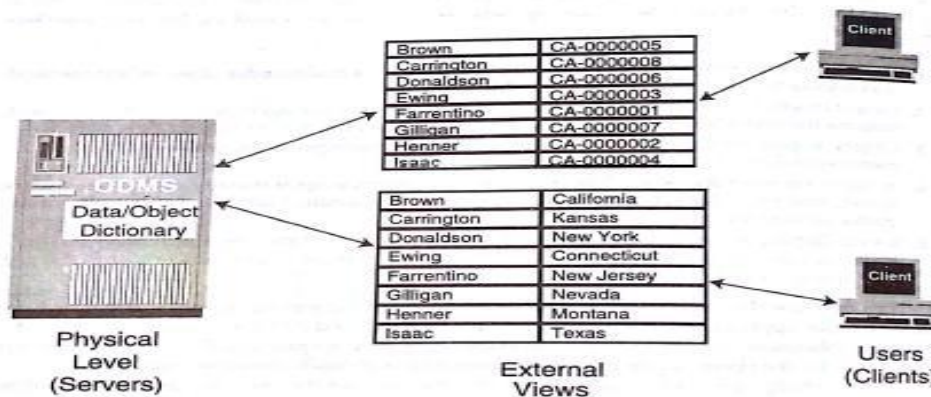


Fig. 10-1 Client-Server Custom Views in Large Databases

### Clients in Distributed Work Group Computing

Clients in distributed workgroup computing are the end users with workstations running multimedia applications. The client systems interact with the data servers in any of the following ways.

1. Request specific textual data.

2. Request specific multimedia objects embedded or linked in retrieved container objects.
3. Require activation of a rendering server application to display/ playback multimedia objects.
4. Create and store multimedia-objects on servers.

Request directory information. on locations of objects on servers

### **Servers in Distributed Workgroup Computing**

Servers are storing data objects. Includes the following functions,

- storage for a variety of object classes,
- transfer objects on demand on clients.
- hierarchical storage for moving unused objects to optical disk libraries or optical tape libraries.
- system Administration functions for backing up stored data.
- direct high-speed LAN and WAN server-to-server Transport for copying multimedia objects.

### **Database Operation:**

Most database systems are used to perform a basic set of operations these includes the following,

- **Search-** find the object in record in response to a query.
- **Browse-** not only retrieve attribute information about object but also render frames of the object contents.
- **Retrieve-** Retrieval functions are different for images , audio, video from symbolic text only database because all three multimedia objects require the retrieved data to be processed by specialized decompression engines before being rendered.
- **Create and Store-** concerned with finding the tables in which the data has to be stored and updating the distributed storage indexing information.
- **Update-** A modification to the existing or previously stored data.

### **Middleware in Distributed Workgroup Computing**

The middleware is like interface between back-end database and front-end clients. The role of middleware is to link back end database to front end clients in a highly flexible and loosely connected network model. Middleware provides the glue for dynamically redirecting client requests to appropriate servers that are on-line.

### **Video Content / Details of website for further learning (if any):**

<https://slideplayer.com/slide/4367454/>

<https://slideplayer.com/slide/5335849/>

<https://studybay.com/blog/multimedia-systems-and-applications-computer/>

### **Important Books/Journals for further learning including the page nos.:**

Andleigh, P. K and Kiran Thakrar, "Multimedia Systems and Design", PHI, 2003. PAGE NO:553-555  
<https://www.igi-global.com/journal/international-journal-mobile-computing-multimedia/1102>

**Course Faculty**

**Verified by HOD**