CHAPTER – 4

Video and Animation

- Both video and animation give us a sense of motion. They exploit some properties of human eye's ability of viewing pictures.
- Motion video is the element of multimedia that can hold the interest of viewers in a presentation.

Basic Concept:

The human eye views pictures and motion pictures. The immanent properties of eye determine, in connection with neural processing some essential conditions related to video systems.

Visual Signal Representation:

In conventional black and white TV sets, the video signal is displayed using a CRT. An electron beam carries corresponding pattern information, such as intensity in a viewed scene.

Video signal representation includes three aspects:

- The Visual Representation
- Transmission and
- Digitization

A. Visual Representation:

- The main objective of visual representation is to offer the viewer as a sense of presence in the scene and of particular in the events portrayed.
- To meet this objective, the televised image should convey spatial and temporal content of the scene.

Important aspects of Visual Representation are –

(1) Visual Detail and Viewing Distance
(2) Horizontal Detail and Picture Width
(3) Total Detail Content of the image
(4) Perception of Depth
(5) Luminance and Chrominance
(6) Temporal Aspects of Illuminance
(7) Continuity of Motion
(8) Flicker
(9) Temporal Aspect of Video Bandwidth

(1) Visual Detail and Viewing Distance:

The geometry of a TV image is based on the ratio of the picture width W to height H. It is called aspect ratio.

(2) Horizontal Detail and Picture Width:

The picture width chosen for conventional TV service is 4/3 x picture height. The horizontal field of view from the horizontal angle can determine using aspect ratio.

(3) Total Detail Content of the image:

- The vertical resolution is equal to the number of picture elements separately presented in the picture height, while the number of elements in the picture width is equal to the horizontal resolution times the aspect ratio.

- The product of the number of elements vertically and horizontally equals the total number of picture elements in the image.

(4) Perception of Depth:

- In natural vision, perception of the third spatial dimension, depth, depends primarily on the angular separation of the images received by the two eyes of the viewer.
- The choice of the focal length of lenses and changes in depth of focus in camera influence the depth perception.

(5) Luminance and Chrominance:

- Color vision is achieved through three signals, proportional to the relative intensities of Red, Green and Blue light (RGB) in each portion of the scene.
- The three signals are conveyed separately to input terminals of picture table, so that the tube reproduces at each point the relative intensities of Red, Green and Blue.

(6) Temporal Aspects of Illuminance:

- Another property of human vision is the boundary of motion resolution.
- To represent visual reality, two conditions must be met.

(i) The rate of repetition of images must be high enough.
(ii) The rate must be high enough.

(7) Continuity of Motion:

- Continuous motion to be happen if frame rate faster than 15 frame per second.
- Video motion seems smooth and achieved at only 30 frames per second, when filmed by a camera and not synthetically generated.

(8) Flicker:

- Another problem known as flicker occurs due to a periodic fluctuation of brightness perception.

(9) Temporal Aspect of Video Bandwidth:

- An important factor to determine which video bandwidth to use transmits motion video is its temporal specification.
- Temporal specification depends on the rate of the visual system to scan pixels, as well as on the human eye's scanning capabilities.

B. Transmission:

- Video signals are transmitted to receive through a single TV channel.
- To encode colour, a video signal is a composite of three signals for transmission purpose, a video signal consists of one luminance and two chrominance signal.
- The transmitter also uses the comb filter during the luminance –chrominance encoding process.

Approaches of Color encoding

(i) RGB signal
(ii) YUV signal
(iii) YIQ signal
(iv) Composite signal

RGB signal:

In the case of signal coding the color can be encoded in the RGB signal, which consists of separate signals for red, green and blue colors.

YUV signal:

This signal widely used in encoding color for use in TV and video.

- The Y signal encodes the brightness information.
- The U and V signal encodes the chromatic information.
- The components division of YUV signal is:

$Y=0.3R+0.59G+0.11B$
$U=(B-Y)*0.493$
$V=(R-Y)*0.877$

YIQ signal:

The coding of YIQ signal is similar to YUV signal. The component division is slightly different.

The component division of YIQ signal is –

$Y=0.30R+0.59G+0.11B$
$I=0.60R-0.28G-0.32B$
$Q=0.21R-0.52G+0.31B$

Composite signal:

The alternative component encoding composes all information into one signal i.e. the individual components (RGB, YUV and YIQ) must be combined into one signal.

C. Digitization:

- Before a picture or motion video can be processed by a computer or transmitted over a computer network, it needs to be converted from analog to digital representation.
- In the ordinary sense, digitization consists of sampling the gray (color) level in the picture at MxN array of points. The result of sampling and quantizing is a digital image, at which point we have obtained a rectangular array of integer values representing pixels.
- The creation of digital motion video is to digitize pictures in time and get a sequence of digital images per second that approximates analog motion video.

Computer Based Animation:

- To animate something is literally to bring it to life.
- An animation covers all changes that have a visual effects, visual effect can be of two major types.

(i) Motion dynamic: time varying positions
(ii) Update dynamic: time varying shape, colour, texture or even lighting, camera position etc.

- The visual effect is the result of exploiting the properties of human vision system.
- A computer animation is an animation performed by a computer using graphical tools to provide visual effects.

Basic Concepts:
Input process:

- The first step in producing computer animation is input process.

- Key frames have to created and input into the computer.
- Key frames are the frames in which the objects being animated are at extreme or characteristic positions.
- They can be drawn using traditional artistic tools, such as pen and brush and then digitized.

Composition stages:

- In composition stage, the foreground and background figures are combined to generate the individual frames.

Inbetween process:

- The animation of movement from one position to another needs to a composition of frames with intermediate positions in between the key frames. This is called inbetween process.
- This process of inbetweening is performed in computer through interpolation.
- Spline interpolation can make object move more smoothly.
- Inbetweening also involves interpolating the shapes of objects.
- Some animation involves changing the color of objects.
- Morphing is a popular effects in which one image transforms into anoter.

Animation Language:

- There are many different languages for describing animation and new ones are constantly being developed.
- Animation languages are fall into three categories.

(1) Linear-List Notation:

- In linear-list notations for animation each event in the animation is described by a starting and ending frames numbers and an action that is to take place (event). Example, A statement such as 42, 53, B, ROTATE “PASS”, 1, 30 means: between frames 42 and 53, rotate the object called PASS about axis 1 by 30 degrees determining the amount of rotation at each frame from table B.

(2) General Purpose Language:

- Another way to describe animation is to embedded an animation capability within a general-purpose programming language. The values of variables in the language can be used as parameters to the routines, which perform the animation.

(3) Graphical Languages:

- General animation languages describe animation in a more virtual way. These languages are used for expressing, editing and comprehending the simultaneous changes taking place in an animation.

Methods of controlling Animation:

- Controlling animation is independent of the language used for describing it.
- Animation control mechanisms can employ different techniques.

(i) Full Explicit Control
(ii) Procedural Control
(iii) Constraint based System

(iv) Tracking Live Action
(v) Kinematics and Dynamics

Full Explicit Control:

The animator provides a description of everything that occurs in the animation either by specifying simple changes, such as scaling, transformation or by providing key frames.

Procedural Control:

- Using a program to calculate the position, angle, etc. of the objects.
- In physical systems, the position of one object may influence the motion of another.

Constraint based System:

- Movement of objects that are in contact with each other is constraint by physical laws. An animation can be specified by these constraints.

Tracking Live Action:

- People or animals act out of the parts of the characters in the animation. The animator trace out the characters.

Kinematics and Dynamics:

- Kinematics refers to the position and velocity of points.
- The final result of an animation is the sum of all the steps. If it does not fit, the animator has to try again. This is known as forward kinematics.
- Inverse kinematics (IK) is concerned with moving a skeleton from one pose to another.
- Dynamics takes into account the physical laws that govern the masses and forces acting on the objects.

Displaying Animation:

- The rules governing the showing of video apply to animation as well.
- The frame rates should be at least 10, preferably 15 to 20, to give a reasonably smooth effect.
- There are three common ways to display animation:

Generate a digital video clip:

- Many animation tools will export an animation in common digital video format. Example, Quick Time

Creating a package including runtime system of the animation:

- For example, Director can create a projector including all casts. The projector can then be distributed and play the animation.

Show the animation in the animation tool:

Some animation tools are:

(i) Micromedia Director and Flash
(ii) Meta Creation Poser
(iii) Discrete 3D Studio max
(iv) Animation language VRML (Virtual Reality Modelling Language)

Transmission of Animation:

- Animated objects can be represented symbolically using graphical objects or scan-converted pixmap images.
- The transmission of animation over computer networks may be performed using following approaches:

(i) Symbolic representation: The symbolic representation (example, circle) of animation objects (example, ball) is transmitted together with operation commands (example, roll the ball) performed on the object, at the receiver side the animation is displayed.

In this approach, the transmission rate of an object depends:

(a) On the size of symbolic representation structure, where the animated object is encoded.
(b) On the size of the structure, where the operation command is encoded and
(c) On the number of animated object and operation commands sent per second.

(ii) Pixmap representation: The pixmap representation of the animated object is transmitted and displayed on the receiver side.

- In this case the transmission rate is longer than symbolic representation.
- In this approach, the transmission rate of the animation is equal to the size of pixmap representation of an animated object (graphical image) multiplied by the nature of graphical images per second.