

BHARATHIAR UNIVERSITY,COIMBATORE

Modified Syllabus for ANIMATION TECHNIQUE Paper

**COMPULSORY DIPLOMA IN MULTIMEDIA AND ANIMATION PAPER III-
ANIMATION TECHNIQUES FOR B.C.A.,B.Sc.SOFTWARE SYSTEM & M.SC
SOFTWARE SYSTEM DEGREE COURSES WITH EFFECT FROM 2007 – 08
ONWARDS**

**CORE PAPER 9 – ANIMATION TECHNIQUES FOR B.SC.MULTIMEDIA AND
WEBTECHNOLOGY DEGREE COURSE WITH EFFECT FROM 2008 – 09
ONWARDS**

UNIT-I: What is mean by Animation – Why we need Animation – History of Animation – Uses of Animation – Types of Animation – Principles of Animation – Some Techniques of Animation – Animation on the WEB – 3D Animation – Special Effects - Creating Animation.

UNIT-II: Creating Animation in Flash: Introduction to Flash Animation – Introduction to Flash – Working with the Timeline and Frame-based Animation - Working with the Timeline and Tween-based Animation – Understanding Layers - Actionscript.

UNIT-III: 3D Animation & its Concepts – Types of 3D Animation – Skeleton & Kinetic 3D Animation – Texturing & Lighting of 3D Animation – 3D Camera Tracking – Applications & Software of 3D Animation.

UNIT-IV: Motion Caption – Formats – Methods – Usages – Expression – Motion Capture Software's – Script Animation Usage – Different Language of Script Animation Among the Software.

UNIT-V: Concept Development –Story Developing –Audio & Video – Color Model – Device Independent Color Model – Gamma and Gamma Correction - Production Budgets – 3D Animated Movies.

TEXT BOOK:

1. **PRINCIPLES OF MULTIMEDIA – Ranjan Parekh, 2007, TMH. (Unit I, Unit V)**
2. **Multimedia Technologies – Ashok Banerji, Ananda Mohan Ghosh – McGraw Hill Publication. (Unit II: Chapter 10)**

Text for Unit III, IV & V is appended.

Unit III

3D Animation & Its Concepts

Introduction

In 3D computer graphics, 3D modeling is the process of developing a mathematical, wireframe representation of any three-dimensional object (either inanimate or living) via specialized software. The product is called a 3D model. It can be displayed as a two-dimensional image through a process called 3D rendering or used in a computer simulation of physical phenomena. The model can also be physically created using 3D Printing devices.

Models may be created automatically or manually. The manual modeling process of preparing geometric data for 3D computer graphics is similar to plastic arts such as sculpting.

Models

3D models represent a 3D object using a collection of points in 3D space, connected by various geometric entities such as triangles, lines, curved surfaces, etc. Being a collection of data (points and other information), 3D models can be created by hand, algorithmically (procedural modeling), or scanned.

Representation

Almost all 3D models can be divided into two categories.

Solid - These models define the volume of the object they represent (like a rock). These are more realistic, but more difficult to build. Solid models are mostly used for non visual simulations such as medical and engineering simulations, for CAD and specialized visual applications such as ray tracing and constructive solid geometry

Shell/boundary - these models represent the surface, e.g. the boundary of the object, not its volume (like an infinitesimally thin eggshell). These are easier to work with than solid models. Almost all visual models used in games and film are shell models.

Because the appearance of an object depends largely on the exterior of the object, boundary representations are common in computer graphics. Two dimensional surfaces are a good analogy for the objects used in graphics, though quite often these objects are non-manifold. Since surfaces are not finite, a discrete digital approximation is required: polygonal meshes (and to a lesser extent subdivision surfaces) are by far the most common representation, although point-based representations have been gaining some popularity in recent years. Level sets are a useful representation for deforming surfaces which undergo many topological changes such as fluids.

The process of transforming representations of objects, such as the middle point coordinate of a sphere and a point on its circumference into a polygon representation of a sphere, is called tessellation. This step is used in polygon-based rendering, where objects are broken down from abstract representations ("primitives") such as spheres, cones etc, to so-called meshes, which are nets of interconnected triangles. Meshes of triangles (instead of e.g. squares) are popular as they have proven to be easy to render using scanline rendering. Polygon representations are not used in all rendering techniques, and in these cases the tessellation step is not included in the transition from abstract representation to rendered scene.

3D models are widely used anywhere in 3D graphics. Actually, their use predates the widespread use of 3D graphics on personal computers. Many computer games used pre-rendered images of 3D models as sprites before computers could render them in real-time.

Today, 3D models are used in a wide variety of fields. The medical industry uses detailed models of organs. The movie industry uses them as characters and objects for animated and real-life motion pictures. The video game industry uses them as assets for computer and video games. The science sector uses them as highly detailed models of chemical compounds. The architecture industry uses them to demonstrate proposed buildings and landscapes through Software Architectural Models. The engineering community uses them as designs of new devices, vehicles and structures as well as a host of other uses. In recent decades the earth science community has started to construct 3D geological models as a standard practice.

Modeling processes

There are five popular ways to represent a model:

Polygonal modeling - Points in 3D space, called vertices, are connected by line segments to form a polygonal mesh. Used for example by 3DS Max. The vast majority of 3D models today are built as textured polygonal models, because they are flexible and because computers can render them so quickly. However, polygons are planar and can only approximate curved surfaces using many polygons.

NURBS modeling - NURBS Surfaces are defined by spline curves, which are influenced by weighted control points. The curve follows (but does not necessarily interpolate) the points. Increasing the weight for a point will pull the curve closer to that point. NURBS are truly smooth surfaces, not approximations using small flat surfaces, and so are particularly suitable for organic modeling. Maya and Rhino 3d are the most well-known commercial software that uses NURBS natively.

Splines & Patches modeling - Like NURBS, Splines and Patches depend on curved lines to define the visible surface. Patches fall somewhere between NURBS and polygons in terms of flexibility and ease of use.

Primitives modeling - This procedure takes geometric primitives like balls, cylinders, cones or cubes as building blocks for more complex models. Benefits are quick and easy construction and that the forms are mathematically defined and thus absolutely precise, also the definition language can be much simpler. Primitives modeling is well suited for technical applications and less for organic shapes. Some 3D software can directly render from primitives (like POV-Ray), others use primitives only for modeling and convert them to meshes for further operations and rendering.

Sculpt modeling - Still fairly new method of modeling 3D sculpting has become very popular in the few short years it has been around. There are 2 types of this currently, Displacement which is the most widely used among applications at this moment, and volumetric. Displacement uses a dense model (often generated by Subdivision surfaces of a polygon control mesh) and stores new locations for the vertex positions through use of a 32bit image map that stores the adjusted locations. Volumetric which is based loosely on Voxels has similar capabilities as displacement but does not suffer from polygon stretching

when there are not enough polygons in a region to achieve a deformation. Both of these methods allow for very artistic exploration as the model will have a new topology created over it once the models form and possibly details have been sculpted. The new mesh will usually have the original high resolution mesh information transferred into displacement data or normal map data if for a game engine.

The modeling stage consists of shaping individual objects that are later used in the scene. There are a number of modeling techniques, including:

- constructive solid geometry
- implicit surfaces
- subdivision surfaces

Modeling can be performed by means of a dedicated program (e.g., form•Z, Maya, 3DS Max, Blender, Lightwave, Modo) or an application component (Shaper, Loftter in 3DS Max) or some scene description language (as in POV-Ray). In some cases, there is no strict distinction between these phases; in such cases modeling is just part of the scene creation process (this is the case, for example, with Caligari trueSpace and Realsoft 3D).

Complex materials such as blowing sand, clouds, and liquid sprays are modeled with particle systems, and are a mass of 3D coordinates which have either points, polygons, texture splats, or sprites assign to them.

Scene setup

Scene setup involves arranging virtual objects, lights, cameras and other entities on a scene which will later be used to produce a still image or an animation.

Lighting is an important aspect of scene setup. As is the case in real-world scene arrangement, lighting is a significant contributing factor to the resulting aesthetic and visual quality of the finished work. As such, it can be a difficult art to master. Lighting effects can contribute greatly to the mood and emotional response effected by a scene, a fact which is well-known to photographers and theatrical lighting technicians.

It is usually desirable to add color to a model's surface in a user controlled way prior to rendering. Most 3D modeling software allows the user to color the model's vertices, and that color is then interpolated across the model's surface during rendering. This is often how models are colored by the modeling software while the model is being created. The most common method of adding color information to a 3D model is by applying a 2D texture image to the model's surface through a process called texture mapping. Texture images are no different than any other digital image, but during the texture mapping process, special pieces of information (called texture coordinates or UV coordinates) are added to the model that indicate which parts of the texture image map to which parts of the 3D model's surface. Textures allow 3D models to look significantly more detailed and realistic than they would otherwise.

Other effects, beyond texturing and lighting, can be done to 3D models to add to their realism. For example, the surface normals can be tweaked to affect how they are lit, certain surfaces can have bump mapping applied and any other number of 3D rendering tricks can be applied.

3D models are often animated for some uses. They can sometimes be animated from within the 3D modeler that created them or else exported to another program. If used for animation, this phase usually makes use of a technique called "keyframing", which facilitates creation of complicated movement in the scene. With the aid of keyframing, one needs only to choose where an object stops or changes its direction of movement, rotation, or scale, between which states in every frame are interpolated. These moments of change are known as keyframes. Often extra data is added to the model to make it easier to animate. For example, some 3D models of humans and animals have entire bone systems so they will look realistic when they move and can be manipulated via joints and bones, in a process known as skeletal animation.

Types of 3D Animation

Animation is the process of rendering images in quick succession so as to give an impression of continuous motion. In 3D animation, the images that are used are three dimensional. They can be shown from all possible directions, are made to adhere to natural physics laws, and therefore appear exceedingly real to the viewers.

There are many different types of three dimensional animation. Some of the main ones are stop motion animation, claymation, computer generated imagery (CGI) and motion capture animation. These animations are done using hand-crafted as well as computer-generated puppets, objects, backgrounds and special effects.

In **stop motion animation**, the 3D characters and their backgrounds are designed by hand. First the animator makes an armature or skeleton using metal and then fashions the objects on this using clay, plastic or rubber. Different materials like wood, cloth, hair gel, toothpaste and cotton wool may be used to create finer details.

The handmade objects are arranged in a scene and a photograph is taken. Then the objects are moved slightly and photographed again. After photographing the objects every time their position is altered, the animator uses the photographic frames to create the 3D animation.

Claymation is a stop motion animation using clay models. The clay is worked on over an aluminum wire frame and shaped with fingers and clay tools. To prevent the sculpted figures from being misshapen in handling, quick hardening clay is used. Once it has dried, the figures are painted as required.

The use of computers has, in many ways, revolutionized the three dimensional animation. Animators are no longer required to draw, sculpt or color everything by hand. By switching to the digital medium, the entire 3D animation process can be carried out in a faster, less cumbersome and more cost-saving manner.

So much so that **CGI** is also used in non-animated movies. The computer graphics create scenes that might have otherwise been very expensive or difficult to produce. Some scenes would be even impossible to create without computer generated imagery.

In computer generated 3D animation, the animator builds virtual skeletons and models 3D figures over them. Then the digital models are rigged and can be manipulated as required for the animation. The animator must take care to get all the physical movements and details right so that the 3D animation looks real.

Motion capture animation goes a step further and makes use of live action. Here, an actor is outfitted with sensory devices that plot the movement and positioning of the actor's joints. The actor then goes through the motions in place of an already designed character that is to be animated.

The **sensory devices record** the resulting motions and transmit the video-recording into a computer. The computer now uses these inputs to give movement to the character. This brings motion capture animation as very close to movements seen in real life.

Some well-known animated films are *Shrek*, *Finding Nemo*, and *Wall-E*. 3D animation films are becoming more and more inclined towards realism.

Skeleton & Kinetic 3D Animation

Overview

Visualization Pipeline procedural workflow was introduced in K-3D. The project has been split into three parts.

Skeletal / Deformation Bones

This is what most people think about when they hear "skeletal" animation. Simply put it is a way to deform a mesh. You associate one group of points in a mesh with a bone and another group with a second bone and when a bone is reoriented the associated points will do so accordingly.

However there are several takes on how to deform the mesh because the deformation at the joints is always a problem. A bone may be associated with an entire mesh, e.g. when dealing with mechanical assemblies (think of animating a solid robotic arm).

A bone object in K-3D would have the following properties:

- input mesh
- output mesh
- input matrix
- output matrix

The main processing for the bone would be to deform the input mesh, based on the difference between the input matrix and some "resting" state.

Kinematics

Bones have to be linked together using **joints** to make a skeleton. In ODE's documentation, bodies connected to each other with joints are called **islands**.

Kinematics is the process of calculating the position in space of the end of a linked structure given the angles of all the bones at the joints. It is easy, and there is only one solution. Inverse Kinematics does the reverse. Given the end point of the structure, what angles do the joints need to be in to reach that end point? It can be difficult, and there are usually many or infinitely many solutions.

Dynamics engine

After creating a skeletal object (deformation bones + joints), really want to animate it using kinematics, inverse kinematics, and even physics.

ODE is a very nice and competent library for simulating rigid structure physics. It has advanced joint types and integrated collision detection with friction.

There are issues when it comes to ODE like K-3D's nonlinear approach to time, but time is going to be an issue with any dynamics library.

Texturing & Lighting of 3D Animation

Understanding the Art of Lighting

Like every aspect of 3d, lighting must be created from scratch. Unfortunately, the techniques for emulating the real world are not always obvious or intuitive. Luckily, a wealth of lighting theory exists in the form of historical artwork, photography, and motion pictures. There are five different categories in lighting. Before moving into the various lighting methods, there are few common lighting terms to be defined.

Key the most intense light in a scene. The key light's source is generally identifiable (the sun, a lamp, and so on). The key light usually produces the strongest shadow in the scene.

Fill a secondary light that is less intense than the key. this light "fills" in the dark areas of a subject and the shadows produced by the key. Fill lights often represent light from a key that has bounced off a surface, such as a wall.

Rim an intense light source placed behind a subject that strikes the subject along the edge. Rim lights are often employed as hair lights. these lights are commonly known as backlights or kickers.

Using 1-Point Lighting

The 1-point lighting scheme is dramatic, sometimes stark, and often foreboding. The lighting involves a single, easily identifiable key light source, with no significant supplemental sources. 1-point lighting can be found in the following situations:

- A man lights a cigarette in an otherwise dark alley.
- A woman drives a car down a dark country road, lit only by the car's instrument panel.
- Sunbeams burst through the window of an otherwise unlit interior.
- A theater audience is illuminated by the light of the movie screen.

The motion picture genre that most closely emulates 1-point lighting is film noir. Film noir is a style historically associated with crime dramas of the 1940s and 1950s. The style is typified by black-and-white film stock, sparsely lit characters, and deep black shadows.

Aesthetically, the lighting stemmed from stories with cynical, paranoid, or nihilistic outlooks. Technically, the stark lighting was the result of placing only a few lights on the set, in some cases because of budgetary restrictions. Although multiple lights were generally needed for any given shot for proper exposure, the result often *appears* as if a single light source exists.

Using 2-Point Lighting

The 2-point lighting scheme matches many of the lighting scenarios that encounter in our everyday lives. The scheme often involves a strong key and an extremely diffuse fill. The following are examples of 2-point lighting:

- Sunlight streams through a window. the light bounce from the interior walls serves as a fill.
- Office workers sit in a windowless room lit with overhead fluorescent lights. The light bounce from the walls, desks, and floor serves as a fill.
- A couple walks down a sidewalk on a sunny day. the light bounces off the concrete, providing fill to the bottom of their hands, the underside of their chins, and their eye sockets



Often 2-point lighting in painted portraits. For example, in the above Figure a man is lit by a strong key light arriving from the left. a second light source delivers fill from the right; thus, no part of the person or his outfit is left unlit. this painting was created by Frans Hals whose loose, powerful brushstrokes inspired the impressionism movement. This style of lighting is called short lighting in studio photography; the side of the head facing away from the camera receives the key. The opposite style of lighting is called broad lighting, in which the side of the head facing the camera receives the key.

Using 3-Point Lighting

Perhaps the most commonly discussed and applied lighting technique is 3-point lighting. Descriptions can be found in numerous 3d, film, and video instructional materials. Although 3-point lighting is a reliable way to light many scenes, it has inherent drawbacks. In the standard 3-point lighting scheme, a strong key is placed to one side of a subject (approximately 15 to 45 degrees off the camera axis). A fill light is placed on the opposite side and is at least half the intensity of the key (*Figure below*). A rim light is placed behind the subject so that it grazes the subject's edge.



Using Naturalistic Lighting

Naturalistic lighting is an adaptable scheme that matches the natural lighting scenario of the subject location. Any light that is visible is logically driven by a recognizable source. Naturalistic lighting is sometimes called “transparent” in that no artificial lighting methods can be detected. Another way to define naturalistic lighting is to list what it *lacks*:

- Unmotivated shadows
- Impossibly distinct rim light
- Perfectly placed lights that never permit a character to fall into shadow or be unglamorously lit

In the field of motion pictures, there are numerous examples of non-naturalistic lighting. Many films feature stylized or exaggerated lighting. This is particularly evident with musicals, which are fantastic by their very nature. Such films as *The Band Wagon* (1953) and *Silk Stockings* (1957) employ high-key lighting, in which the fill light is intense and there is a low key-to-fill ratio. The characters in these films are therefore evenly lit and carry a minimum number of deep, dark shadows. High-key lighting is also evident in many television sitcoms, in which it is necessary to keep a character well lit at all positions on the set. Similar lighting is employed for advertising and catalog art (see Figure Below).



In other situations, non-naturalistic lighting is a result of technical limitations or time and budget restrictions. A common problem with older motion pictures is the unintended creation of unmotivated, multiple shadows. For example, light representing the sun casts multiple shadows of a character on the ground. More commonly, a lamp casts multiple, distinct shadows of its own fixture (see Figure below). This is caused by a need to illuminate a set with multiple lights to attain correct exposure even though the desired light source—in terms of the story—is singular.



Using Stylized Lighting

Stylized lighting pays no heed to the real world but fabricates fantastic sources of light or simply ignores the lighting information altogether. The oldest form of stylized lighting can be called 0-point lighting. In this case, lighting plays no part in the artistic

representation. You can see this in prehistoric art, as well as in the art of ancient or primitive cultures (see Figure below). To this day, 0-point lighting survives as line-art cartoons.



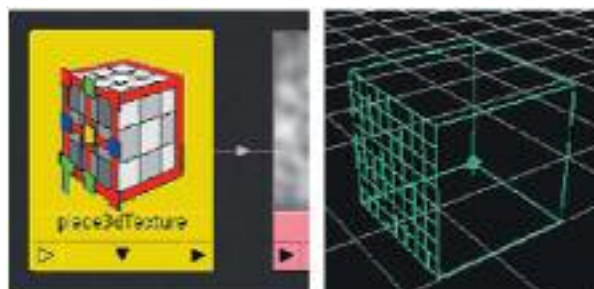
Stylized lighting is well suited for 3d animation, since the medium places no limitation on the type of lighting employed.

3D Textures

3D textures are procedural. That is, they are generated mathematically through predefined algorithms. Procedural textures are resolution independent and do not have defined edges or borders. Many of the algorithms employed by Maya make use of fractal math, which defines non regular geometric shapes that have the same degree of non regularity at all scales. Thus, Maya 3D textures are suitable for many shading scenarios found in the natural world. For example, the addition of 3D textures to a shading network can distress and dirty a clean floor and wall (see Figure).



When you MMB-drag a 3D texture into the Hypershade work area or choose it through the create render node window, a 3D placement utility is automatically connected to the texture and named place3dTexture (see Figure).



The scale, translation, and rotation of the 3D placement utility's placement box affect the way in which the texture is applied to the assigned object. If the assigned object is scaled, translated, or rotated, it will pick up different portions of the texture. By default, new placement boxes are positioned at 0, 0, 0 in world space and are 2 · 2 · 2 units large. If the 3D placement utility is deleted or its connection is broken, Maya assumes that the 3D texture sample is at its default size and position.

The 3D placement utility determines the color of each surface point by locating the point's position within the placement box. Each position derives a potentially unique color. This process is analogous to a surface dipped into a square bucket of swirled paint or a surface chiseled from a solid cube of veined stone. Should the surface sit outside the placement box, the surface continues to receive a unique piece of texture border at the edge of the placement box. A significant advantage of 3D textures, and the use of the 3D placement utility, is the disregard of a surface's UV texture space.

Camera Tracked 3D Animations

Introduction

One of the biggest advancements in 3D animation is camera tracking. Put simply, it is the process of combining real video footage with 3D animation. The finished result is amazing as the subtle irregularities of reality are picked up perfectly in 3D. A well prepared scene will have 3D additions that aren't noticeable at all.

This kind of special effect used to be restricted to big-budget Hollywood, but now most companies can have access to it.

Shooting the video footage

At Archiform 3D, people now use helicopters and High-Definition video cameras the most. Aerial footage is the best way to portray large, unique projects and helicopters give us the flexibility we need to get almost any kind of shot.

Advancements in camera technology also means that the typical gyro-stabilized camera mounts are not necessary as the image stabilization in the camera and the work we can do in post gets a shot that is rock steady. Large budget movies can afford to have expensive stabilization pods and even better cameras, but made for TV, corporate or real estate budgets can't stretch that far. Archiform 3D has always been a specialist in getting maximum value for money, so hand held, in harness shots are 90% of our work.

High-definition video cameras also give us an incredibly clear, sharp image with the resolution we need to accurately process the footage. And to make the process even faster, these cameras interface either directly or via a tape deck to our work stations.

While Archiform 3D's rates are fixed we do not include the helicopter costs, so you need to budget them. Helicopters can't be the least expensive ones either - they should preferably be large jet turbine models that don't bounce around and have the power to carry out the maneuvers that we need to get the best shots. For an hour of time in the air you should allow between \$800 and \$1200.

Tracking the video

Firstly the video is stabilized. This process, while taxing on a workstation, doesn't actually require much human time - just hours of CPU time. All the bumps and jumps from

the footage are removed and the result is silky smooth video. If the shot is good then less stabilization is needed, but if it was taken from a small helicopter or in turbulent weather then more is needed and there is a slight reduction in finished quality.

The actual tracking of the video is partly automated task although still requires a great deal of human time. The simple fact is that it is a very complex process that cannot be done by man or computer alone. Points in the video are marked and through a process of manual input and automated tracking the computer determines a set of moving 3D coordinates that depict where the camera was at each point in time. As you may imagine, especially if you have a mathematical background, the computational power to determine this and track the points is somewhat huge and would have been next to impossible in the recent past.

The process of tracking a few minutes of video footage can take days, possible weeks, depending on the quality of the shoot and the subject.

Adding the 3D animation

Building the 3D model itself is a different process again, so from this point on we will assume it is done. The camera coordinates are brought into the 3D scene as is the stabilized footage. Then there is another painstaking process, which is aligning the camera and the 3D model with the video background. Even though the footage is tracked the coordinates will not actually relate to the 3D scene until adjustments are made. This may take hours or days to get right. Then the lighting in the 3D scene needs to be adjusted to match the lighting on the actual day the video was shot. The idea is to get a seamless combination of the model and reality.

Other factors come in to play as well, such as foreground objects in the video. These require a technique called rotoscoping, which is a moving layer of transparency that is added to the final 3D rendered footage to ensure that anything that is supposed to be in front of the building is still there after the 3D footage has been added. Once again this is a computer/human combination that can take some time. Normal rates for Archiform 3D to create camera tracked 3D animations do NOT include rotoscoping and we will shoot to avoid it's need, but if you require it we can do it for an additional fee.

Uses for tracked 3D animations

It is likely you have seen camera tracked 3D animations many times, you just haven't known it. The technique started where all cool 3D techniques come from - Hollywood. The use of 3D has grown so much and the need for virtual sets has also grown. But virtual sets cant always be perfect and the need to blend reality became overwhelming.

For example, imagine you want a scene of travelers on camels riding to the pyramids of Egypt but set in BC times. You could build it all in 3D but to get it perfect and have your actors in the scene gets hard and expensive. Camera tracking allows you to use real actors, real camels and real desert, fly over in a helicopter and then add the pyramids, city and people in 3D. You now have a perfect scene that can have your actor somewhere that is real but thousands of years ago.

Archiform 3D has used the technique for new buildings and features. We fly over in a helicopter and then add in the new work so the viewer sees it as though it was complete. If the property has some kind of unique or attractive feature, like a beach, lake, park or great location, then this technique is quite valuable.

Applications & Software of 3D Animation

Uses

3D modelers are used in a wide variety of industries. The medical industry uses them to create detailed models of organs. The movie industry uses them to create and manipulate characters and objects for animated and real-life motion pictures. The video game industry uses them to create assets for video games. The science sector uses them to create highly detailed models of chemical compounds. The architecture industry uses them to create models of proposed buildings and landscapes. The engineering community uses them to design new devices, vehicles and structures as well as a host of other uses. There are typically many stages in the "pipeline" that studios and manufacturers use to create 3D objects for film, games, and production of hard goods and structures.

Features

Many 3D modelers are general-purpose and can be used to produce models of various real-world entities, from plants to automobiles to people. Some are specially designed to model certain objects, such as chemical compounds or internal organs.

3D modelers allow users to create and alter models via their 3D mesh. Users can add, subtract, stretch and otherwise change the mesh to their desire. Models can be viewed from a variety of angles, usually simultaneously. Models can be rotated and the view can be zoomed in and out.

3D modelers can export their models to files, which can then be imported into other applications as long as the metadata is compatible. Many modelers allow importers and exporters to be plugged-in, so they can read and write data in the native formats of other applications.

Most 3D modelers contain a number of related features, such as ray tracers and other rendering alternatives and texture mapping facilities. Some also contain features that support or allow animation of models. Some may be able to generate full-motion video of a series of rendered scenes (i.e. animation).

Major packages

A comprehensive comparison of significant 3D packages and software are as follows:

3ds Max (Autodesk), originally called 3D Studio MAX. 3ds Max is used in many industries that utilize 3D graphics. It is used in the video game industry for developing models and creating cinema cut-scenes. It is used in architectural visualizations because it is highly compatible with AutoCAD--also developed by Autodesk. Additionally 3ds Max is used in film production. With its price of around \$3500 USD, it is one of the more expensive products in the market for this type of work.

AC3D (Inivis) is another 3D modeling application that began in the 90's on the Amiga platform. While it is used in a number of industries, MathWorks actively recommends it in many of their aerospace related articles due to price and compatibility. Additionally it is the first commercial 3D modeler to integrate full support for exporting models to the metaverse platform Second Life. AC3D is priced in the range of \$79 USD and is available for Mac OS X, Windows and Linux.

Aladdin4D (DiscreetFX), first developed for the Amiga, was originally developed by Adspec Programming in Ohio. It developed an enthusiastic following and sold over 18,000 copies on the Amiga platform alone. After being acquired by visual effects company DiscreetFX, the package has finally been repositioned as a multi-platform product for Mac OS X, Amiga OS 4.1, MorphOS, Linux, AROS and Windows. It is priced at \$99.95 USD and is available for Windows, Linux, MorphOS, Amiga OS 4 and AROS.

Cinema 4D (MAXON) is a slightly lighter package than the others in its basic configuration. The software is claimed to be artist-friendly, and is designed with the less-technical user in mind. It has a lower initial entry cost due to a modular a-la-carte design for purchasing additional functions as users need them. For example, a module called MoGraph allows the user to create motion graphics titles more easily. Originally developed for the Commodore Amiga, it is also available for Mac OS X, Windows and Linux.

Electric Image Animation System (EI Technology Group) is a 3D animation and rendering package available on both Mac OS X and Windows. Mostly known for its rendering quality and rendering speed it does not include a built-in modeler. EIAS features the ability to handle very large polygon counts. Recently, the blockbuster film "Pirates of the Caribbean: The Curse of the Black Pearl" and the Television hit "Lost" utilized the software.

Inventor (Autodesk) The Autodesk Inventor product line provides a comprehensive and flexible set of software for 3D mechanical design, product simulation, tooling creation, and design communication that help cost-effectively take advantage of a Digital Prototyping workflow to design and build better products in less time.

LightWave 3D (NewTek), first developed for the Amiga, was originally bundled as part of the Video Toaster package and entered the market as a low cost way for TV production companies to create quality CG for their programming. It first gained public attention with its use in the TV series "Babylon 5". Lightwave is used extensively in film production. It is priced at \$795 USD and is available for both Windows and Mac OS X.

Maya (Autodesk) is currently used in the film and television industry. Maya has a high learning curve but has developed over the years into an application platform in and of itself through extendibility via its MEL programming language. A common alternative to using the default built in rendering system named mental ray is Pixar's Renderman. In 2005, Autodesk, acquired Alias--the original creator of Maya. Maya comes in two versions: Maya Complete (\$1999 USD) and Maya Unlimited (\$4995 USD).

Softimage (Autodesk) is feature-similar to Maya and is sold as a competitive alternative. It is used in the production of professional films, commercials, video games, and other media. Softimage (formerly Softimage|XSI) is a 3D modeling and animation package that integrates with mental ray rendering. Prior to its acquisition by Avid and later Autodesk, Softimage, Co. originally promoted its predecessor for use in the video game industry and secured its promotion as part of the Nintendo N64 SDK.

Solid Edge (Siemens PLM Software) is a commercial application for design, drafting, analysis, and simulation of products, systems, machines and tools. All versions include feature-based parametric modeling, assembly modeling, drafting, sheetmetal, weldment, freeform surface design, and data management. Application-programming interfaces enable

scripting in Visual Basic and C programming. The Solid Edge Velocity series is Siemens' mid-range CAD software product family.

Swift 3D (Electric Rain) Swift 3D is a powerful, approachable, and relatively inexpensive 3D design, modeling, and animation application targeted to entry-level 3D users and Adobe Flash designers. Swift 3D is the de-facto Mac OS X & Windows application for vector and raster-based 3D animations for Adobe Flash and Microsoft Silverlight XAML. Swift 3D is the only 3D software to directly integrate with Flash through the Swift 3D File Importer and SmartLayer Technology, which separates the exported 3D animation into different layers (Colors, Outlines, Shadows, Highlights, Reflections and Transparency), giving designers additional creative control. Initially a pioneer in the 3D-to-vector Flash world, Swift 3D is now accepted as a highly-capable and versatile 3D authoring application, while maintaining its reputation as the marquee tool for producing vector-based 3D content for Flash and Microsoft Silverlight. It is priced at \$249 USD.

***** End of Unit III *****

Unit IV

Motion Capture - What is it?

Motion capture is defined as "The creation of a 3D representation of a live performance." in the book *Understanding Motion Capture for Computer Animation and Video Games* by Alberto Menache. This is in contrast to animation that is created 'by hand' through a process known as keyframing.

Motion capture (AKA Mocap) used to be considered a fairly controversial tool for creating animation. In the early days, the effort required to 'clean up' motion capture data often took as long as if the animation was created by an animator, from scratch. Thanks to hard work by the manufacturers of motion capture systems as well as numerous software developers, motion capture has become a feasible tool for the generation of animation.

Software tools for working with motion-captured data, such as *MotionBuilder*, have evolved to the point where animators now have the means to edit and blend takes from multiple capture sessions and mix and match them with keyframed animation techniques; allowing great control of style and quality of final output, for anything ranging from realistic to 'cartoony' motion.

Motion Caption

Introduction

Traditional character animation is an involved process that takes large amounts of time using skilled artists to manually pose characters using tools such as 3D Studio Max [Max], Maya [Maya] or Poser [Poser]. However with the ever increasing demands placed on computer graphics for better looking 3D scenes and in shorter spaces of time, alternative character animation techniques are needed.

While the use of forward and backward kinematics can be used to speed up the process of traditional character positioning, the overall creation phase is still a comparatively slow one. Therefore, to meet the demands of modern character animation many production houses have turned to motion capture technologies, in a bid to find a better solution. With the aid of motion capture techniques much of the laborious posture configuration is eliminated as character animation is recorded directly from actors performing the desired motion, thereby reducing the need of artists to manually position characters.

Motion capture devices allow the recording of live motions by tracking a number of key points in space over time, which are translated into a 3 dimensional digital representation. The captured subject can be anything that exists in the real world, with the key points positioned on the object such that they best represent the orientations of the moving parts of the object, for example the joints or pivot points. In order to accurately triangulate marker positions at least 4 cameras are used, however generally no more than 32 are used.

Motion capture is most hot topic in today's world. Motion capture has spread everywhere from movies to television commercials, from sports titles to action games, even to click-and-explore adventures. Publishers are climbing all over each other trying to get the words "Motion-

Captured 3D Characters” on their boxes. A lot of hype has been loaded onto those words, often to the player’s disappointment. As usual, expectations exceed what the technology can truly deliver. But we’re getting so much closer; we have new ripping hardware and the experience from past-generation motion capture downfalls. Yet the desire for more keeps increasing.

The hype has gotten so over-the-top that for the last couple of years, It has been threatening to put out *VIRTUA HANGMAN* as a demo at E3. I can just see it, these realistic real-time 3D characters marching up to the gallows as you relentlessly guess letters. If we want to be cliché, we could even have a 3D character turning the letters. Now *that* would be an excessive use of technology. While I wouldn’t consider using motion capture for characters better suited to traditional key framing, motion capture technology clearly has a place in game development. Luckily, the techniques needed for programmers to apply motion capture data to real time characters work equally well with any type of animation data, be it key framed, motion captured, or animated through procedural dynamics.

The Need of Motion Capturing

Let’s imagine a scenario in which your brilliant producers have assigned you, the programmer, to develop a real-time 3D character based game. They have charged you with the tasks of designing the game engine and creating the production pathway. For a variety of design, budgetary, and staffing reasons, you’ve decided to use motion capture to supply the bulk of your animation data.

Your first task is to decide where you’re going to get this data. It doesn’t really matter whether you have your own capture setup or a service bureau is doing it for you plan on plenty of cleanup time. Motion capture is not simple. The data needs quite a bit of massaging to get it ready for the game, and you can get in trouble by underestimating the amount of post-production work the data needs. You also need to be aware that motion capture data is specific to the hierarchy and body dimensions of the person captured. It’s possible, but tricky, to scale this motion to other body types and sizes. However, I would recommend getting all your data from one session with one capture artist. This will make your life much easier in the long run.

Still, as an experienced production company, you won’t be burdened with these details because your producers have budgeted the motion capture session correctly. Now you need to decide how you want this data to come to you. Other formats exist, but the Bio vision (.BVA/.BVH) formats and the Acclaim Motion format are the big ones, and all the service bureaus and animation packages support these.

Your file format decision depends on your application and engine needs. You can bring these formats into a commercial animation package and export the data from there, but the formats are very compact and easy to use with your own tool set.

Definition of Terms

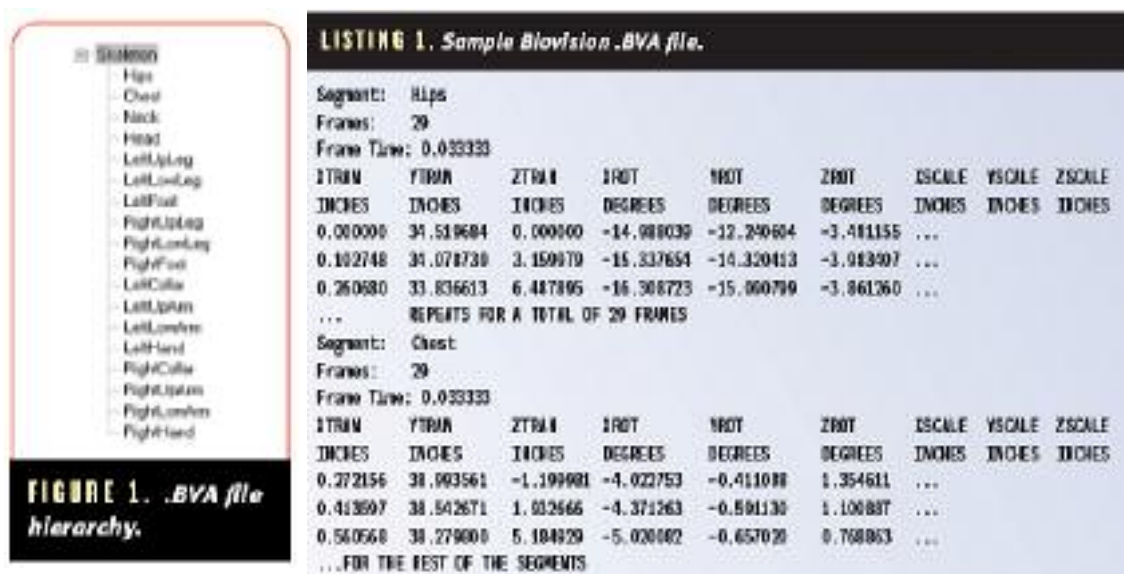
We’ll refer to the character that you apply motion capture data to as a skeleton. The skeleton is made up of bones. To create the character’s looked, you attach geometry or weighted mesh vertices to these bones. The attributes that describe the position, orientation, and scale of a

bone will be referred to as channels. By varying the value in a channel over time, you get animation. These channels are combined into an *animation stream*. These streams can have a variable number of channels within them. Each slice of time is called a *frame*. In most applications, animation data has 30 frames per second, though that's not always the case.

Motion Caption Formats

BIOVISION'S .BVA FORMAT

This is probably the easiest file format to handle. It's directly supported by most of the 3D animation packages. Let's take a look at a piece of a .BVA file (Listing 1). This is as simple as animation data gets. For each bone in the skeleton (or what Biovision calls Segments), there are nine channels of animation. These represent the translation, rotation, and scale values for each bone for each frame. You'll also notice that there is no hierarchy definition. That's because each bone is described in its actual position (translation, rotation, and scale) for each frame. This can lead to problems, but it sure is easy to use. Figure 1 shows the hierarchy of a sample .BVA file. In Listing 1, we see that Hips as the first bone described. There are 29 frames of animation in the Hips. The frame time is described as 0.03333 seconds (per frame), which corresponds to 30 frames per second. Next comes a description of the channels and units used, then the actual channel data. There are 29 lines of nine values, followed by a segment block that describes the next bone, and so on, continuing to the end of the file. That's all there is to it.



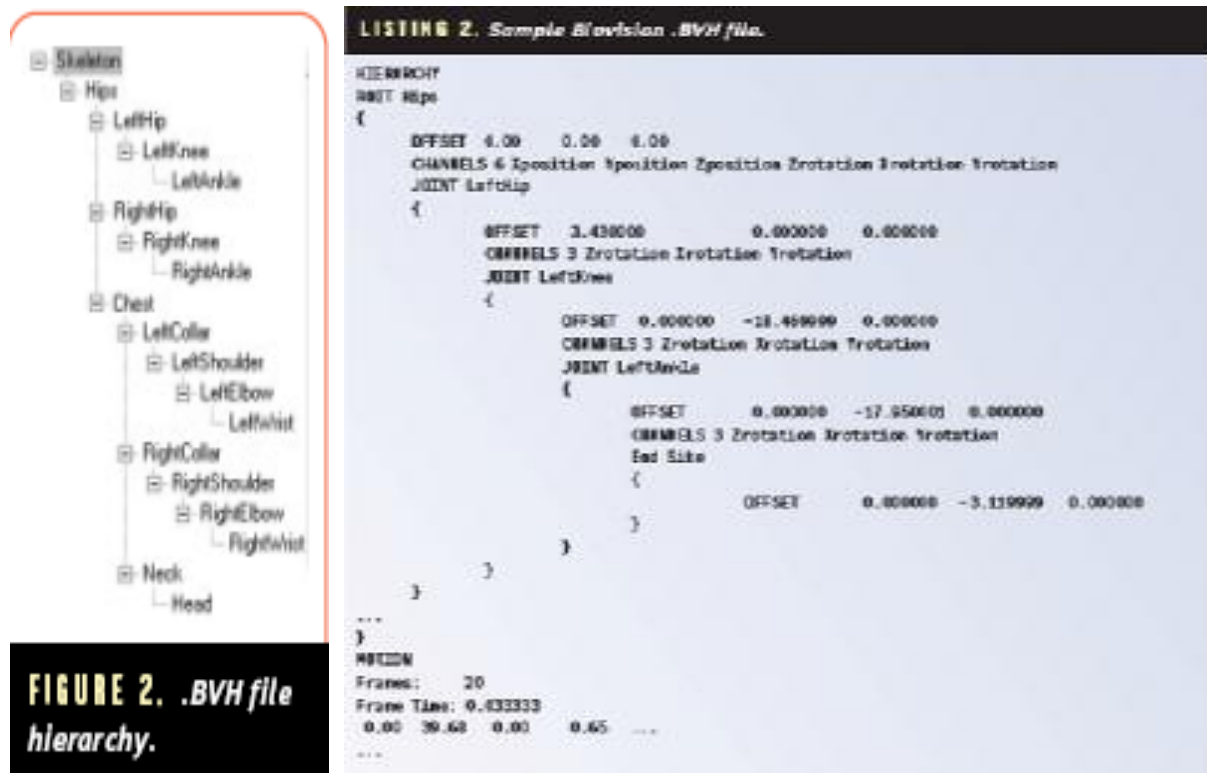
BIOVISION'S .BVH FORMAT

This format is similar to the .BVA format in many respects. In practice, I know of no off the shelf way to import this file format into Alias|Wavefront or Softimage, although Biovision's plug-in, Motion Manager for 3D Studio MAX, reads it. Still, it's an easy-to-read ASCII format that can be useful for importing and storing animation data. Obtaining data in this format should be easy because the format is supported by many motion capture devices and service bureaus.

The .BVH format differs from the .BVA format in several key areas, the most significant of which is that .BVH can store motion for a hierarchical skeleton. This means that the motion

of the child bone is directly dependent on the motion of the parent bone. *Figure 2* shows a sample .BVH format hierarchy.

In this sample, the bone Hips is the root of the skeleton. All other bones are children of the Hips. The rotation of the LeftHip is added to the rotation and translation of the Hips, and so on. This hierarchy will certainly complicate the game engine's render loop. Why would you want to bother? You can do many more interesting things if your motion is in a hierarchy. Let's take the example of wanting to combine a "walk" motion with a "wave" motion. In the .BVA format, there is no relationship between the LeftUpArm and the Hips. If we were to apply a different motion to the different bones, nothing would stop them from separating. A motion hierarchy allows you to combine such motions fairly easily. Also, should we ever want to add inverse kinematics or dynamics to the game engine, a hierarchy would make this possible. *Listing 2* shows a fragment of a .BVH file.



The word HIERARCHY in the first line signifies the start of the skeleton definition section. The first bone that is defined is the ROOT. This bone is the parent to all other bones in the hierarchy. Each bone in this hierarchy is defined as a JOINT. Braces contain the root and each joint. All joints within a set of braces are the children of that parent joint.

Within each braced block is the OFFSET and CHANNELS definition for that bone (or JOINT). The OFFSET describes displacement of the root of the bone from its parent. This (x,y,z) coordinate is the world coordinate offset from the parent bone. In the example, the Hips bone is located at offset (0,0,0) and the LeftHip is 3.43 world units away from the Hips in the x axis.

The CHANNELS line defines which bone parameters will be animating in the file. The first parameter is the number of channels animated for this bone. Next is a data type for each of these channels. The possible types are: Xposition, Yposition, Zposition, Xrotation, Yrotation, and Zrotation. Note that the scale channels have been dropped in the .BVH format.

Normally, only the root bone has any position data — the rest of the bones have only rotational data and rely on the root and the hierarchy for their position. The CHANNELS can be in any order. This order defines the sequence in which the operations need to be processed in the playback.

For example, in the LeftAnkle joint, the order of channels is Zrotation Xrotation Yrotation, meaning that the bone is first rotated around the z axis, then the x axis, and finally the y axis. This becomes important when we try to display the data.

The branch of the hierarchy ends with the End Site joint. This joint is offset is only useful in determining the length of the last bone. Following the HIERARCHY section is the MOTION section. This section actually describes the animation of each bone over time. As in the .BVA format, the first two lines of this section describe the number of frames and the time for each frame. However, unlike the .BVA format, the next lines describe the animation for all the bones at once. In each line in the rest of the MOTION section, there is a value for every CHANNEL described in the HIERARCHY section. For example, if the HIERARCHY section describes 56 channels, there will be 56 values on each line of the MOTION section. That continues for the total number of frames in the animation. That's it for the .BVH format. While it's a bit more complex, it gives the programmer designing the engine greater flexibility.

ACCLAIM SKELETON FORMAT

This is the most complicated of the three file formats. It's also the most comprehensive, and supported by most of the 3D animation packages.

LISTING 3. Sample Acclaim ASF file.	
<pre> :version 1.10 :scene BioSkeleten :units mass 1.0 length 1.0 angle deg :documentation Data translated and provided by BioVision Motion Capture Studios :root axis XYZ order Tl Ty Tz Rz Ry Rx position 0.0 0.0 0.0 orientation 0.0 0.0 0.0 :bonesets begin id 1 name hips direction 0.00000 1.00000 0.00000 </pre>	<pre> length 0.00000 axis 0.00000 0.00000 0.00000 XYZ def rx ry rz limits (-180.0 180.0) (-180.0 180.0) (-180.0 180.0) end begin id 2 name hips1 ... end :hierarchy begin root body_root1 body_root1 hips hips hips1 hips2 hips3 ... end </pre>

An Acclaim motion capture file is actually made up of two files; the .ASF, which describes the actual skeleton and its hierarchy, and the .AMC file, which contains the motion data. The separation of these two files has a nice benefit. In a single motion capture session, you can have one .ASF file that describes the skeleton and multiple .AMC motion files. The Acclaim format is such a technical and complex file format that this overview may not provide all the needed information.

The .ASF file is similar to the HIERARCHY section of the .BVH file in many ways. Both files describe the joints and the hierarchy, but the .ASF file extends this a bit. *Listing 3* displays a portion of an Acclaim .ASF file. In this file format, lines beginning with a pound sign (#) are ignored. The .ASF file is divided into sections. Each section starts with a keyword preceded by a colon. The section continues until another keyword is reached. The :version, :name, and :documentation section are self-explanatory. The :units section describes a definition for all values and units of measure used.

The :root section describes the parent of the hierarchy. The axis and order elements describe the order of operations for the initial offset and root node transformation. The position element describes the root translation of the skeleton and the orientation element defines the rotation. The :bonedata keyword starts a block that describes all of the remaining bones in the hierarchy. Each bone is delimited by *begin* and *end* statements. This bone description section is what makes the Acclaim format very useful.

The **id** and **name** elements describe the bone by number or string. The initial rest position of the bone is described by the **direction** vector, and the **length** describes the physical length of the bone. The **axis** parameter describes the global orientation via an axis vector, and the token letters **xyz** describe the order of rotations. Not included in the sample are two optional elements: **bodymass**, which defines the mass of the bone, and **cofmass** which pinpoints the center of mass via a distance along the bone.

The **dof** element describes the degrees of freedom possible in the bone. This is a list of tokens. The possible values are tx, ty, tz, rx, ry, rz, and l. The first of these six define freedom to translate and rotate around the three axes. The last **dof** defines the bone's ability to stretch in length over time. Each of these tokens represents a channel that will be present in the .AMC file in that order. The order of these channel tokens also describes the order of operations in the transformation of the bone.

The **limits** element is very interesting. It describes the limits of the degrees of freedom. It consists of value pairs of either floats or the keyword **inf**, meaning infinite. This information can be useful for setting up an inverse kinematic or dynamic 3D character.

Usage of Motion Capture

Games

Game development is the largest market for motion capture. With games drawing as much revenue as movies, it is easy to see why game development often calls for enormous quantities of motion capture. The immense competition to produce the 'coolest game possible'

means that greater production capabilities mean higher quality. More time is left for aesthetic finishing touches and fine-tuning of game play.

Generally there are two main types of 3D character animation used in games: Real-time playback vs. cinematics. Real-time allows the game player to choose from pre-created moves, thus controlling the character's moves in real-time. Cinematics are the fully rendered 'movies' used for intros and 'cut-scenes'. Often the last part of game production, or a process that is sub-contracted to a separate studio, cinematics are generally not essential to game-play, but do add a lot of appeal to the game, and help immensely with story development and mood generation.

Video and TV

Real-time motion is becoming popular for live television broadcasts. Motion capture can be used to place a virtual character within a real scene, or to place live actors within a virtual scene with virtual actors, or virtual characters within a virtual scene.

Motion capture for real-time broadcast requires mock-ups of any non-standard physiology to keep the performer's motions from causing the character's limbs to interpenetrate its body. Joint limits on the shoulders and knees also help maintain believability of the character. A real-time adaptation feature such as MotionBuilder's real-time motion mapping is essential when the character's body is very different from the actor's body.

When combining live elements with virtual elements the real and virtual cameras must share the same properties otherwise the illusion looks strange.

The Gypsy is ideal for real-time broadcast animation since it is so easy to transport, fast to set up, easy to use, and it works well in just about any environment.

Daily Features

Use of the PhaseSpace optical motion capture system, combined with MotionBuilder is makes it easy to produce daily 3d animated features, allowing TV stations to keep their content fresh and exciting, and giving viewers yet another reason not to 'touch that dial'.

Post-Production for Ongoing Series

Motion capture for ongoing series is becoming very popular. Creating a weekly show without motion capture invariably causes shows to be late or production studios to go bankrupt. Having an efficient motion capture pipeline is essential to the success of an ongoing character animation based series.

Film

Motion capture is being used more and more in films nowadays. Motion capture based animation is essential for creating characters that move realistically, in situations that would be impractical or too dangerous for real actors. Motion capture was also used extensively in Titanic for 'filler' characters or in situations with virtual camera fly-bys over a virtual ship. Many of these shots would have been difficult or impossible to do with real cameras and a real ship, or real models, so virtual models, actors, and cameras were used. Some film characters require the use of motion capture, otherwise their animation seems fake. More and more independent

companies are starting to put together desktop studios - The idea of two or three people creating an entire movie is not that far off, if motion capture is used correctly. The Gypsy is ideal for small and large shops. Motion capture animation can be done very quickly and inexpensively, without scheduling expensive motion capture sessions in a studio.

Web

Motion capture is ideal for the web, whether used to create virtual hosts or greeting cards. As the web becomes more sophisticated and bandwidth increases, motion capture will help bring a 'human element' to the web, in the form of characters that viewers can relate to and interact with.

Live events

Motion capture generated Performance Animation can be thought of as 'Improvisation meets Computer Graphics (CG)'. At trade shows, meetings or press conferences, a good improviser acting through a CG character in real-time can create a very intriguing lasting experience for the viewer. Integration with live actors further helps create a fascinating experience.

Scientific research

Motion capture is useful for perceptual research. By presenting test subjects with abstract movements, distilled from motion capture data, repeatable experiments can be developed that provide insights into human perception.

Biomechanical analysis

Biomechanical analysis for rehabilitation purposes, relies extensively on motion capture, for its ability to produce repeatable results. Motion capture can be used to measure the extent of a client's disability as well as a client's progress with rehabilitation. Motion capture can also help in effective design of prosthetic devices.

Engineering

Motion capture is essential for producing product designs that are ergonomically practical, as well as designs for physical products that are comfortable and appealing. The Gypsy has tremendous advantages over optical or magnetic systems when it comes to working in an enclosed space, such as a car interior or an aircraft cockpit. Optical systems are easily occluded and require a large distance between the subject and the cameras. Magnetic systems have major problems with metal in the capture space.

Education

Motion capture training can make a huge difference in an animators training. While access to motion capture is not a substitute for developing good art skills and good traditional character animation abilities, it can go a long way towards making someone more employable.

Motion Caption Methods

It is sometimes suggested that the roots of motion capture can be seen in the motion studies of Eadweard Muybridge and Etienne Jules Marey. In the form we think of it today,

mocap technology has been developing since the 1970s, when it was created for military use, and has been used in entertainment since the mid-1980s. Over the years, mocap has taken many forms, each with its own strengths and weaknesses. Following is a summary of three types of mocap used in entertainment and the ways in which they work.

1. Mechanical

- ❖ Performer wears a human-shaped set of straight metal pieces (like a very basic skeleton) that is hooked onto the performer's back; as the performer moves, this exoskeleton is forced to move as well and sensors in each joint feel the rotations
- ❖ Other types of mechanical motion capture involve gloves, mechanical arms, or articulated models (like Monkey), which are used for 'key framing'
- ❖ pro: no interference from light or magnetic fields
- ❖ con: a) the technology has no awareness of ground, so there can be no jumping, plus feet data tends to slide, b) equipment must be calibrated often. c) unless there is some other type of sensor in place, it does not know which way the performer's body is pointing, d) absolute positions are not known but are calculated from the rotations.

2. Optical

- ❖ Performer wears reflective dots that are followed by several cameras and the information is triangulated between them
- ❖ Markers are either reflective, such as a system manufactured by Vicon or Motion Analysis, or infra-red emitting, many of which have been developed for musical applications (such as conducting)
- ❖ Developed primarily for biomedical applications (sports injuries, analysis of athletic performance, etc.)
- ❖ pro: a) performer feels free to move due to no cables connecting body to the equipment, b) larger volumes possible, c) more performers are possible, d) very clean, detailed data
- ❖ con: a) it is prone to light interference, b) reflective dots can be blocked by performers or other structures, causing loss of data, or occlusion-this can be compensated for with software which estimates the position of a missing dot, c) rotations of body parts must be solved for and are not absolute, d) performer must wear a suit with dots and balls (20-30 for body, in 1995), which may be uncomfortable, e) information has to be post-processed or 'tracked' before viewing so performer cannot see his or her image and so cannot be as creative or identify potential problems (a hand hitting a giant nose, for example), f) higher cost than magnetic (a cost of US\$150,000 to 250,000 in 1995), g) tracking can take 1-2 minutes per captured second for straightforward data (complicated can take 15-30 minutes per second, according to 1995 data)

3. Electromagnetic (magnetic)

- ❖ Performer wears an array of magnetic receivers which track location with respect to a static magnetic transmitter
- ❖ One of the first uses was for the military, to track head movements of pilots
- ❖ Often this type of motion capture is layered with animation from other input devices
- ❖ The two main manufacturers of this type of motion capture equipment are Polhemus and Ascension

- ❖ pro: a) positions are absolute, rotations are measure absolutely; orientation in space can be determined, which is very useful, b) can be real-time, which allows immediate broadcast as well as the opportunity for performers to puppeteer themselves with instantaneous feedback (more spontaneity in the performance), c) relatively cheaper than optical (1995 price under US\$40,000 for a typical system)
- ❖ con: a) magnetic distortion occurs as distance increases, b) data can be noisy - it's not as good as optical, c) prone to interference from magnetic fields - cement floors usually contain metal, so stages must be built, d) performers wear cables connecting them to a computer, which limits their freedom, e) in 1995, sampling speed too low for many sports applications

The typical magnetic motion capture session is run much like a film shoot. Careful rehearsal ensures that the performers are familiar with the constraints of the tethers and the available 'active' space for capture. Rehearsal often includes the grips for the cables to ensure that their motion aligns to the motion of the performers. The script is broken down into manageable shot lengths and is often story boarded prior to motion capture. Each shot may be recorded several times, and an audio track is often used as a synchronizing element.

Because the magnetic systems provide data in real-time, the director and actors can observe the results of the motion capture both during the actual take and immediately after, with audio playback and unlimited ability to adjust the camera for a better view. The tight feedback loop makes magnetic motion capture ideally suited for situations in which the motion range is limited and direct interaction between the actor, director, and computer character is important. Today, wireless magnetic systems are available from Ascension, for example, though the performer still must wear a relatively bulky pack of materials on his or her suit.

Other types of motion capture technologies include: sonic, which employs ultrasound and is subject to several types of interference; biofeedback sensing, which measures bodily movement from the heart, brain, retina, eyes, skin, and muscles, and is used extensively in biomechanical and sports related work, but also has been used for music performance; electric field sensing, in which the body either works as a transmitter or a source of interference, which is measured; inertial systems, which measure acceleration, orientation, angle of incline and other characteristics; and video, employing optical technologies which can detect changes in luminescence and color.

Part of what makes motion capture technology such a challenge is the speed at which everything must occur. In real-time mocap, within 1/30th of a second, the length of one frame of video, motion must be sampled, data must be applied to a digital scene representing various body parts of a character, and a scene must be rendered into a digital image. Depending on the system used, interference of the signals can impede accurate collection of data.

Motion Capture Expression

In full body motion capture, typically sensors, or markers, are placed at selected joints on the performer. Several marker segments make up a body segment and each has a 'weight' -that is, influence or priority in bone hierarchy (degrees of freedom). Movements of performers captured in real-time mocap can be supplemented with automated movements, such as blinking,

breathing, hand gestures, or secondary actions (for example, when a foot hits ground, its toes spread out).

These are called '*expressions*': program components written to control a number of low-level features from one high-level attribute, so that the movement becomes more interesting. Related to this are voice recognition systems, such as one developed by Shane Cooper at Protozoa, which allow almost real-time synchronization of mouth movements with words; however, the movements necessarily follow the words and so are at least slightly out of synch. Cooper says that the proper way to work is actually through the audio bank: to have visuals rendered from audio information, not vice-versa. He has not been able to perfect his work, though, because the mocap systems he works with are led by visual material (that is, movement of some sort other than sound waves).

Although the above categories- mechanical, optical, magnetic, sonic, biofeedback, electric field, inertial, and video-are common ways of classifying mocap, another means is by whether a system is 'active' or 'passive'. Active devices include magnetic equipment and synchronized lights, if used in optical motion capture, while passive systems most commonly refer to the use of reflective markers in optical mocap. Passive systems usually are more economical, since there is more 'wear and tear' on active devices. However, the cost of the passive optical mocap process overall generally is higher than the active magnetic mocap process, since optical usually involves more post-production and magnetic is often employed for real-time animation without labor-intensive post processing.

There are also categories for the motion capture itself, most commonly divided into the areas of body movement, facial capture, and hand gestures. Special facial capture systems and gloves can be used to record the more subtle movements of faces and hands that add personality to animated images. Typically, this recording is done separately from the body capture, though it can be done all at once. Shane Cooper notes that "people are very critical of facial animation," in terms of sensing the 'realism' of a character.

Though audiences are perhaps not as critical about the hands of characters, nonetheless these appendages are very important to the animation process. As a result, most 'high quality' mocap will involve post production facial animation and work on hand gestures, to create nuances that make characters more complex. However, in low-budge productions, little post work is done.

Expression Capture Software's

Real-Time Animation Tools

Using tools that are designed for non-technical artists, you'll get instant playback of character performances, alleviating the need to preview or render your work. The real-time capabilities of MotionBuilder makes it the character animation software of choice whether for an individual artist, or as the animation backbone of a large production pipeline.

Revolutionary Character Technology

With its powerful full body FK/IK manipulation rig, Autodesk® Motionbuilder provides powerful automated character setup, so you can quickly setup a powerful rig, independent of

your character's size or proportions. You can customize the look and feel of a character's manipulation rig easily, without the need for scripting or constraint setups. You can also repurpose an animated motion from one character to another with real-time motion retargeting.

Unified Non-Linear Editing Environment

The story timeline for pre-visualization and layout saves even more production time by allowing you to easily blend, edit and sequence tracks composed of animations, cameras, digital video, and audio. You can also make camera shot decisions and re-order and re-time your shots "on-the-fly", similar to traditional non-linear video editing.

FBX

Autodesk® MotionBuilder™ 7.5 natively supports FBX, a platform-independent, high-end 3D authoring and interchange format. It lets you acquire and exchange 3D assets and media from a wide variety of sources quickly and easily. FBX is widely supported by the industry's leading software and hardware manufacturers and film studios.

Different Languages of Script Animation

There is a whole world following the lead of W3C's *SMIL-Synchronized Multimedia Integration Language* and defining animations and especially human animation with XML/XSL derived markup languages. But the whole problem with the XML/XSL approach is what has been seen in the Web database development arenas. XSL and XSLT can be used to derive fairly powerful transformations and queries but only of fairly restrictive XML markup and objects. Call them the XSL languages - they have only the most primitive of notions for conditional tests, functional/subroutine calls and iterative control of operations - and forget notions of operators and operator overloads. The result is that XSL or XSLT based mark ups really require a XML-smart scripting agent (think Groovy, Java, JavaScript with E4X extensions, JudoScript, PHP 5, or Ruby) to really get things done. Nonetheless, there are some fascinating animation components and interactions being built up. Various Script languages are as follows:

RRL - Rich Representation Language (RRL) which is used in the NECA system. The NECA system generates interactions between two or more animated characters.

VHML - Virtual Human Markup Language is designed to accommodate the various aspects of Human-Computer Interaction with regards to Facial Animation, Body Animation, Dialogue Manager interaction, Text to Speech production, Emotional Representation plus Hyper and Multi Media information. Given no small mandate, much is going on but primarily declarative not programmatic.

Metaface - provide a SouthPark-like faces with advanced speech and facial expressions which can be used standalone or in a browser using Java technology and VHML.

BAML - Body Animation Markup Language, like FAML-Facial Animation Markup Language, and others in the VHML set are primarily declarative and then interfaced to Java or other XML consumers.

AML- Avatar Markup Language encapsulates Text To Speech content, Facial Animation and Body Animation in a unified manner with appropriate synchronization information. A top down VRML influenced markup.

ActionScript is well represented in this world with two products. Swift3D from *Electric Rain* and *MindAvenue's Axel 2* both offer dramatically improved 2D and 3D modeling capabilities including smart output to Flash. But the programming interface to both is primitive with only very basic Action scripts. Developers must do the advanced scripting within Flash using carefully constructed SWF movie clips. Not the most effective of interfaces.

In contrast there are some vendors offering scripting and 2D/3D animation but a number appear to be on the brink of solvency. VisViva appears to have a very powerful 3D and animation creation system with a nifty language, Script V, that is Web facing. But emails to the company received no reply. Small has been made open source and is an elegant c-like language for animation and games; but it appears continued development is limited.

Mel scripting

Mel stands for Maya Embedded language and it's a script language similar to C embedded in Maya. Code written in Mel can be executed from the script editor, from the shelves and from drop down menus.

Mel lets the user have more access and more control than the User Interface; some functions of the software and advanced options are only available by using Mel. All maya preferences are maya code so are the drop down menus. This means that it is always possible, with a little digging, to retrieve the mel commands and mel functions that maya calls when you click a specific button of the UI.

Mel is not object oriented, this means it is not possible create classes and methods or functions associated to it as you would in C++ or Python. This however shouldn't be seen as a mere limitation because it gives Mel a strong structure making it accessible and easier to understand to Maya users and to first time programmers. Also the linear scripting nature of the language would assist the user in making the most of the maya nodes instead of tempting him/her to make its own objects, as in case of object oriented languages.

Python

Python is a dynamic object-oriented programming language that can be used for many kinds of software development. It offers strong support for integration with other languages and tools, comes with extensive standard libraries, and can be learned in a few days. Many Python programrs report substantial productivity gains and feel the language encourages the development of higher quality, more maintainable code.

Python runs on Windows, Linux/Unix, Mac OS X, OS/2, Amiga, Palm Handhelds, and Nokia mobile phones. Python has also been ported to the Java and .NET virtual machines. Python is distributed under an OSI-approved open source license that makes it free to use, even for commercial products. The Python Software Foundation (PSF) holds and protects the intellectual property rights behind Python.

Following are the important features of Python:

- ▣ Readable syntax and strong introspection capabilities
- ▣ Intuitive object orientation
- ▣ Natural expression of procedural code full modularity
- ▣ Supporting hierarchical packages
- ▣ Exception-based error handling
- ▣ Very high level dynamic data types
- ▣ Extensive standard libraries and third party modules for virtually every task extensions
- ▣ Modules easily written in C, C++ (or Java for Jython, or .NET languages for IronPython) embeddable within applications as a scripting interface.

ActionScript

ActionScript is a scripting language based on ECMAScript. ActionScript is used primarily for the development of websites and software using the Adobe Flash Player platform, but is also used in some database applications, and in basic robotics, as with the Make Controller Kit. Originally developed by Macromedia, the language is now owned by Adobe. ActionScript was initially designed for controlling simple 2D vector animations made in Adobe Flash. Later versions added functionality allowing for the creation of Web-based games and rich Internet applications with streaming media.

**** End of Unit IV ****

Unit V

Concept (*Conceptualizing*) Development

This Topic describes the typical sequence of tasks required to complete an animation project. Let's pretend you're an animation studio owner or a top-level manager in a production facility where you run one or more animation projects. A project comes to you on day one, and you've got to plan and execute the job within a given amount of time. Your success depends on your ability to manage resources (labor, computers, and supplies), time (from day one until the deadline), and money (the budget for the project). What is the work process you must initiate to achieve success?

Conceptualizing the Animation

Often an animation studio head or a lead animator is required to assist the client in conceptualizing the animation. Sometimes the client may not even know animation is the solution to the problem. The conceptualization process might not call for animation, or it might include the possibility of live-action video, photography, and even live performances. The more experience an animation producer has, the more useful he or she can be during client contacts. Obviously, client contact requires the highest level of both animation and personal communications skills.

Conceptualization is the process by which a creative vendor helps a client achieve a communications goal. If the client wants to sell a designer shoe, for instance, the conceptualization may take the form of a commercial or a website page. In either case, the concept must identify the unique sale propositions (USPs) of the shoe (it's fashionable, its soft) and present them in a memorable message. This message might be an animation, live video, graphics or a combination of all three.

As a creative vendor, it's your job to choose the best combination of media, images, statements and styles to achieve the client's goals. If your expertise is animation you will be able to address a fair percentage of the requirements of a conceptualization, but not all. Therefore you will either subordinate your efforts to a creative director who has broader experience in all media, or you will only meet with clients who require animation concepts.

At such meetings, and the sessions that follow them, your job will be to solve problems (or entertain an audience) with animation. A client may have a toy that is selling poorly west of the Mississippi or a skin cream that employs a new scientific process. Your job as a conceptualizer is to first understand the client's problem and be able to address it with graphic solutions.

Once you think you have the solution, you are required to present it effectively to the client, who will then have to decide if your solution is worth the money to execute. As an animator, your solution will tend to be animation oriented, but you must also keep your mind open for other media that, when combined with animation, will make the solution even more effective. Knowing how to combine animation with video, film, web site content and even print applications will enhance your effectiveness. And lead you to

become a creative director. Your role as an animator therefore may be part of a larger production or a stand-alone animation.

Sooner or later, your job as a conceptualized must include being able to sketch your ideas with a pencil and paper. You may need to draw a cute character and convince your client that the character will win him or her more customers. You may need to sketch a forest setting or an urban street where your animation will be staged. Finally, you will be required to create a full, graphic depiction of the entire animation—a series of drawings, a lot like a comic book. This is called a storyboard.

The Story Development (Storyboard)

The storyboard is the blueprint of an animation. Depending on your role in the production, you may be required to create the storyboard from scratch, adapt and modify an existing storyboard, or be given a storyboard that is complete and over while you have little or no control. I'm going to use a real case study from a recent production. conceptualization. This project was for JVC's new line of video projection systems called D-ILA. The client expressed an interest in creating a one-minute animation that could introduce the product's slogan, "Images of Perfection."

The animation itself would be shown on a D-ILA projector at the National Association of Broadcasters (NAB) convention in Las Vegas, the largest technical tradeshow in the world. The animation had to be completed in 50 days. Because the projectors were capable of high definition (HD) resolution, the animation would have to be created in the 1080i HD format, requiring interlaced frames measuring 1,920 pixels wide by 1,080 pixels high. Given this challenge, I returned to my studio and had a meeting with Jack Ehrbar, then my chief animator.

Because our meeting only involved the two of us, we sat at a table with a large pad of white paper. Conceptualization meetings in larger studios or 59 From Concept to Screen: The Workflow Process advertising agencies can include dozens of people, so a whiteboard might be used. The paper or whiteboard acts as a kind of visual kick start, its emptiness prompting you to get thinking.

The first task of conceptualization is to list the objects of the animation. What does the client want out of the project? These objects might start at the basic level:

- Attention to the new product
- Immediate sales leads
- Product brand recognition
- Corporate brand recognition

I usually put basic objects on the board or paper with lots of space beneath, because once written they demand further details, such as the following:

- Attention to the new product
 - USPs
 - Competitive features
 - Weak points
 - Focus group results

- Immediate sales leads
 - Geographic-specific issues
 - Direct appeal to action
 - Consistency with client collateral
- Product brand recognition
 - Preexisting product characters or elements
 - Preexisting image of the product

Clients who want to know what their customers think about a product often conduct focus groups. The client, usually anonymously, assembles a group of customers and has a professional interviewer solicit opinions. Without knowing which company is sponsoring the group, customers often give frank appraisals that reveal weaknesses and strengths about the product.

These are concerns that relate to the location in which the animation will appear. Often, viewer expectations with regard to race, accent, subject matter, and other demographic issues play a part in animation design, particularly character design.

Collateral consists of material the client is distributing in addition to your animation. For instance, if the object of an animation is to get the viewer to order a videotape, should the animation design be adapted to the graphic appearance of the video and its package?

- Radical animation idea
- Humor
- Clever characters
- Corporate brand recognition
- Corporate image
- Logos and design limitations
- Legal issues

Straight away, as an artist, you might look at this outline and think, “What does all this have to do with a creative design?” A lot. Despite what you might think about society’s debt to you or your entitlement to enjoy a life of fulfilling, enjoyable work, the basic fact of life that underscores almost all animation work is that our work is used for practical purposes. Aside from pure artwork that you might create on spec (that is, you don’t get paid up front) or under a (rare) grant or commission, your work is going to be contracted for and judged by its commercial value. That’s why it is important to think commercially before you create. The closer you can get your creative mind around the specific business goals of your client, the more completely your end product will satisfy your client. In the commercial animation business, total client satisfaction is the main goal.

Learning how to organize your creative thoughts along a predetermined course of necessities is not such a bad habit to acquire. If you don’t believe me, consider how many times you’ve sat in front of a blank screen or paper totally lost for an idea. Try making a personal satisfaction list of what you want out of your animation similar to my client

satisfaction list above, and I guarantee the ideas will flow a lot faster. In fact, you may have to discipline yourself to finish the list as ideas start flowing from your first notes.

So Jack and I are sitting with this list of client satisfaction issues for the JVC animation, and we can see some important things forming up right away. Here's how our list developed. Under Unique sales points, we wrote "Excellent images, advanced design chip." Under Competitive features, we wrote "Best resolution of any projector, no moving mirrors on chip." For Weak points, we wrote "Relatively expensive, bulb lasts 1,000 hours, costs \$1,000, \$1.00 per hour to run." Under Focus group results, we wrote "None." For Immediate sales leads—Geographic-specific issues, we wrote "Best to sell in large metro markets, especially New York and LA." Under Direct appeal to action, we wrote "Get everyone at NAB to watch the following video sample reel." For Consistency with client collateral, we noted "JVC 61 From Concept to Screen: The Workflow Process Brochure has a full-page logo we should incorporate as closing frame in animation."

Under, Product brand recognition—Preexisting product characters or elements, we noted "Product Slogan: Images of Perfection. Corporate Slogan: JVC Takes You Further." I also noted, "Let's try to find out who actually owns the Nipper the Dog image?" Jack added, "Egyptian themes popular in current cinema releases (Mummy II, cover of National Geographic, Indiana Jones)."

Under, Preexisting image of product and Radical animation idea, we wrote "No controls here. Let's see how far we can take the client. Humor has to be tasteful and bicultural (JVC is a Japanese company). Clever characters, but only if they support the basic sales theme." Under Corporate brand recognition—Corporate image, we noted "Excellent engineering at an affordable price. Always bringing out new technology, but not enough money behind marketing. Need new image for acquired projector line." (JVC acquired a division of Hughes that brought video projectors into JVC's product line.)

Drawing the Storyboard With all of this now on paper, Jack and I let our creative juices flow. Each idea was filtered through the statements we had written in our list of objectives. I was keen on using the Nipper the Dog image. This is a really old logo that goes back to the Victor Company and features a little dog staring into the megaphone of a wind-up Victrola record player.

Under the picture is a slogan, "His Master's Voice." The idea behind this logo is that the Victrola can record a person's voice so well that the dog will think it's real. My idea was to bring this logo up-to-date and have a dog looking at the screen of the D-ILA projector and thinking it was really his master. The slogan would be "His Master's Image." I went off to start sketching storyboards that had the dog running repeatedly at the screen, bouncing off and running back. Finally, the dog, tired out, lifts his leg toward a fire hydrant that appears onscreen.

Jack took a different approach. He focused on the Egyptian theme and sketched out a storyboard that was reminiscent of Indiana Jones. In Jack's story, a group of Egyptians led by a Dr. Jones tries to break into a pyramid searching for "Images of

Perfection.” Finally, in the innermost chamber, the explorers find a living pharaoh watching scenes of his pyramid on the D-ILA projector. This concept especially countered the bulb-life issue. I’m not as good a storyboard artist as Jack, but after we were finished, we critiqued each other’s work, pointing out weaknesses, adding ideas in order to stick to the list of objectives, and otherwise honing the results. Eventually, Jack finished the two boards in his highly professional hand.

The leg-lifting scene was deleted. It wasn’t in the best of taste obviously. I also had to call lawyers and the Library of Congress to find out if JVC did or did not own the logo. JVC thought it was still owned by RCA but were not sure. Jack’s idea got revised a bit too. We took out the crowd of explorers and honed it down to one Egyptian and Dr. Jones. The idea worked just as well and it’s easier to animate two characters than eight.

Once the storyboards were done, we set an appointment with the client and then started to write dialog for the characters in our boards. Adding Dialog It’s not often a good idea to put dialog in storyboards, unless absolutely necessary for the concept to work, or unless you are going to send the boards to someone without the benefit of a live presentation. This is done for two reasons. First, a really good animation board should work without dialog. This is not to say that dialog is bad. Many great animations can’t work without the characters talking. It’s just a good test of your visual abilities to try to create boards that need a minimum of dialog.

The second reason is that clients tend to criticize a board based on text. Text is easily picked apart. As far as pictures, most clients can’t draw, so they don’t tend to be critical about pictures. They either like them or they don’t. So if you attach too many words to your pictures, you are giving the client a chance to criticize and perhaps reject your work. With animation boards, it’s so much better to go in to a meeting and talk your way through the dialog. That way, if you see a frown or read displeasure, you can switch your direction and change the dialog on the spot, that is, if you’re creatively fast on your feet.

Production Budget

Equipment and Software Obsolescence

In the past, animation equipment was too expensive for a beginner to own. It wasn’t like today, where you buy a computer for as little as \$500 along with some software for a few thousand dollars and, you’re in business. Back in the 1970s when all this got started, you had to buy a whole “animation system.”

Computers like the PC and Mac weren’t on the market yet. People didn’t even know what computers did! The smart guys, who did know, tooled up some computers, put some proprietary software on them, and sold them as “systems.” These systems, such as the Bosch FGS4000 and the Dubner CGB-2, sold for upwards of \$250,000! That’s a lot of money even today. Just to impress you with how primitive things were back then, it was considered cool if your animation system could handle 256 colors onscreen at one time.

Of course, today, you can buy a video card for \$50 that throws millions of colors on the screen without even trying. Aren't you glad you're an animator today? Actually, in 10 years you'll be old like me and talking about how long it took to . . .

Okay, how little equipment can you own to get started as an animator? That's a good way to start off, isn't it? Why spend gazillions on a studio if you can start making "day-one dollars" with no money down. It's possible. In fact, you don't need to own any computers to get started as an animator. Instead you can be a briefcase producer.

Rather than having an office filled with expensive equipment, a briefcase producer has nothing more than a briefcase. You arrive at a client's office, show your reel, get the job, and then hire subcontractors and rental facilities to do the job. You get the reel, of course, from your internship and entry-level work, done on your employers' computers. You don't think this can work for you?

I did it. And I didn't even have to do an internship or work entry level to get my first reel. All I did was convince a few animators that I would get work for them. They gladly lent me their reels and I simply edited them onto a reel of my own, under my company name, with the appropriate animator's name preceding each batch of borrowed clips. In client presentations, I simply said that I represented a group of talented animators and that I would design the storyboards and make the soundtracks while the animators did the pictures.

Whenever you buy equipment for a business, you should be familiar with some basic concepts about money and investing. This topic covers these simple ideas first, and then the basic tool set for a beginner's animation workstation will be outlined. After that, you will learn how to build on that workstation until you have a fairly diverse platform suitable for animation and compositing productions. I'll take a chance and name some products that seem to have lasting value, although they will certainly go through upgrades and mergers as the months and years pass.

Audio & Video

Refer **PRINCIPLES OF MULTIMEDIA – Ranjan Parekh (Chapter 7 & 8)**

Color Model – Device Independent Color Model – Gamma and Gamma Correction

PRINCIPLES OF MULTIMEDIA – Ranjan Parekh (Chapter 5.4, 5.11 & 5.12)

3D Animated Movies

1985 - Nov 22, 1985 - One-dimensional cartoon with **3D** technology. Twelve-year-olds and **animation** freaks will enjoy it. "Star Wars" did it better with live people, Only 12-year-olds who have never seen or heard of "Star Wars" - and **animation** freaks.

2000 - Jul 31, 2000 - Getty Images; May 13, 2009 ; 167 words ...**3D animated movie** "Up crew, executive producer [John Lasseter](#)... Full [Size JPG](#) (1322 KB) **3D animated movie** "Up crew, executive producer John Lasseter...opening ceremony and the screening of **3D animated movie** "Up" during the 62nd Cannes Film

2002 - Feb 12, 2002 - HIT **movie** Monsters, Inc. has topped [Toy Story](#) 2 to score the biggest opening weekend for an **animated movie** in UK cinema **history**, Full Size JPG (1322 KB) **3D animated movie** "Up crew, executive producer John Lasseter...opening ceremony and the screening of **3D animated movie** "Up"

2003 Mar 30, 2003 - Janus, Prajurit Terakhir is a family **movie** produced by PT Spektra Film. Combining live action and computerized **3D animation**, ... What caused the buzz was that Janus will be the first locally made, feature-length, **3D**, computerized-**animation movie**

2004 Jul 19, 2004 - India is one of the few countries that has the capability to produce **3D animated movies**. The Chennai-based [Pentamedia Graphics](#) has produced the most number of **3D animated movies** in the world - six - and a few more are under production. One of the company's **movies**, the \$6-million Buddha

2005 Apr 18, 2005 - Getty Images; May 13, 2009 ; 167 words ...**3D animated movie** "Up crew, executive producer John Lasseter... Full Size JPG (1322 KB) **3D animated movie** "Up crew, executive producer John Lasseter...opening ceremony and the screening of **3D animated movie** "Up"

2006 Nov 16, 2006 - Full Size JPG (1322 KB) **3D animated movie** "Up crew, executive producer John Lasseter...opening ceremony and the screening of **3D animated movie** "Up" during the 62nd ... Picture from: Getty Images; May 13, 2009 ; 131 words ...**3D animated movie** "Up" executive producer John

2007 Mar 13, 2007 - Adlabs is producing "Superstar", a **3D animated movie** starring Rajnikanth, which is meant for both - kids and adults. Also, "[Gini & Jony](#)", which is based on the characters of the clothing brand of the same name, is an **animated movie** for kids. Both are targeting a 2008 release

2008 Sep 4, 2008 - To graduate from Icreation, students have to create a **3D animation movie** of their own. "Students have submitted their works to compete with adults in various competitions. They do not have to win, but they may pass into the final round or receive a complimentary prize.

2009 May 13, 2009 - Its dazzling **3D** digital effects add a striking new dimension to a classic odd couple tale but the filmmakers insisted that they had focused primarily on conveying old-fashioned emotion. 'I knew this **movie** was going to be very unusual but also loaded with heart,' Lasseter told reporters