ANIMATOR

Edited by
Prof. Chandrabhanu Pattanayak

- 3D Design & Modelling
- Video Editing
- Sound Editing
- Composition
- Digital Sculpting
Animator

A Complete Animation and VFX Production-Ready Training Curriculum
(Aligned to MES/ Q 0701 of Media and Entertainment Skills Council, India)

INSTITUTE OF KNOWLEDGE SOCIETIES
CENTURION UNIVERSITY OF TECHNOLOGY AND MANAGEMENT
ANIMATOR

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About This

Animator course is structured in the same way, as outlined below.

How this document is structured

The Course Overview

The course overview gives you a general introduction to the course. Information contained in the course overview will help you determine:

- If the course is suitable for you.
- What you will already need to know.
- What you can expect from the course.
- How much time you will need to invest to complete the course.

The overview also provides guidance on:
- Study skills.
- Where to get help.
- Course assignments and assessments.
- Activity icons.
- Units.

We strongly recommend that you read the overview carefully before starting your study.

The Course Content

The course is broken down into units. Each unit comprises:

- An introduction to the unit content.
- Unit outcomes.
- Terminology.
- Core content of the unit with various learning activities.
- A unit summary.
- Assignments and/or assessments, as applicable.

Resources

For those interested in learning more on the subject, we provide you with a list of additional resources at the end. These may be books, articles or web sites.

Your Comments

After completing the course we would appreciate if you would take a few moments to give us your feedback on any aspect of this course. Your feedback might include comments on:

- Course content and structure.
- Course reading materials and resources
- Course assignments.
- Course assessments.
- Course duration.
- Course support (assigned tutors, technical help, etc.)

Your constructive feedback will help us to improve and enhance this course.
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Welcome to Animation Audio-Visual Production - A Complete Animation and VFX Production-Ready Training Curriculum

Animation Audio-Visual Production is an extensive and capacity building skill course for the Animation and VFX aspirants ready to start their career in the industry as professionals, technicians, creative resources or academicians. This course is designed out of two decades of experience and expertise both in industry and academia from the writer. The prime objective of this course is to bridge the gap between the common problems that arise from the industry level production and academics mismatch.

Is this course for you?

This course is intended for people who aspire to become:
Skilled Creative and Artistic Workforce
Skilled Technicians and CG Artists
Skilled Animators, Assistant Animators
Skilled Composers and Animation Editors, Assistant Editors
Skilled Creative and Animation Directors, Assistant Directors
Skilled VFX Artists of Various Expertise and Specializations
Skilled Audiographers, Foley Artists, Mimicry Artists, Ambiphonists
Animation Production Managers, Animation Production Coordinators, Assistant Production Manager, Assistant Production Coordinators
Academicians or and Skill Trainers of Industry Standard

The Prerequisites and Skills Needed for This Courses are:
General interest in and aptitude for creative and artistic visualization
Basic urge to visualize, write, draw and imagine out of the box
Basic knowledge of Physics, Biology with Fine Arts is an added advantage.
Curiosity regarding various art forms, visual medium, various artifacts, museum and archive studies

Course Outcomes

Upon completion of the course you will be able to:
• PRODUCE Animated Contents
• DESIGN Animated Films
• DIRECT Animated Contents for Various Purposes
• DESIGN Characters and Props
• BECOME Bg and Layout Artist
• BECOME Cg Modelling Artist
• BECOME Cg Texturing Artist
• BECOME Cg Lighting Artist
• BECOME Rigger
• ANIMATE Characters and Movable Assets For 2d, Cg and Stop-Motion
• **BECOME** Compositor For 2D, CG and Stop-Motion
• **BECOME** VFX ARTIST
• **EDIT** Animation Films
• **BECOME** Audio Technician Or/and Artist For Animation
• **MANAGE OR COORDINATE** Animation Production

**Study Skills**

As an adult learner your approach to learning will be different from your school days: you will choose what you want to study, you will have professional and/or personal motivation for doing so and you will most likely fit your study activities around other professional or domestic responsibilities.

Essentially you will be taking control of your learning environment. As a consequence, you will need to consider performance issues related to time management, goal setting, stress management, etc. Perhaps you will also need to be reacquainted with areas such as essay planning, coping with exams and using the web as a learning resource.

Your most significant considerations will be **time** and **space**, i.e. the time you dedicate to your learning and the environment in which you engage in that learning.
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Unit 1

Animation History and Evolution

Introduction

Deep into the synthesis of time and space, creation of the universe and biological life forms are meant for motion and different kinds of movements. These movements through time and space are no programmes, yet can be imitated, reproduced similarly for accurate archival presentation, representation and effective communication.

Without movements there is no life. To study life means to study movements. An accurate and perfect study of movements can make us think or be capable of reproducing such movements and activities through time and space in various mediums. So far we have been in perfect control of the human race, i.e. various forms of audio-visual presentation, representation and reproduction.

To 'animate' is literally 'to give life to', etymologically derived from the Latin root “Animae” (to move). 'Animating' is moving something which can't move itself. In other words, it is a process of giving life to a non-living form.

Hence, animation is universally defined as the process of making the illusion of motion and the illusion of change by means of the rapid display of a sequence of static images that minimally differ from each other.

Since the days of cave paintings till date of virtual realism of life things have evolved in such a direction by all races irrespective of geographies.

Before diving into a multi-skill integrated course like this which would definitely give the learner an edge over other trainees and aspirants, we must study the history and evolution of animation in order to make our fundamental understanding of this integrated and ever evolving skill stronger throughout time.

This highly industry standard production-ready curriculum is developed with years of enormous efforts into its making and compilation. With an objective of making the students, intelligent skilled professional/s perfectly in sync with the rapid evolution in this virtual universe, for sure they are going to play second god.

1.1 History of Animation

Watch this introductory video on History of Animation at goo.gl/mYjgFZ

The idea of animation is far older than the films or television. The human race began painting animals on cave walls, sometimes drawing four pairs of legs to show motion 35,000 years ago.
More interestingly at Konark temple, Odisha, the 24 wheels represent 24 hours. Twelve wheels show the life of Oriyas of that age in day time and the other 12 represents life after dark. If closely observed, one wheel which was showing life of a woman from sun rise to sun set is accurately maintained body volume in such a way that if we click every pose individually and flip it, we would find a key frame animation of the lady.
Some Egyptian drawings also express progressive movement

![Egyptian burial chamber mural](Source: Wikimedia)

1.2 Various Imaging Forms and Tools

The Ancient Greeks sometimes decorated pots with figures in successive stages of action. Spinning the pot would create a sense of motion.

As far as we know, the first attempt to project drawings onto a wall was made in 1640 by Athonasius Kircher with his ‘Magic Lantern’.

Kircher drew each figure on separate pieces of glass which he placed in his apparatus and projected on a wall. Then he moved the glass with strings, from above. One of these showed a sleeping man’s head and a mouse. The man opened and closed his mouth and when his mouth was open the mouse ran in.

Although photography was discovered as early as the 1830s, most new devices for creating an illusion of movement were made using drawings, not photos.

In 1824 Peter Mark Roget discovered (or rediscovered, since it was known in classical times) the vital principle, ‘the persistence of vision’. This principle rests on the fact that our eyes temporarily retain the image of anything they have just seen. If this was not so, we would never get the illusion of an unbroken connection in a series of images, and neither movies nor animation would be possible. Many people don’t realize that movies don’t actually move, and that they are still mages that appear to move when they are projected in a series.

Roget’s principle quickly gave birth to various optical contraptions.

**The Thaumatrope:** A cardboard disc mounted on a top — or held between two pieces of string. A birdcage drawing is on one side and a bird on the other. When the top is spun or the strings are pulled the disc twirls, the images merge and the bird seems to be in the cage.
The Phenakistoscope: Two discs mounted on a shaft — the front disc has slits around the edge and the rear disc has a sequence of drawings. Align the drawings with the slits, look through the openings and as the discs revolve we have the illusion of motion.

The ‘Wheel of Life’ (or the Zoetrope): Appeared in the USA in 1867 and was sold as a toy. Long strips of paper with a sequence of drawings on them were inserted into a cylinder with slits in it. Spin the cylinder, look through the slits and the creature appears to move.

The Praxinoscope: Devised by the Frenchman Emile Reynaud in 1877. He was the first to create short sequences of dramatic action by drawing on a 30 foot strip of transparent substance called ‘Crystaloid’. This opened the way for the tremendous advances to come.

The Flipper Book: In 1868 a novelty called ‘the flipper book’ appeared worldwide and it remained the simplest and most popular device. It is just a pad of drawings bound like a book along one edge. Hold the book in one hand along the bound edge and with the other hand flip the pages and ‘see them move’. The result is animation - the illusion of continuous action. Drawings in time.

This is the same as school children making drawings in the corners of their maths books and flipping the pages.

Fig 5: Flipper Book  (Source: Wikimedia)

Today the ‘classical’ animator still flips his drawings the same way as a flipper book before testing it on the video or film camera. He places the drawings in sequence, with the low numbers on the bottom, then flips through the action from the bottom up. Eventually he should get good enough at it to approximate actual screen time and spot any errors or drawings that need altering. Now that we have the video camera with its instant playback of the drawings at film speed, not everyone learns to flip.

In 1896 a New York newspaper cartoonist James Stuart Blackton interviewed the inventor Thomas Edison who was experimenting with moving pictures. Blackton did some sketches of Edison, who was impressed by Blackton’s speed and drawing facility and asked him to do some drawings in a series. Later, Edison photographed these - the first combination of drawings and photography.

In 1906 they publicly released Humorous Phases of Funny Faces. A man puffed a cigar and blew smoke rings at his girl friend, she rolled her eyes, a dog jumped through a hoop and a juggler performed. Blackton used about 3000 ‘flickering drawings’ to make this first animated picture - the forefather of the animated cartoon. The novelty brought explosions of laughter and was an instant hit.

A year later, Emile Cohl made and showed his first animated film at the Follies Bergères in Paris. The figures were childlike - white lines on black - but the story was relatively sophisticated: a tale of a girl, a jealous lover and a policeman. He also gave lampposts and houses intelligence and movement, with emotions and moods of their own. Cohl’s work prefigures the later animation dictum, ‘Don’t do what a camera can do — do what a camera can't do!’
Winsor McCay, brilliant creator of the popular comic strip 'Little Nemo in Slumberland,' was the first man to try to develop animation as an art form. Inspired by his young son bringing home some flipper books, he made 4000 drawings of ‘Little Nemo’ move. These were a big hit when flashed on the screen at Hammerstein’s theatre in New York in 1911.

As another experiment he drew a bizarre short film, How a Mosquito Operates, which was also enthusiastically received.

Then in 1914 McCay drew Gertie the Dinosaur and McCay himself performed live in front of the projected animation, holding an apple in front of Gertie and inviting her to eat. Gertie lowered her long neck and swallowed the fruit - astounding the audience. This was the first ‘personality’ animation - the beginnings of cartoon individuality. It was so lifelike that the audience could identify with Gertie. It was a sensation.

In McCay’s words: "I went into the business and spent thousands of dollars developing this new art. It required considerable time, patience and careful thought timing and drawing the pictures. This is the most fascinating work I have ever done - this business of making animated cartoons live on the screen.'

McCay also made the first serious dramatic cartoon, The Sinking of the Lusitania, in 1918. A war propaganda film expressing outrage at the catastrophe, it was a huge step forward in realism and drama - the longest animated film so far. It took two years of work and needed 25,000 drawings.

Later, as an older man being celebrated by the younger funny-cartoon animators in the business, McCay lashed out at them saying that he had developed and given them a great new art form which they had cheapened and turned into a crude money-making business done by hack artists.

This well defines the endlessly uncomfortable relationship between the pioneering artist/idealist and the animation industry - working to comfortable and predictable formulas.

Still doth the battle rage…

In the 1920s Felix the cat became as popular as Charlie Chaplin. These short Felix cartoons were visually inventive, doing what a camera cannot do. But more importantly, a real personality emerged from this flurry of silent, black and white drawings and Felix himself” connected with audiences worldwide.

The Felix cartoons led straight to the arrival of Walt Disney, and in 1928, Mickey Mouse took off with his appearance in Steamboat Willie - the first cartoon with synchronized sound.

The brilliant Ward Kimball, who animated Jimmy Cricket in Pinocchio and the crows in Dumbo, once told me, ‘You can have no idea of the impact that having these drawings suddenly speak and make noises had on audiences at that time. People went crazy over it.’

Disney followed Steamboat Willie with The Skeleton Dance. For the first time, action was coordinated with a proper musical score. This was the first Silly Symphony. Ub Iwerks was chief animator on both films and most of the sophisticated action of The Skeleton Dance still holds up today.

Disney leapt forward again in 1932 with Flowers and Trees — the first full colour cartoon.

Then he followed it one year later with Three Little Pies. This had a major impact because of its fully developed personality animation - clearly defined and believable separate personalities acting so convincingly that the audience could identify with and root for them. Another first.

Astonishingly, only four years after that, Disney released Snow White and the Seven Dwarfs, the world’s first fully-animated feature-length film, raising cartoon drawings to the level of art and holding the audience spellbound for eighty-three minutes. A truly staggering feat accomplished in an incredibly short space of time. (It is said that many of the artists booked themselves in advance into hospital to recover from the effort of completing the film.)

The tremendous financial and critical success of Snow White and the Seven Dwarfs became the foundation of Disney’s output and gave birth to the ‘Golden Age’ of animation: Pinocchio, Dumbo, Bambi and Fantasia, as well as the Silly Symphonies and Donald Duck and Mickey Mouse shorts. Surrounding the potent Disney centre were the satellite studios: Max Fleischer with two features - Gulliver’s Travels and Mr. Bug Goes to Town - and Popeye shorts; Warner Bros’ Looney Tunes and
Merrie Melodies with Bugs Bunny, Daffy Duck, Porky Pig; MGM with Tom and Jeny, Droopy and the great anarchic Tex Avery shorts, and Walter Lantz with Woody Woodpecker. Fed as they were by the knowledge and expertise emanating from the Disney training centre, their much wilder humour was often in reaction to or in rebellion against Disney ‘realism’ and ‘believability’.

1.3 Contemporary Animation and Its Future

For animation professionals and technicians all around, it has become extremely important to get updated skill learning and to keep the pace with the technology, smart production pipeline and delivery with growing demand for contents from all works of life across the globe. The way technology and human imagination is racing ahead it is a key factor to groom the next generations of professionals and technicians particularly in the field of animation building and upgrading their skills from time to time to become productive with the growing demand not only in quantity but quality, perfection and finesse.

Technology Driven Animation and Various Populist Forms

With time, various technologies evolved in the field of Animation Production to ease the production process with a smartness to deliver faster without compromising on the quality. Tech-invasion apart, animators, creative directors and animation directors from all around the world bring in their own styles and forms of animation inspired from various cultures, art forms and indigenous creative impulses. Delving into such in-depth production skill sets requires understanding the former technology, various types and forms of animation produced in the last century.

Dimensional Animation [From Classical to Tra-digital]

Watch this introductory video on Dimensional Animation at goo.gl/PNSYFH

Since the1800s, 2D animation has existed as the standard form of creating animated films. It is also known by other popular names such as classical animation, CEL animation, or hand drawn animation. It is a number of different frames, followed by the other in a slightly different pose. Generally, it combines 24 frames per second, hence giving the impression of a moving drawing. Technically, there is a lot of difference between the “Traditional” animation and Computer or Digital Animation. The primary difference is of the tools involved, the cost and effort, and the quality of the final output.

Traditional animation is a hands-on-process, which is done by hand-drawing hundreds of thousands of individual frames and then transferring them onto clear plastic “Cels”, painting them by hand and then filming the whole thing in a sequence over a painted background image. This requires a whole team of artists, painters, directors, background artists, storyboard artists, script writers, along with filming crew. This may sound easy and basic; however it takes a staggering amount of patience, time and resources. Besides Cartoons and Animations, the other main areas where the traditional 2D animation technique has been employed are Typography, Cartography, Technical Drawings, and Advertising.

Cel animation has many advantages over the computer generated animation. The advantages being firstly being cheaper to make, which is due to no technology required and therefore the resources would be a minimum of Cels and equipment in order to draw and sketch illustrations. A second advantage of this technique would be the animation looking very detailed; this is due to the repetition of similar scenes resulting in a buildup of artwork.
Like many people of my generation, my childhood consisted of watching mostly the traditional 2D within television and film, from Mickey Mouse, Dennis the Menace to Tom and Jerry and Wacky Racers. There were hours on a weekend or before/after the school day that you would spend time watching instead of doing your homework due to their classic silly playful fights and the pure brilliance of the show endlessly delivering the entertainment we love. For me, personally, I loved watching all these programmes for the stories and the comedy that is shown in these classic shows. Often trivial, silly and occasionally violent - it was all fun entertainment.

But it was also something that from an artistic point of view inspired me. There was something about the art that even as a child was the most important reason I found these cartoons so personally appealing and magical that I wanted more and more of it. It was more than just the classic comedy, laughter and sometimes violent outbursts I got out of it; it was the rich and colourful power I could feel from the quality of the classic hand-crafted image, frame by frame.

The traditional ‘keys that are used in classic cartoons range from dust on the ground, if for example a car brakes or a person who is running suddenly screeches to a halt, or the ground shaking like an earthquake from the impact of someone falling. This is one of many things I feel is becoming more and more lost in CGI.

3- Dimensional or CG:
A new generation of films and movies has now erupted onto our screens; from the early Pixar movies, such as Toy Story, to some of the latest hits like Frozen and Lego Movie. The entire generation of feature animations is changing and becoming more and more reliant on computer technology which gives a whole new feel from a visual perspective.
Most films in the present generation still maintain a storyline well and there is still always the one sidekick character who may be far from the lead of the main plot but still provides a crucial coherence and a vital comedic aspect to the film.

However, I feel that some of the most recent animated feature films and television programmes show a decline in the appeal of imagery. There is no longer a feeling of authenticity in these shows, there is no longer a feeling that an individual has sat down and put pen to paper, there is no raw creativity coming through our screens. Every frame that is put in a CGI creates a block between the artist and the viewer, and I feel a slight passing regret for the artistic skill from our first ever creators.

Stop-Motion Animation

Stop-motion (hyphenated stop-motion when used as an adjective) is an animation technique that physically manipulates an object so that it appears to move on its own. The object is moved in small increments between individually photographed frames, creating the illusion of movement when the series of frames is played as a fast sequence. Dolls with movable joints or clay figures are often used in stop-motion for their ease of repositioning. Stop-motion animation using plasticine is called clay animation or "clay-mation". Not all stop-motion requires figures or models; many stop-motion films can involve using humans, household appliances and other things for comedic effect. Stop-motion using objects are sometimes referred to as object animation.

Stop-motion animation has been around for a long time, almost as long as traditional film-making. Originally stop-motion involved animating objects which included the animated movement of any "non-drawn" objects such as toys, blocks or any rigid inanimate object you care to mention. This was quickly followed by cell animation. And then animators experimented with clay animation and puppet animation which is what you may be familiar with in Wallace and Gromit and so forth.

The term "stop-motion", related to the animation technique, is often spelled with a hyphen, "stop-motion". Both orthographical variants, with and without the hyphen, are correct, but the hyphenated one has, in addition, a second meaning, not related to animation or cinema: "A device for automatically stopping a machine or engine when something has gone wrong" (The New Shorter Oxford English Dictionary, 1993 edition).

Stop motion is often confused with the timelapse technique, where still photographs of a live surrounding are taken at regular intervals and combined into a continuous film. Time lapse is a technique whereby the frequency at which film frames are captured is much lower than what is used to view the sequence. When played at normal speed, time appears to be moving faster and thus lapsing.

Some early examples of stop-motion films and techniques can be seen in the The Humpty Dumpty Circus (1898) and in Fun in a Bakery Shop (1902). In 1907 The Haunted Hotel was a very successful movie with the cinema audience of the time. In 1912 one of the first clay animation movies using stop-motion was released to great critical acclaim. It was called Modeling Extraordinary. In 1916, the first woman animator, Helena Smith Dayton, began experimenting with clay stop-motion. She released her first film in 1917, Romeo and Juliet. December of 1916, brought the first of Willie Hopkin's 54 episodes of Miracles in Mud to the big screen.

Some other notable milestones in stop-motion history are:

- Edwin Porter directed The Teddy Bears, one of the earliest stop-motion animation films. A short sequence of playing teddy bears, just over a minute in length, takes over 50 hours to animate.
- Willis O'Brien's The Lost World included 49 prehistoric animals in stop-motion, which took a huge step in stop-motion history.
- Willis O'Brien directed another film called Mighty Joe Young, a well-known film in 1945, with the help of Ray Harryhausen, and stop-motion animator. Ray Harryhausen received the Gordon E. Sawyer Award from the Academy of Motion Picture Arts and Sciences for his technological contributions in 1991.
Stop-motion has changed dramatically since the early 20\textsuperscript{th} century. Though this medium seemed to die a natural death due to the enormous invasion of 3D animation, but it has been evolved with the passion of stop-motion animators, sculptors, set-designers and puppeteers.

The recent great movies are:

\textbf{Fig 8: The Pirates! In an Adventure with Scientists! (Source: Wikipedia)}

\textbf{Fig 9: Para Norman (Source: Wikipedia)}

\textbf{Fig 10: Frankenweenie (Source: Wikipedia)}
Understanding the Technology, Software-Driven Animation Production

Animation technology over the years has been inspired by the greatest animators, animation directors in more than a century time. From the cell painted animation to the virtual real interactive cinema, the technology has evolved considerably. But the major turning point of this rapidly upgrading technology is the rise of digital technology. Computers have really broken many constraints in the making of animated contents. The productions have never been so easy and faster. There was a time when we were waiting to watch an animated movie in a production span of 7 years or more.

Thanks to these super computers and great render farms, now one major production house is capable of producing more than 2-3 full length animated features. With more and more professionals becoming conversant with the technology and getting upgraded everyday with the advantage cloud computing, these breeds of second gods are really eyeing the cosmos and beyond.

Yet depending on the comfortability of the maker/s and demand of the tale, various pipelines have been chosen for the production.
So to know these processes and skills, before we start the detailed in-depth skill lessons, an overview of the interfaces and behavioural practices with the software and some hardware gadgets is mandatory.

**UI Overview, Learning The Generic Tools and Techniques**

2D Classical and Tra-digital Softwares to be conversant for animation aspirants are:

**Fig 13: Toon Boom Studio**

**Fig 14: Toon Boom Animate Pro**

**Fig 15: Toon Boom Harmony**
Note: Most of the software today are moved into cloud version for several reasons like keeping updated with the technology, smart production pipeline and productivity with less possible memory usage, anti-piracy, etc.

Multi-skill based or/and integrated software have customizable UI [User Interface] with specialized skill area interfaces suitable to the production pipeline standards set by the studio or Production Head and Production Manager.
3D or CG Softwares to be conversant for animation aspirants are:

Fig 19: Blender (Source: Wikimedia)

Fig 20: Autodesk Maya (Source: Flickr)

Fig 21: Cinema 4D (Source: Flickr)
Rather than delving into many software, the aspirants should choose 1-2 software as per their comfortability of area of specialization, affordability or/ and suitable to the production pipeline they aim to work with.

For the practice session of these software, the contact hours would be with the software instructor and faculty most preferably from the industry production background are suggested.

1.4 Effective Communication Tools for Education, Medical Sciences, Engineering, etc

Myth and Reality

Myth: The society at large has a myth that animation is only related to fun, entertainment and for children.

Reality: Animation as an effective communication tool not only for entertainment but education, medicine, health, engineering and capacity building gives a sensible and thorough understanding of the medium.

Myth: India could only get sub-contracts and is considered a low-end production place as far as animation is concerned.

Reality: Contract work for foreign companies has helped production studios in India build the domestic animation market resulting in a spate of commercials, TV shows, educational videos and even a feature film. Studios are stretching the technology incorporating 2D and 3D animation; computer-generated special FX and live action in their productions. Some of the production houses have done Oscar winning animation and VFX works indigenously produced in India though outsourced from abroad.

Myth: Indian animation and VFX professionals are not considered excellent and efficient.

Reality: Larger studios throughout the world are increasingly relying on India’s talent and resources. Every year, animation work worth Rs. 8000 crores is being contracted out to Asia and in the last few years this figure is expected to double.

Myth: Indian studios only focus on their own style and mythological contents.
Reality: India is the melting source of all cultures as it has been exposed and invaded by so many cultures, tribes and foreign emperors including Alexander, the great, etc. Added to that when success of the film Gandhi set at the historically global appeal of the character and multicultural intervention in the life and times of Gandhi, there are so many to follow, only from India. Following the same heritage the various animated genre like Manga, Anime, Russian and French style apart from American animation have been outsourced largely to Asian countries.

1.5 Basic Drawing for Animation

Basics of Sketching

Introduction

Sketching is the visualization drafted over an archiveable surface or medium. Though there are many advanced tools that have entered the new digital and augmented reality age, the basics have remained the same for ages since the invention of coal pencil and paper. However for the comfort, user-friendliness and pace of the artwork there are further segments of tools to do sketching. Let us know about them in detail.

Basic Tools of Sketching

The major basic pencils for sketching are HB, 2B, 4B, mechanical pencil and 5B.

HB is used for general sketching of lines and arcs. 2B is mainly used for basic shading which is not too dark nor too light. 4B pencils are however used for darker impressions and most shadowy patches in the drawing. On the other hand, 5B is used for darker and thicker lines and only when such impressions are required. Further, 2B dull pencils and sharp pencils are required for shading and giving shape outlining impressions. An expert artist switches back and forth with such tools frequently to save time.

Another important tool the artist must have is the pencil extensions of various lengths to adjust the size of the pencil once it is reduced to a smaller size and becomes difficult to sketch. The other mechanical pencils don’t have such constraints as you always have the same size as the lead gets adjusted with the click of clutch. That is why it is called clutch pencil.

Along with the pencil, the professional artists must use a non-dusting eraser. There is a dough type eraser to shuffle the surfaces to have a clean side for erasing. The advanced ones are like electronic erasers to have strong cleaning and mostly used for perfect highlighting and a sharp clean line in the darker areas. The artist may need a cleaning comb like brush to clear the dust from the surface or paper on which she or he is sketching. The sketching more specifically for animation drawings does not require brushes and inking sets as these things are done most digitally.

Sketching Basic Techniques

There are two common ways of holding the pencil. The first is the tripod grip that holds the pencil between palm, index, middle finger and thumb. This is most comfortable for using the tip of the pencil since it is not practical to use the side of the pencil. It is also comfortable to have a control over your figures to draw small, precise and uniform lines.

The second one is overhand grip that holds your hand over the pencil. Your hand should be relaxed with the fingers and thumb lightly holding the pencil. You can still use the tip of the pencil with this grip in one of two ways. By drawing on a horizontal surface like a table top simply bend the wrist and forward slightly. If drawing on a vertical surface, you can put your wrist upside down and move your elbow to sketch lines or curves. Along with the tip the overhand grip allows the artist to use the side. The artist can use soft lines, hard lines, thick and thin lines with this grip at ease. While drawing small lines, the artist with tripod grip can only move the wrist to draw but for longer lines and curves the artist with this grip must use her/his shoulder to draw. Yet while drawing longer lines or curves the artist should opt for overhand grip and move her/his shoulder to draw smoothly.

Similarly while drawing small circles the tripod grip works well. For the bigger ones the overhand grip is preferably recommended. However, for detailing the tripod grip is always advised for the
artists/aspirants but for the shading and hashing the overhand grip is always recommended. Since the use of the wrist does not allow longer lines or curves, holding the pencil in overhand allow the artist to give larger strokes and longer lines with flexibility to use the side of the pencil tip. For using the side of the pencil, the sharpening of the pencil tip has to be longer and thicker for better results. This grip sketching also allows having force and impression variations as needed for the drawing.

**Straight Lines and Curves: The Preliminary Practices to Complex**

To begin it is only the straight lines and curves that give the basic structure from simple drawings to most complex ones in the universe.

Lines can be straight or curved. A line is a form with width and length, but no depth. Artists use lines to create edges, the outlines of objects. A line is created by the movement of the artist's pen.

**Two points connected at any direction is known as line.**

In animation line has a vital role to play; in classical animation the use of line is deferent. Here line has several meanings, and occurs according to all principles of animation. Thin line and thick inter-relation should be necessary. You can animate the line by using the animation principles.

**In animation, the line is distinguished like this:-**

- Straight line…..
- Curved line……
- Wave……
- Zigzag
- Vanishing (thick line to thin line)

**Line Direction**
The direction of a line can convey mood.

Horizontal lines are calm and quiet,

**Fig 23: Horizontal Line**

Vertical lines suggest more of a potential for movement,

**Fig 24: Vertical Line**

While diagonal lines strongly suggest movement and give more of a feeling of vitality to a picture.

**Fig 25: Diagonal Line**
Contour and Gesture

Fig 26: Contour and Gesture

Lines used to follow the edges of forms are called contour drawings.

Fig 27: Contour Drawing

Drawings which seem to depict more movement than actual outline are called gesture drawings.

Line as Value

Lines or crosshatching can also be used to create areas of grey inside a drawing. These areas of darker shading inside a figure, called areas of value, can give a more three-dimensional feeling to an object.

Circle and curve drawings: For drawing circles and curvatures, you need to have better control of your hand and wrists. For beginners, you must keep your hand loose and move your arm and not the wrist more while drawing the circles. Keep drawing it in both ways like clockwise and anti-clockwise. Keep practising it till you have the mature confidence to give hard and forceful impressions. Try to draw circles at one go which is not that easy to achieve in a single sitting. But once you are perfect in your exercises, you can draw a nice cool circle. However, you must remember to keep the same size of circle for one session. This way you can have control over your aimed volume in circles.

But to draw curvatures, sometimes you have to move your wrist too simultaneously depending on the kind of curvature you want to draw. Keep practising to achieve the results in your drawings with force.

Line Drawings: To draw lines with force, accuracy and aim, you need to practise various ways like giving two points and joining them, having one point to aim and draw from different points to reach that point in straight lines. The tripod grip is advisable to start drawing lines. For longer lines you may give shorter lines and continue starting from the point where you ended. Your pressure over the pencil is the key to draw the exact impression you want to create through your lines. Lines in one direction are normally used in shading for creating lighting illusions in the drawing. You must start practising the same. However, you must use lines for hatching. Hatching can be of various types. For more, you may refer to many great artists’ works in various kinds of graphic novels and poster works.

Shape Drawings: Before getting into the complex drawing process, the artist must prepare her/his hands perfectly drawing various shapes like balls, cubes, prisms, cones, cylinders, torus, hoses, etc. The artist
must also understand the light and shade over those shapes to create volume later on. But she/he has to combine these shapes and draw. Keeping close to each other or keeping them at a distance to create perspective drawings and foreshortening into it. The artist must also explore various eye level perspective from low angled vision to bird’s eye view of those shapes, their permuted and combined placements into her/his drawings.

**Still Life and Assignment of Basic Drawings**

Drawing is basically a visualization impressed on paper. Moreover, it is an individual visualization along with perception, interest, observation, character, philosophy, and a host of other qualities all coming from one source. It cannot and to be successful should not, be anything else. Drawing is very closely related to the other creative arts, all of which are outcroppings of a desire to express individual emotion, to make the other fellow conscious of our inner feelings. We want him to listen or look, and we want his appreciation of what we have to offer. Perhaps we wish to receive admiration for our particular accomplishments or have a message we deem worthy of others’ attention. Perhaps we see in such an effort an enjoyable means of making ourselves useful or providing ourselves with the livelihood that we must achieve in some way.

To create the effective appeal out of a drawing, we must possess a certain ability like intelligent perception or integrated perception out of common multiple perceptions. A kind of visualization well coordinated with common populist or/& effortless visualization analyzed in our brain. Brains accept certain effects or appearances as truth, and abide by these decisions. It is brain that distinguishes appearances, size, proportion, colour and texture from one to the other. We also have a sense of dimension in space to have the cerebral geometrical calculation of depth, even if we know nothing of the science of perspective. We are the best judges of deformity and distortions in appearance which is a mismatch to our lifetime experience of registered forms and visuals.

But when we are about to reflect in our drawings, we need to develop a sense of hand and mind coordination with perfect synchronization of observations and visualization. So, the more meticulous and detailed the observation, the better it will be reflected in the drawings of the artists, sooner or later.

While drawing on any medium, the artist is basically engaged in constructing her/his own visualization combined with her/his observations, perception, visual memory and experience. Construction is based on viewpoint and perspective. The appearance of an object may be different from every angle. Therefore we must establish an eye level to which we relate all construction and contour. No subject can be drawn correctly to more than one eye level. This is because it is impossible to look at any object from two positions at the same time. For this reason, the information we have must be adjusted to fit the problem. Two clippings or two photographs of the same subject will seldom have the same eye level, or – and this is vitally important – the same source or kind of light. The ideal information, of course, is secured by having all parts of the subject before you at once, in the same lighting, from one viewpoint of eye or camera. Beginners especially should work this way. That is why still life, art-school poses, and outdoor scenes are the best subjects from which to learn to see and to draw. But we still need the fundamental information on how to draw them.

Without knowledge of perspective and the lighting of the basic forms, or some idea of measuring and proportion, the artist becomes a slave to photostats, projectors, or any other kind of technology-driven gadgets, software or tools. This habit will eventually kill the artist inside her/him.

Think of your paper as representing open space, not as a two-dimensional surface, but as if its edges were the boundaries of an open window. You look at all of life and nature through this paper window. Think of your paper as representing open space, not as a two-dimensional surface, but as if its edges were the boundaries of an open window. You look at all of life and nature through this paper window.

Attempt either to set forms into this space that exists before you or to give a feeling of actuality to forms which you create from knowledge of the laws of nature. We study nature for effects and set them down.

This involves dimension, contour, viewpoint (meaning perspective), and lighting. Only through light, which produces all tone, colour and appearance, can we produce a true image of life.

Really to draw, we cannot think only of any single aspect of drawing, such as contour, without the other essentials, but must seek to unify all aspects into a complete and organized whole.
**Thumbnail Sketching is the Way**

The habit of setting down your mental conception of a subject in miniature roughs can play a most important part in your development as an artist. The best way is to shut your eyes and try to visualize what is taking place, as it would be in life. You have no detail to go by, so just suggest the material. Think of some kind of light. It will come. This kind of practice is called thumbnail sketching and the sketches are called thumbnails.

Various kinds, levels and styles of thumbnails:

![Fig 28: Thumbnail Sketching (Source: Wikimedia)](image)

### 1.6 Factors behind Appeals of Drawings

According to Loomis in "Successful Drawing," the appeal of a drawing involves several factors. Among those factors are The Five Ps.

Loomis believes that a drawing's appeal for a viewer is encompassed in "intelligent perception," vision coordinated with the brain. The human brain simply knows when it is looking at something that works and is attracted to it while being repulsed by that which does not work (the uncanny valley.) It is important for artists to be aware of the viewer's intelligent perception to ensure that our work gets the intended response. These are a few basic elements to a good drawing and those elements can be learned.

Let us start with The Five Ps:

1. **Proportion:** Every object has height, width and depth. The ratio among these three dimensions is proportion. When the ratios are correct, the drawing looks good.

2. **Placement:** The positioning of the object within the boundaries of the drawing area.

3. **Perspective:** The object's relationship to the eye level/horizon. No object can be drawn without perspective.
4. **Planes:** In order to correctly show an object’s light, halftone and shadow, the object must be divided into planes. The effect of light on planes makes a form appear solid.

5. **Pattern:** The overall tonal arrangement of a composition.

Similarly while drawing, the following Cs have to be considered and practised with utmost care and caution.

1. **Conception:** Before beginning to draw, close your eyes and see what you want to draw. Thumbnail what you see.

2. **Construction:** Gather your thumbnails, sketches and reference material. Establish the volume, bulk, mass of your object(s). Determine your drawing’s point of view and perspective.

3. **Contour;** The outer edges of your forms.

4. **Character:** The quality that distinguishes one thing from another. Uniqueness. Loomis: "Real presentation of character lifts the artist to the top of his profession."

5. **Consistency:** The truth as recognized by a viewer’s intelligent perception. Also, it is the handling of all the drawing elements, Harmony. Unity.

**Proportion**

When we draw something, we must draw visualizing three dimensional geometric forms in our mind. Without this basic geometric sense no drawing can be correct or perfect. Most of the artists fail in maintaining proportions because of lack of geometric sense to be applied to their drawings.

As in geometry, the major parts of a proportionate drawing are:

- Width
- Height
- Length

But while we are drawing a realistic human figure, we divide the drawings into eight parts whereas in Asia seven head characters are practised. So we further break these parts into

- **Height**
- **Width**
- **Midpoint**
- **Quarter points**
- **Eighth/Seventh points**

There are various age group characters, semi-realistic to surrealistic characters vary from this standard 7 head or 8 head proportions. In various cartoon shows or and fantasy movies the characters normally defy this standard proportion though reciprocally their body parts’ volume is maintained which has been established since the beginning.

**Placement**

When the artist prepares to draw from her/his studies of still life, memory or simply from an observation, she/he simply starts giving impressions on a two-dimensional medium, whereas her/his observations, memory or studies are three-dimensional in nature. So to maintain that dimensional imagery she/he has to place the objects, characters and other elements in such an order, size and proportion in the drawing to create that three-dimensional illusion on the medium.

The similar element placement is very important for animated contents as the camera moves with the action and tale. And so the placement in such compositions works well in animation. In fact in the other way, it is called staging of the characters, backgrounds and overlays.
By placing background elements in various positions the character in front can become lost or constricted for movement. Similar problems occur when placing elements in front of the character.

To further define the responsibilities of the layout artist, the creation of an atmosphere and environment that a character could freely move and interact within is important. Each project will yield new and exciting solutions, but understand that by using a strong foreground, mid-ground and distant elements do not guarantee a successful drawing.

**Foreground**
An element that is up close and usually partially illustrated with the remainder of the object situated off the page. The foreground is used in conjunction with the mid-ground and background areas of an environment.
Mid-Ground
In conjunction with the foreground and background areas of an environment, the mid-ground is the main acting stage for the animation to take place. This area must have environmental objects drawn in such a way that they do not interfere with the animation.

An example is taking a picture of a person outside, near a flagpole. If you mistakenly line up the person and the flagpole, the picture will show a person that has a flagpole growing out of the top of his head. Tangential growth is also a concern; lines that run-on and intersect to form one line, on the background and character. By moving the composition the picture becomes clear from obstruction.

Background (BG) or Distant
In conjunction with the foreground and mid-ground areas of an environment, the background is the furthest portion of the environment such as mountains, trees, clouds or stars in space. Generally there is minimal detail drawn in this area. The purpose of the distant element is to confirm what the mid-ground has described as the environment.

By combining the foreground, mid-ground and distant levels, a strong visual is created. Using these elements and perspective together creates depth. How the elements are arranged is just as important as what is arranged within a scene. The next step is to develop interest in the composition.

It is sometimes frustrating for a student or at times a seasoned layout artist, to become consumed by the elements of a drawing and create a piece that looks less than acceptable. Why? When designing an environment add a simple pattern. Patterns that lead the eye throughout the composition create a dynamic drawing. Without it, the drawing is weak.

Each pattern shown here is only a fraction of what can be used. Consider what is presented, as the foundation to a strong composition.

S Curve: Comfort Z Curve: Apprehension Arches: Spiritual Triad: Balanced

There are many different versions of these patterns from studios such as Disney and Nelvana, to studies of the great masters of design and painting. The concept of pattern is tried, tested and proven to be an effective method of embedding eye candy for the viewer.

Note: Eye candy is a term often used to describe a drawing that controls and creates interest for the person viewing a drawing. Open doors, dark corners, absence of light and winding stairways in a composition direct the viewers’ eye to keep looking within the drawing. This creates Eye Candy.

Note: All compositional experimentation must be done during the thumbnail stage of creation. Minor refinement can be completed during the drawing of the full-sized blue rough artwork. Before you start to draw ask, what is the focal point of this drawing? Build your patterns around this concept.

Design your background (BG) with the character in mind. If the character cannot physically fit into the layout, or is interfered by objects within the layout, change it.

The artist needs to plan the scene thoroughly, while working on the thumbnails. As she/he completes the blue roughs for the full-size layouts and poses, then she/he can continue to consciously observe her/his work for any new problems.

This material is inspired and taken from Animation Background Layout: From Student to Professional by Mike S. Fowler. Caistor Centre, Ontario, Canada: Fowler Cartooning Ink.
1.7 Perspectives
Horizon: The Must Have of Any Drawing

One-Point (Parallel) Perspective:
Combining most of the mentioned terms, the one-point parallel perspective drawing consists of a horizon line, one vanishing point placed on the horizon line and the understanding that all horizontal lines drawn will be parallel to each other.

Fig 31: One-Point (Parallel) Perspective

Two-Point Perspective
The two-point perspective drawing consists of two vanishing points that are both situated on a horizon line. The further apart these vanishing points are on the horizon line, the more relaxed or realistic the perspective will visually seem.

Fig 32: Two-Point Perspective (Source: Wikimedia)
Three-Point Perspective

A three-point perspective drawing is usually an exaggerated form of illustration, and is usually drawn with the spectator either below the horizon (ant's-eye view) or above the horizon (bird's-eye view). This perspective drawing has three vanishing points, two on the horizon line and one either above or below the horizon. In the above example, we see that the right and left parallel lines of the buildings are extended and projected to the right, and the left vanishing points on the horizon line and the vertical parallel lines are projected to the third VP in the sky or the ground. If you look at the building from an ant's-eye view, the topmost point is known as the zenith (highest point), and when you look at the building from a bird's-eye view, the lowermost point, is known as the nadir (lowest point). A three-point perspective is used mainly for skyscrapers, and it is slightly difficult to understand compared to the previous two types of perspectives. This is because of the third VP that is added here, and it rules out all the parallel lines.

Four-Point Perspective

This is a curvilinear version of a two-point perspective, and can give a panoramic or a 360° view, as the number of vanishing points surpass the least needed amount. In simpler terms, the vertical lines emerging from a two-point perspective sketch which meet at the vanishing points would now get curved at the VPs. This type of projection can be viewed both vertically as well as horizontally, and when viewed vertically, it describes a bird's-eye view, and at the same time an ant's eye-view too. In this projection, four vanishing points are equally spaced, two on the horizon line, and one above and below, to define four vertically-drawn lines in a 90° angle related to the horizon line.
Five-Point Perspective

An easy way to define a five-point perspective drawing would be that, it is a collection of five one-point perspective drawings, the difference being, it has curved lines instead of horizontal or vertical ones. The entire visual field is put together into the shape of a circle, and the lines are distorted, giving a wide-angled or a fish-eye lens effect to the image. For example, imagine yourself at the centre of a globe, a five-point view allows you to see the entire half of the globe that is in front of you. The two differences between a five- and four-point perspective drawing are, a five-point drawing has curved, vertical and horizontal lines, and it has a fifth point at the centre (central vanishing point), both of which are not depicted in a four-point sketch.

Six-Point Perspective

In the image below, we are able to see boxes from all six directions, and draw them well beyond the vanishing points, while allowing them to still look like boxes.
Zero-Point Perspective

Because vanishing points exist only when parallel lines are present in the scene, a perspective with no vanishing points ("zero-point" perspective) occurs if the viewer is observing a non-linear scene. The most common example of a non-linear scene is a natural scene (for example, a mountain range) which frequently does not contain any parallel lines.

Planes
As the artist is preparing to draw objects that look three-dimensional as it is observed in still life studies in real 3D, the objects are actually combination of two-dimensional planes placed perfectly connecting to each other for giving the illusions of object drawings. This will take hours, days and months to achieve perfection but determined artists burn it their way to get skilled and become experts later on.

1.8 Pattern
Mannequinization
Once the artist gets conversant with the basic shape drawings and has a thorough understanding of perspective drawings, it is time to do mannequinization which has to be drawn and practised in the shape of a biped or quadruped mannequin. This is how the artist will grow constructing the basic shapes, lines, curves and circles to complex drawings. Mannequinization somehow would be easier bridging skill between these elementary drawings to principal drawings.

Mannequinization is constructing the pose from simple three-dimensional basic forms that lock together to form a human or quadruped body. These basic three-dimensional shapes are all separate but they are all connected together to bring a figure with gesture.

Practising with making figures from a single kind of shape to multiple-shaped figures gives the artist understanding of the volumes needed at different parts of a body. Knowing the rigidity and contours of it brings him perfection.
Unit 2

Perpetual System, Anatomy of Various Characters, Visualization, Designing and Developing Capacity Building Skills

Introduction

The prime level and base of any animation production pipeline is its pre-production stage. To get skilled in this area is really a great artistic and creative work. Along with an appropriate skilled training and practice, the aspirants for this skilled area must be innately talented that would definitely give the resource a unique edge over others. This particular unit will take the aspirants through a rigorous journey of months and years of practice to get skilled.

This particular set of skilled resources in the animation industry is much in demand and very rare to match anyone in the field. They are normally highly paid and hardly go unemployed. Most of these resources enjoy the status of blue-eyed boys or girls for the animation production houses or broadcasting companies. So get ready, fasten your waist belts to be prepared for this rarest of rare jobs on the earth.

This unit geometrically deals with art making, correcting and brushing the skills further to make the basic assets ready for the production which is backgrounds and layouts, characters and prop designs, gestures, costumes and other gadgets, assets, cinematic storytelling composed board drawings, etc. As such skill with precision does a perfect balancing act between living and non-living beings with story specific merger and combination of both. The aspirants need to get more focused, practice, get mentored whenever required, take references understanding various forms, movies, cultures, species and of course believe in their own imaginary intuitions and instincts.

Note

However, the basic drawing practices for these complex forms’ designing skills are quite challenging portion and is not mentioned in the content. Yet there is a step-by-step learning process to help the aspirants achieve the most complex production level designing.

Preparations: Sketching kit, pencil holding and control types for various drawing objectives, force, thick and thin line, shading, hatching, cross-hatching.

Suggested Practice Exercises:

- Line Drawings: Straight, Curved
- Shape Drawings: Circles, Boxes, Cubes, Cylinders, Cones, Prisms, Pyramids and other combination of shapes, permutted shapes, etc.
- Volume for Character Building: To maintain the volume in a human, animal or bird form. The basic shape structure is a must to practise for correct, flawless character build up and designs.
- Cubical Bipeds, Quadrupeds and Birds
- Cylindrical Bipeds, Quadrupeds and Birds
- Mannequinization

Figures, Heads and Body Parts for Major Animal Types (Male, Female, Child)
2.1 Zoological Anatomy (realistic, unrealistic, semi-realistic, surrealistic)

This section deals with the limits or/and exaggeration of the zoological world and their animate-able features along with eyeing a blend of surrealitic lively world which can only exist inside a creative or artistic eye.

2.1.1 Basic Animal Groups' Anatomies

Not all animals propel themselves with the use of arms and legs. Some use their bodies. So to develop each classified group and their anatomy structure more geometrically, mechanically and proportionately it is essential to understand their zoological limits and moving styles, bone rigs and gears, their kinematic ranges. This will definitely help make their respective character designs look perfect and animate-able.

Vertebrates and Invertebrates

Almost all animals fall into one of two groups. Adult vertebrates have a spinal column, or backbone, running the length of the body; invertebrates do not. Vertebrates are often larger and have more complex bodies than invertebrates. However, there are many more invertebrates than vertebrates.

Vertebrates

- **Fish** breathe through gills, and live in water; most are cold-blooded and lay eggs (although sharks give birth to live young). Fish propel themselves through a fluid environment, which is very pertinent to the way that they move. They do this by flexing their backbone in such a way that a wave runs along the length of the body. As it travels along the fish's body the wave gets bigger. This is called a sinusoidal wave.

- The fishes movement grouping types: Some cruisers and burst swimmers however move together in groups which is called schooling [Shoaling]

- The zoological family differentiates fishes into three categories: Swimming Mammals, Flat Fish, Rays

- Various fins and their positions

Fig 39: Anatomy of Fish (Source: Wikimedia)

- **Amphibians** are cold-blooded and live both on land (breathing with lungs) and in water (breathing through gills) at different times. Three types of amphibians are frogs and toads, salamanders, and caecilians. Caecilians are primitive amphibians that resemble earthworms. They are found in the tropics.
• **Reptiles** are cold-blooded and breathe with lungs. They have scales, and most lay eggs. Reptiles include snakes, turtles, and tortoises, crocodiles, alligators and lizards. Dinosaurs were reptiles, although certain scientists believe that some were warm-blooded.

• **Birds** are warm-blooded animals with feathers and wings. They lay eggs, and most can fly (although many, including penguins and ostriches, cannot).
Flying

Birds are adapted for flying in several ways. Their forelimbs are specialized as wings covered with flight feathers; they have powerful wing muscles, rigid body skeletons, light hollow bones, a large heart and a well-developed nervous system. Think of the wings as being elongated arms (in the same way that you should think of the front legs of an animal as being like humans’ arms).

![Fig 42: Anatomy of Bird (Source: Wikimedia)](image)

In order to generate the power required to fly, a bird must have huge wing muscles. The wing muscles make up about 40% of the weight of a bird.

In order to anchor the huge wing muscles there has to be a keel at the front of the rib cage. This is called the sternum. There is also a system of air sacs within the bones and between the body organs that provides extra air for the increased respiration while the bird is in flight. Consequently birds of the same volume as a non-flying animal are far lighter in weight. This gives lightness to the way that they move. The wings are concave below and convex above and have a thick front (leading) edge tapering off to a thin trailing edge, like the wings of an aeroplane. They provide the initial lift to launch the bird in the air, and then give it forward propulsion through the air. Birds take off with a jump or short run, preferably into the wind, followed by powerful semi-circular beating of the wings, which produces lift on the down-stroke and forward thrust on the up-stroke. After gaining height the wings move with an up-and-down flapping, with the lift and thrust coming from the down-stroke.

Mammals

Mammals are warm-blooded, and are nourished by their mothers’ milk; most are born live (however, the platypus lays eggs). Most mammals also have body hair.

![Fig 43: Anatomy of Mammals (Source: Wikimedia)](image)
Pantomime Horse

This involves constructing your four-legged animal like two actors in a horse suit. When the two actors walk in unison they will probably do something like that shown in the illustration. Both pairs of legs doing a basic human walk. The walk consists of the four major key positions.

![Fig 44: Anatomy of Horse (Source: Wikimedia)](image)

Invertebrates

- **Sponges** are the most primitive of animal groups. They live in water (usually saltwater), are sessile (do not move from place to place), and filter tiny organisms out of the water for food.
- **Coelenterates** are also very primitive. Their mouths, which take in food and get rid of waste, are surrounded by stinging tentacles. Some coelenterates are jellyfish, corals, and sea anemones.
- **Echinoderms** include starfish, sea urchins, and sea cucumbers. They live in seawater and have external skeletons.
- **Worms** come in many varieties and live in all sorts of habitats — from the bottom of the ocean to the inside of other animals. They include flatworms (flukes), roundworms (hookworms), segmented worms (earthworms), and rotifers (philodina).

Wings: Insects and Humming Bird

The wings on these animals move very fast. Anywhere between 60 to a 100 wing-beats per second with a frame rate of 25 frames per second only a fraction of the movement is ever going to be caught. This means that you have got to give randomness to your animation. You will also need to blur the wings. You can do this by giving the impression of catching the position of the wings in a single frame with indications of their position a fraction of a second before. To produce an insect flying and hovering, use repeated, translucent images of the wings on each frame in order to give a blur. Work out between four and six different wing shapes, and shoot these at random. To get an insect or humming bird to fly around the screen, animate the body first and then add the random wings later.

![Fig 45: Wing movement of insects (Source: Pixabay)](image)
• **Mollusks** are soft-bodied animals, which often live in hard shells. They include snails, slugs, octopus, squid, mussels, oysters, clams, scallops, chitons, and cuttlefish. Mollusks are the second-largest group of invertebrates, with 50,000 living species.

• **Arthropods** are the largest and most diverse of all animal groups. They have segmented bodies supported by a hard external skeleton (or **exoskeleton**). Arthropods include insects, arachnids (spiders and their relatives), centipedes, millipedes, and crustaceans like crabs, lobsters, and shrimp.

### 2.1.2 Focus on Bipeds, Quadrupeds and Bird

![Male and Female Anatomy](https://via.placeholder.com/150)

*Fig 47: Male and Female Anatomy (Source: Wikimedia)*
Fig 48: Biped Movement (Source: Royal Society of Publishing)

Quadrupeds

The purpose of this lesson is to give a simple approach to animating a four-footed creature. An animator should feel confident in the character he is animating. If not, his work will lack strength and conviction. He needs to feel "free" to animate and not get bogged down in complex anatomy.

Fig 49: Quadruped Movement (Source: Wikimedia)
Activity
Make key poses for the walk of a dog and a horse. Reflect the difference in motion due to difference in anatomies.

Birds: Anatomy with Locomotive Limits and

![Fig 50: Flying Movement (Source: Wikimedia)](image)

Possibilities
Let us think of flying as swimming through the air. The wings have to force as much air as possible downwards and backwards on the down-stroke and then have to cause as little wind resistance as possible on the up-stroke.

When flapping downwards the wing will spread open to push as much air as possible backwards and downwards. When moving upwards, it will tuck in on itself in order to cause as little air resistance as possible. The tail helps to steer and the legs are tucked out of the way making the body smooth and streamlined.

Taking Off, Flying and Landing Key Poses

![Fig 51: Bird Take off (Source: Pixabay)](image)

![Fig 52: Bird Flying (Source: Wikimedia)](image)

![Fig 53: Bird Landing (Source: Wikimedia)](image)
2.1.3 Unrealistic, Semi-Realistic and Surrealistic Anatomies and Referral Studies

There are scientific experiments carried out universally for unrealistic anatomy and surrealistic anatomies. They have still remained unreal though the possibilities in those areas have to be explored. Surrealism exists deep down in our mythologies all around the world and more frequently in Indian mythology starting from the very first deity of worship, Lord Shri Ganesha. However, the mythology says his body is basically a biologically transmuted one.

Semi-realism in animated character designs are quite common though not biologically possible anatomy and have not yet surpassed scientific limits. However, semi-realism is quite common and popular in animation owing to extensive use of principles and exaggerated movements, actions defying realistic principles of the moving world.

Most common and popular characters can be Popeye, Mickey, Tom and Jerry.

2.1.4 Various Art Forms' Inspired Convergence and Permutated Designs

All over the world various art forms have been transformed to animated forms of characters and environment. Most eminent of them are Anime and Bleach from Asia. However in India, several attempts have been made by many animators and genre designers. A popular TV show *Krish Trish and Balti Boy* by Munjal and Tilak is made out of Madhubani paintings from Bihar.

*Freedom Song*, another international award winning short film by Narayan Shi is made in Madhubani and Kalighat painting style. Similarly Nina Sabnani’s animation short film *Hum Chitra Banate Hai* is made of tribal Bhil paintings of Madhya Pradesh. Shilpa Ranade’s award winning film *Goopi Gawaiya Bagha Bajaiya* (English: *The World of Goopi and Bagha*) is inspired and researched with several art forms, shadow and puppet dance forms. *Loving Vincent*, a short animated film tribute to Van Gogh is made of moving acrylic paintings.

![Loving Vincent](image)

*Fig 54: Loving Vincent (Source: Wikipedia)*

Films made with several Painting Animation Work Stations [PAWS], specially-designed work stations enable painters to produce one frame every 40 minutes.
Mah Meri Stories This animated film depicts five Mah Meri stories derived from mask carvings by the indigenous Mah Meri in Carey Island, Malaysia.

Sulekha.com made an ad campaign Aaj ka Arjun which used the art of Patta Chitra Katha (a traditional folk art of storytelling featuring illustrations of characters from Indian mythology, hand-printed on sun dried leaves exclusively made in Odisha, India). This ad film has won several international awards and recognitions.

2.1.5 Objects, Props, Gadgets, Wardrobes, etc.

In a production pipeline, such a process actually starts with roughing out a sketch of your character and building a profile that defines the person behind the drawing: who they are, where they come from, and how they got their powers. Then the mentor to incorporate those qualities in the character's facial features: eyes, nose, mouth, and distinguishing marks such as wrinkles, scars, and tattoos. Ben goes back and forth between good characters and evil ones, so members get a feel for what kinds of details give a sinister impression vs a trustworthy one. Mentor guides you on how to use clothing and props to further tell the character's story. Eventually though such rigorous practice like anatomy is not needed in the asset creation process, yet several stylist artists over time establish many immortal gadgets, properties and costumes. These creations around the world contribute to many kinds of animation and comic conventions.

Once you are happy with the costumes...on each of your characters, ask yourself if it is crucial...that they have a prop or a weapon....So, when you think about props and weapons...and characters who need those things,...think about characters like He-Man....He has got his Power Sword,...and he is not even able to turn into He-Man without it,...so that is an example of an extension...of his character or personality....And this is an example of a very quick Power Sword....There is Green Lantern, which is another example...of someone who really needs that prop....

All his power is derived from it,...so you have Green Lantern....And then there is Ben 10, who is awesome,...and he has this watch, called the Omnitrix,...and that allows him, again, to use his power...to turn into the various alien superheros....So those are props that have to be there,...they are part of that character....They would have been in our character profile....So take a look at your own character profiles....

2.1.6 Animatable Aspects and Limits of the Designed Characters

What Is Character Design?

Characters are something we learn to love since we are children, through animations and cartoons. Characters are wild, unpredictable and unrealistic. We grow attached to cartoon characters and most of the time that bond never truly disappears from our hearts. That is why even as adults we can spot a character that reminds us of ourselves, how we wanted to be or how we are now, and fall in love with it.

Fig 55: Animated Characters (Source: Flickr)
Thus creating a good character implies that you must design that character in such a way that people will love and relate to it on a very intimate level. It is all about the personality that you empower your character with, and that unique personality can derive from the way it looks, talks, walks, thinks, etc. **Character design creates lovable or memorable characters**, whether they are good or bad, endearing or weird, happy or sad.

Simply expressed, Wikipedia’s definition of **Commercial Character Design** ”is the process of creating a character and using it to enhance or publicize a commercial entity through design”. Designers use characters in commercial settings specifically because of the way people relate to them. By using a well-designed character as your brand mascot you are more likely to get people to have an emotional relationship with your products or business. Characters are friendly and appeal to almost all age groups. They attract attention with their eccentric behaviour and can instantly make your designs interesting.

### Basic Principles of Character Design

Taking into account that a character must be **designed** and not magically summoned into existence, there are a few basic principles or guidelines which one can use as the base for creating a successful character.

#### 1. Function

One of the most common theories in design is that form **must follow function**, and this applies to all areas including character design. A character with a logical, clearly understandable form is more easily perceived and understood by the human brain. Simple shapes like circles or ovals often work best as the wireframe for a character because of their versatility and visual straightforwardness.

Simplicity in the character’s overall shapes is also great if you need to draw your character from various angles. When rotating or viewing your character from another angle, all the planes within the character’s design will change their appearance in proportion to the angle which makes it harder to maintain consistent proportions and scale for each characteristic. Thus starting from a more basic, generic shape requires less effort in accurately representing the character in different positions.

#### 2. Style / Aesthetic

What can make or break a character is the style or general aesthetic used in its creation. Adding to what we have established before about simple shapes as a starting point for character design, the style of a character comes from the way in which the shapes that compose it blend together in a visually stimulating manner. **Contrast of shape, form or proportion** is a great way to balance shapes and make your character interesting. For example, Wile E. Coyote has a large, long snout, narrow shoulders, thin legs and big feet and hands. Not to mention the large, expressive eyes. Just as how in humans they say the eyes are the window into the soul, characters’ eyes can be essential in defining their personality.

Because characters are – like I said before – odd and indiosyncratic, you have the freedom to play around with proportions and features as much as you want, sometimes the most interesting character designs emerge from extreme visual contrasts. Exaggerating features also adds expressiveness to your character. Tiny eyes, huge ears, just go wild and see what results.

![Fig 56: Character style by design (Source: Pixabay)](image-url)
3. Personality

The personality of a character is composed of many aspects but a large part comes from the character’s physical traits and features since those are the first things you notice when coming into contact with it. Depending on what you want your character to be like you can choose to exaggerate certain features. For example rounded, plump shapes always seem to imply cuteness because of the way they are generally associated with babies in our visual consciousness. Big eyes set very closely together towards the centre of the face also enhance this effect. Sharp, hard angles seem harsher, combined with narrow heads or faces.

Whatever character you want to design, always think of its personality in relation to its features. Another defining thing that some designers may forget when creating a character are verbs. Have your character do something, move, dance, have a certain facial expression or a certain posture to add to its personality. In the example above, you can tell that the young apache is a very confident little man from his stance. Below are examples of round shapes and harsher angles to show how they impact the overall aesthetic of the characters in question.

![Image of personality of a character](https://pixabay.com)

**Fig 57: Personality of a character (Source: Pixabay)**

**The Devils in the Details**

Even if you do intend on animating or drawing your character from many different angles, never forego the details entirely. Like in all aspects of design, the details are what makes characters interesting. A certain type of eyes, shirt buttons, clothing seams, anything can help define your character and make it visually stimulating as well as uniquely designed.

**Examples**

Now let us take a look at the characters below and see how the theory can be applied.

![Image of devil](https://wikipedia.com)

**Fig 58: Devil (Source: Wikipedia)**
Character design can be a tricky beast to tackle, because although many of the classic characters familiar to us through cartoons, movies and advertising look simple, that simplicity usually belies the many hours of work that have gone into their development.

From Mickey Mouse's famous three-fingered hands—drawn to save production time when he was first developed for animations in the 1920s— to the elegant simplicity of Homer Simpson, character design has always been about keeping it simple.

But apart from clean lines and easily readable features, what else are you going to need to know about character design? Know what to exaggerate and what to play down, what to add to give a hint of background and depth, and what to do to develop personality. Getting started can be the trickiest part in any character design project, but once you've got some ideas these tips will help you breathe life into your creation.

1. Decide Who it is Aimed At
Deciding who the character is aimed at should be one of the first steps in your design process

Think about your audience. Character design aimed at young children, for example, is typically designed around basic shapes and bright colours. If you are working for a client, the character's target audience is usually predetermined, as the Australian artist Nathan Jurevicius explains.

"Commissioned character designs are usually more restrictive but no less creative. Clients have specific needs but also want me to do my 'thing'. Usually, I will break down the core features and personality. For example, if the eyes are important then I will focus the whole design around the face, making this the key feature that stands out."

2. Decide Where It Will Appear
Where will the character design be seen and in what medium? This will have a direct bearing on how you go about your character design. For example, if it is for a mobile-phone screen, there is no point designing it to have a lot of intricate details and features.

Nathan Jurevicius says that regardless of the format: "The process of thinking up concepts always starts the same: paper, pencil, green tea... many thumbnails, written ideas, scratches and sketches over sketches."

3. Research Other Designs
It can be helpful to try and deconstruct why certain character designs work and why some don't. There is no shortage of research material to be found, with illustrated characters appearing everywhere: on TV commercials, cereal boxes, shop signs, stickers on fruit, animations on mobile phones, and more. Study these character designs and think about what makes some successful and what in particular you like about them.

4. Make Your Character Distinctive
Matt Groening used yellow to make the Simpsons’ characters stand out from the crowd.

Whether you are creating a monkey, robot or monster, you can guarantee there are going to be a hundred other similar creations out there. Your character design needs to be strong and interesting in a visual sense to get people's attention.

When devising The Simpsons, Matt Groening knew he had to offer the viewers something different. He reckoned that when viewers flicked through TV channels and came across the show, the characters' unusually bright yellow skin colour would grab their attention.
5. Use Line Qualities and Styles to Describe Your Character
The drawn lines of which your character design is composed can go some way to describing it. Thick, even, soft and round lines may suggest an approachable, endearing character, whereas sharp, scratchy and uneven lines might point to an uneasy and erratic character.

Sune Ehlers characters are bold and seem to dance on the page, which echoes his approach to drawing them. He explains: "Drawing a doodle is about decisive pen-manoeuvring. A strong line for me comes from strength and rhythm."

6. Use exaggerated characteristics
Exaggerating the defining features of your character design will help it appear larger than life. Exaggerated features will also help viewers to identify the character's key qualities. Exaggeration is key in cartoon caricatures and helps emphasize certain personality traits. If your character is strong, don't just give it normal-sized bulging arms, soup them up so that they are five times as big as they should be!

.. Choose Colours Carefully
Colours can help communicate a character's personality. Typically, dark colours such as black, purples and greys depict baddies with malevolent intentions. Light colours such as white, blues, pinks and yellows express innocence, goodness and purity. Comic-book reds, yellows and blues might go some way to giving hero qualities to a character design.

8. Add Accessories

![Add Accessories](Source: Wikimedia)

Once you give your character things to wear and interact with, it starts to come to life.

Props and clothing can help to emphasize character traits and their background. For example, scruffy clothes can be used for poor characters, and lots of diamonds and bling for tasteless rich ones. Accessories can also be more literal extensions of your character's personality, such as a parrot on a pirate's shoulder or a maggot in a ghoul's skull.

9. 2D or 3D?
Depending on what you have planned for your character design, you might need to work out what it will look like from all angles. A seemingly flat character can take on a whole new persona when seen from the side if, for example, it has a massive beer belly. If your character is going to exist within a 3D world, as an animation or even as a toy, working out its height, weight and physical shape is all important.

10. Give Your Character Personality
Interesting looks alone do not necessarily make for a good character design; its personality is the key as well. A character's personality can be revealed through comic strips and animations, where we see how it reacts to certain situations. The personality of your character doesn't have to be particularly agreeable, but it does need to be interesting (unless your characters are purposely dull). Personality can also be expressed simply in how the character has been drawn.
11. Focus on Facial Expression

Facial expression is the key to a character's personality, as Tex Avery's Droopy demonstrates. Expressions showing a character's range of emotions and depicting its ups and downs will further flesh out your character. Depending on its personality, a figure's emotions might be muted and wry or explosive and wildly exaggerated.

Classic examples of this can be found in the work of the legendary Tex Avery: the eyes of his Wild Wolf character often pop out of its head when it is excited. Another example of how expressions communicate motions is deadpan Droopy, who barely registers any sort of emotion at all.

12. Give Your Character Goals and Dreams

The driving force behind a character's personality is what it wants to achieve. This missing 'something' — be it riches, a girlfriend or solving a mystery — can help to create the dramatic thrust behind the stories and adventures your character gets up to. Often the incompleteness or flaws in a character design are what make it interesting.

13. Build Up a Back Story

If you're planning for your character design to exist within comics and animations then developing its back story is important. Where it comes from, how it came to exist and any life-changing events it has experienced are going to help back up the solidity of, and subsequent belief in, your character. Sometimes the telling of a character's back story can be more interesting than the character's present adventures (or not, in the case of the Star Wars prequels).

14. Experiment!

Don't be afraid to experiment and ignore all the rules and tips about planning and crafting the look of your character design. Going against what is supposed to be the right way of doing something could create unexpected and exciting results.

When artist Yuck creates his characters he doesn't really know what he will draw. "I just listen to music and draw the result dependent on my mood: freaky or cute. I always want to have a drawing that I find interesting. I then work more on the character after it is fine with me and my brain," he says.

15. Make Your Character Design Flexible

Having decent materials to work with is useful, but not essential, for the early planning of your character design. Many amazing characters were successfully designed years ago when no one had personal computers and Photoshop was just a dream. The drawings of your character should still work when rendered on paper with a simple pen or, as Sune Ehlers puts it: "The character should still be able to work with a stick dipped in mud and drawn on asphalt."
16. Swap Mouse for Pen
Ian of *I like Drawing* generates some of his character designs away from both the computer and the sketchbook, allowing outside elements to influence his work. "I really like characters that interact with their surroundings," he says. "The environment normally suggests an idea and then I let my strange mind do the rest. I prefer drawing in the real world with a pen instead of on the computer, because it feels good and odd things happen."

17. Get Feedback from Others
Show people your creations and ask them what they think. Don't just ask whether they like them or not. Instead, see if they can pick up the personalities and traits of your characters. Find who you think is the suitable or ideal audience for your work and get feedback specifically from them about it.

18. Hone, Plan and Polish Your Design
Instead of just drawing or doodling without too much pre-planning, Nathan Jurevicius prefers to take a different approach. "I take a long time creating finished looking roughs and also thinking about how the character could be expanded beyond a 2D artwork, what the character will do in a specific world, and how it speaks and acts," he says.

19. Create the Right Environment for Your Character
In the same way that you create a history for your character, you need to create an environment for it to help further cement believability in your creation. The world in which the character lives and interacts should in some way make sense to who the character is and what it gets up to.

20. Fine-Tune Your Figure
Question each element of your creation, especially things such as its facial features. The slightest alteration can have a great effect on how your character is perceived.

Illustrator Neil McFarland advises: "Think about the meaning of the word 'character'. You are supposed to breathe life into these things, make them appealing and give them the magic that will allow people to imagine what they are like to meet and how they might move. I think it is strange how creating characters for the sake of it has become a distinct branch of graphic design."

**Words: Jon Burgerman**
*Jon Burgerman is a NYC-based artist interested in instigating improvisation and play through drawing and spectacle.*

### 2.1.7 Gestures, Apeals and Actions
Before we look at this particular chapter, we must have a thorough understanding about the character/s, their behaviour, attitude, dress sense, racial or cultural background. So bringing in their gestures, appeals and actions would be life-like believability and that would exist throughout even in cases of highly unrealistic, semi-realistic and surrealistic characters. This visualization is quite a tough job and challenging can only be portrayed through an in-depth observational journey and experience in the life of the aspirant/s. Even though some of the animators/character designers are born with such ingredients and talents to observe since their childhood, others need to be trained in that alertness to observe every moment, people, creatures and the environment around. The homework for such things is more like an actor’s preparations but the expressions are through pencils, mouse and pen tablets.

Before bringing in those great characters into life their key gestures, appeals and actions must be well archived for the rest of the animators and the production team to refer.

Gesture is the vehicle used in fitting a character into the role it is called upon to act out. We have drawn variously, dogs, mice, owls, elephants, cats, people, and so on; each distinct character with distinct bodily shapes and bodily gestures.
Appeal in a cartoon character corresponds to what would be called charisma in an actor. A character who is appealing is not necessarily sympathetic – villains or monsters can also be appealing – the important thing is that the viewer feels the character is real and interesting. There are several tricks for making a character connect better with the audience; for likable characters a symmetrical or particularly baby-like face tends to be effective. A complicated or hard to read face will lack appeal, it may more accurately be described as 'captivation' in the composition of the pose, or the character design.

**Tips to Bring Appeal into Your Animated Characters:**

1. **Tilts and Rhythms**

   One way to achieve a good rhythm in a pose is to have a bunch of alternating tilts. Try to have a different angle for every joint. A tilt in the body or the head can do wonders and forces you to make a statement.

2. **Flow**

   This leads us to the aspect of flow which describes how well your lines and shapes flow into each other. This is especially difficult in computer animation where you might have to break the rig or even deform the geometry to make two elements connect that are not meant to connect in this way.

3. **Tangents**

   The next thing I want to talk about is partly a matter of design/style, but 2D animators in particular can accidentally let this flaw sneak into their poses or in betweens, even if all the proportions are perfectly on-model.

**Activity**

Using the basic rules of character building, make an appealing animated character of your own choice. Let us try breaking a human anatomy to give it an animal type postures and movements. This is quite peculiarly animated in the case of Tarzan which is a human figure and anatomy but having advanced locomotive actions that of an animal preferably a guerrilla. Please follow Glen Keane’s making of Tarzan videos over YouTube.
2.1.8 Transposing: Humanistic to Other Families of Characters and Vice Versa

Tarzan was first ever reverse transposing in animation history. However, generally most of the transposing of animal and bird characters has been transposed with humanistic expressions and actions since the early days of animating animals, birds, semi-realistic and surrealistic characters.

In Disney’s *Beauty and the Beast, Cars and Planes*, even non-living objects also humanly transposed to express their characters live. Somehow this animation sensibility also inspires civic sensibility for human beings to treat their environment with compassion, decency, life value and their importance in the very existence and contribution to our lives.
From the early days of Disney Animation Studio productions of *Beauty and the Best*, CG animation have given more freedom to create movies like *Cars and Planes* characterizing such machines and transposing human expressions in them again.

Characterized and animated semi-realistic in airplane.

Characterizing and animating Cars and Minions are also other sets of wonderful human transposing in non-living machines.

![Humanistic expression in objects](https://pixabay.com)

**Fig 64: Humanistic expression in objects (Source: Pixabay)**

### 2.1.9 Model Sheets and Gesture Sheet Preparations

Various types of model sheets help us throughout the animation process.

**Rough Character Concept Model Sheets**

It gives us a sense of the basic design of the character, along with attitude poses that help to tell the story of just who he is.

**Rough Construction Model Sheet**

Rough construction model sheets can sometimes focus only on details of a character.

![Rough Construction Model](https://wikimedia.org)

**Fig 65: Rough Construction Model (Source: Wikimedia)**
Anatomical Study Model Sheet
Can give animators a better idea of the structure that exist depending on a particular aspect of the drawing.

Rough Dialogue Model Sheet
Shows various shapes of an organ that are created when the character is in motion. This one has the added benefit of showing a range of emotions.

Final Line Turn Around Model Sheet
When beginning your turnaround model sheet, it is usually easiest to start with either a forward facing view of your character that has the proportions entirely worked out; this will be the drawing that sets the standard for your character. When completed, flip this character face down on a light box (use a lighted window if you don’t have a light box) and trace the outline. Flip it back around and detail in the back view, referencing the front view as you go. Once both are completed, line them up and use a ruler to map out corresponding points on their head and body. Use these to rough out a side view and three-quarter view of your character. You can do each on a separate piece of paper and Photoshop them together once you have the character fully mapped out:

![Turn Around Model Sheet](Source: Pixabay)

Activity
Prepare a turn around and rough construction model sheets same character (made in the previous activity) focusing on the different poses and details (like hair, face, etc) respectively.

2.2 CG Asset Creations

Watch this video on Asset Creation at [goo.gl/dmF2MK](https://goo.gl/dmF2MK)

2.2.1 2D Character Creation
The first step while making a CG character is preparing the character model sheets using the techniques mentioned in the previous article.

Once the model sheets are completed, one can move on to making CG characters using them as reference. There are plenty of 2D animation software on the market such as Adobe Animate, Adobe Flash, Anime Studio, Toon Boom, etc

These software have their own drawing tools that could be used for character and asset creation. But the most preferred method is “tracing” from model sheets or live photos.
Adobe Illustrator is a great software for tracing and the final output could be exported to for rigging and animation.

Watch this video on Rigging at goo.gl/mti971

Watch this video on 2D Animation Creation video at goo.gl/5XhBgo

2.2.2 3D Character Creation

For 3D, we also need turn out model sheets which are converted into image planes and used in the modelling process. After completion of modelling, the assets are then moved ahead in the production pipeline for texturing, rigging and finally animation.

The popular 3D animation softwares are Autodesk Maya, 3Ds Max and Blender.

Below, Maya Interface Showing Different Panels

Fig 67: Maya Interface
Asset Creation

Watch this video on 3D character creation at goo.gl/RVSUFU

Similarly, inorganic models such as the props and backgrounds are also created using reference photos. (Below, left, hard modelling of a spaceship in progress and right, four-plane view of interiors)

![Fig 68: Maya Interface](image)

2.2.3 Texturing

Watch this video on texturing at goo.gl/cmiAid

It is a method for defining high frequency detail, surface texture, or color information on a computer-generated 3D model.

Texturing can be done by applying different materials with the help of a node-based tool such as Hypershade in Maya or by creating maps in Photoshop and then applying it to your model.

But before you can apply a texture map, you need to unwrap the model for correct positioning of the detail and shades.

Now texture maps can be created accordingly and applied on the unwrapped model to obtain the desired results.
2.2.4  Lighting

As the name might imply, lighting is the step where you can control most of the light elements of your scenes and shots (you may touch lighting in both rendering or even a 2D application like Photoshop after creating the render). Lighting lets you control everything from where the sun is in a shot to how much glow a light might have that is in the scene. While it sounds easy, and it will be with practice, lighting can add that exact feel you want a shot to portray.

Some tips to understand lighting in 3D:


2 - Read Photography Magazines. Aside from reading 3D-specific industry magazines, it is also a good idea to read other industry publications, like photography titles. They often deal with lighting and composition topics and also have some useful tips and tricks on post-production that can help to take your 3D renders to the next level.

3- Take the Time to Set Up Basic Lighting. Before starting to set up complex materials and textures, take the time to set up a basic form of your intended lighting setup to get a better idea of how the light will affect the final composition.

4- Use Contrast. Contrast in lighting will make your scene dramatic and interesting. Try using warm colours against cold ones, or using one huge light source on one side balanced by multiple small lights on the other.

05- Keep Experimenting. Try different kinds of lights. I usually change my lighting set up every time – I really like to experiment.

2.3  Perspective and Layout

What is Perspective?

Perspective is a theory of drawing, which allows the artist a way to graphically depict three-dimensional objects on paper or other media, as they exist in space. The rules of perspective are many, but are based on the assumption that a single eye, from a fixed point of view, is looking at the subject being drawn.

Some terminologies:

Field of Vision: Similar to the Picture Plane, the field of vision is all that can be seen from the viewer’s eyes while standing at a stationary point.

Convergence: Is the point in which all lines meet at one point in space. It is like the row of subway support beams or a subway track that extends far off into the distance. All the lines appear to meet together at the one distance vanishing point.

Point of View (POV): Can be described as what you see from where you are looking. I cannot get any simpler than that.

Station Point: This is the point from which the viewer is looking from.

Line of Sight: Without going into unnecessary detail, think of the line of sight as what can be seen from your point of view.

Picture Plane: This is similar to the Field of Vision. However, the images we are looking at have been cropped or adjusted so that only a small portion can be seen. Look through the viewfinder of any still camera to find that only a portion of the world can be seen at any one time. By moving closer or farther away, more or less of the view can be seen through the viewfinder.
2.3.1 Various Perspectives

One-Point (Parallel) Perspective

Combining most of the mentioned terms, the one-point parallel perspective drawing consists of a horizon line, one vanishing point placed on the horizon line and the understanding that all horizontal lines drawn will be parallel to each other.

![Fig 69: One-Point (Parallel) Perspective (Source: Wikimedia)](image)

Two-Point Perspective

The two-point perspective drawing consists of two vanishing points that are both situated on a horizon line. The further apart these vanishing points are on the horizon line, the more relaxed or realistic the perspective will visually seem.

![Fig 70: Two-Point Perspective (Source: Wikimedia)](image)
Zero-Point Perspective

*Fig 71: Zero-Point Perspective (Source: Wikimedia)*

Because vanishing points exist only when parallel lines are present in the scene, a perspective with no vanishing points (“zero-point” perspective) occurs if the viewer is observing a non-linear scene. The most common example of a non-linear scene is a natural scene (e.g. a mountain range) which frequently does not contain any parallel lines.

Six-Point Perspective

In the image below, we are able to see boxes from all six directions, and draw them well beyond the vanishing points, while allowing them to still look like boxes.

*Fig 72: Six-Point Perspective (Source: Wikimedia)*

2.3.2 Other Species POV Visualizations

Generally, we see works of art made from the perspective of the human eye. But in films where the story is built primarily around other species such as (animals, insects, etc.), we may need to fix the camera so that we view environment through their perspective to better understand their worlds and lifestyle.
Unit 3

Recreation of Life and Beyond with Cinematic Dimensions and Limits, Science of Movements, Classic Animation Principles, Practice and Audio for Animated Contents:

Introduction

The physical living cosmos around us and within is a chronometric and spatial affair. This very understanding of time and space defines and limits our vision of motion in every physical matter and complex permuted lives of uncountable biological species. Yet, when we talk about animation which is almost a re-creation of this living cosmos and more often exaggeration of the same, we need to study, calculate and archive it through a athematical and geometric vision with an objective of a believable and acceptable representation of moving life.

3.1 Persistence of Vision, Archival and Reconstruction

‘Persistence of Vision’, this very phrase mainly referred to a visual perception of motion or optical illusion as termed in psychology.

3.1.1 Understanding and Observing Persistence of Vision

As the brain confirms a definite physical existence or/ and motion through visual experience as captured by eyes followed by sending back the signals to the brain, the process however is a meticulously calculated structure can be dissected further for archival. This sense of dissection is a must for aspiring animators and animators at a beginner level.

To develop such highly cinematic memory, the student must be alert observing and studying every movement in life occurring around throughout his/her time. Learners are suggested to have timer or stopwatch to observe the movement timings more easily. In case learners tend to imagine a different kind of fantasy world or universe, they also have to have a standard perimeter of understanding the movements in their own real world and happenings around.

Archival: Once you master such kinds of movement observation, it would be easier to archive things more mathematically and geometrically. As this animation study is a highly skilful training, students should know their tools and techniques perfectly with the system and software they use to practise this archived moves of life before recreating it. The legendary animators of the past and more profoundly The Nine Old Men of Walt Disney Animation Studio have made this archival process a standardised, universally accepted and proven one though there are various modifications, permutations and different archival ways and means were found from time to time.

3.1.2 Time and Space

The fundamental principles of any audio-visual or filmic representation originated from the understanding of Time and Space. These two interlinking concepts, their production and negotiation in a cinematic context is a must learning theory for every film or/ and animation student or practitioner. However, we constantly evolve our perception of space and time and of spatio-temporal relationships and become more complex, particularly in relation to absolute, substantial and relational theories of both space and time, Einstein’s reframing of time as a spatial dimension and the ensuing construct of a space-time continuum.
Dynamic concepts of both space and time and their on-screen representation also afford us the chance to compare how cinematic space and time have been variously negotiated across the different eras of cinema, thus providing us with a fascinating insight into film’s changing relationship with these fundamental physical concepts.

![Diagram of Traditional Montage](image_url1)

**Fig 73: Diagram of Traditional Montage**

### 3.1.3 Real Time Division with Mapping by Major Standard Broadcast Formats

As earlier we have studied the history of animation, the key inspiration to time division and measuring it in a certain number of images started with a lecture by a British photographer Eadward Muybridge, who used his Zoopraxiscope to simulate the motion of animals.

![Muybridge's Zoopraxiscope and Disc](image_url2)

**Fig 74: Muybridge's Zoopraxiscope and Disc (Source: Wikimedia)**

![Phenakistoscope](image_url3)

**Fig 75: Phenakistoscope (Source: Wikimedia)**
Being inspired by them many successors like Edison and the Lumiere brothers developed separate devices to produce movies. However, by now the digital filmmaking process has revolutionized the production in any format and technology seems to be here for a longer period of time. Yet, the division of this cinematic time is counted as frames. Different broadcast formats have a different number of frames worldwide but mainly PAL [Phase Alternate Line] measures 24 Frames/Sec, NTSC (National Television Standard Committee) measures 30 Frames/Sec and SECAM (Sequential Couleur A'memorie) measures 30 Frames/Sec.

In filmmaking, video production, animation, and related fields, the frames are used as a unit of time. However, in animation every image is either manually or digitally produced and so it is the number of images which is produced per second with accuracy matched to persistence of vision. Each image is flashed on a screen with quick succession for that short time to be replaced by the next one. Persistence of vision blends the frames together, producing the illusion of a moving image that actually creates an illusion of the physical living world to the cosmos to a highly imaginary fantasy premise of storytelling.

### 3.1.4 Cinematic Dimensions and Limits

Since the end of the last century we were only exposed to limited 2-dimensional movie or video watching experience, but by the end of the last century and the beginning of this century, we have witnessed a clear change in the viewing experience shifting the technology to 3 dimensional and more of a physical engagement with the viewing experience. However to the latest the VR [Virtual Reality] Cameras and technology is also trending to keep the viewers being interactive with the movie and even to the storytelling pattern too. In animation these things also become a reality with the 3D software and computer-generated colour separation that makes the stereoscopic movie watching both in live action and animated format possible.

**Traditional Film Viewing vs Emerging 3D and Interactive Viewing**

Traditional movie viewing has been 2-dimensional with various aspect ratio and proportions. Of course traditional moviegoers do not make out the stark difference between celluloid film screenings and digital film screenings. Yet digital filmmaking experience created a feel good factor among the viewers due to its in-depth focus and stereoscopic movie options available in many theatres today.

A three-dimensional stereoscopic film (also known as three-dimensional film, 3D film or S3D film) is a motion picture that enhances the illusion of depth perception, hence adding a third dimension. The most common approach to the production of 3D films is derived from stereoscopic photography. In it, a regular motion picture camera system is used to record the images as seen from two perspectives (or computer-generated imagery generates the two perspectives in post-production), and special projection hardware and/or eyewear are used to limit the visibility of each image in the pair to the viewer’s left or right eye only. 3D films are not limited to theatrical releases; television broadcasts and direct-to-video films have also incorporated similar methods, especially since the advent of 3D television and Blu-ray 3D.

3D films have existed in some form since 1915, but were largely relegated to a niche in the motion picture industry because of the costly hardware and processes required to produce and display a 3D film, and the lack of a standardized format for all segments of the entertainment business. Nonetheless, 3D films were prominently featured in the 1950s in American cinema, and later experienced a worldwide resurgence in the 1980s and 1990s driven by IMAX high-end theatres and Disney themed-venues. 3D films became increasingly successful throughout the 2000s, culminating in the unprecedented success of 3D presentations of Avatar in December 2009 and January 2010.

With this ever evolving technology in moviemaking to give viewers the next level of phenomenal sensory experience, animation has also taken a great leap in the creation of technologies that make the production faster, sleek and stunning.

The traditional way of animation was more of human talents and less of technology. The CG Animation however is exactly the opposite. Nevertheless a different breed of animation professionals have come to make this medium and format more appealing and entertaining in the true sense. In recent times, animated movies have generated more revenues than the live action feature films which were again aided with extensive animation, CG and VFX contents.
Hence to cope with this constantly evolving technology, the professionals obviously are required to get updated pacing with the panoramic developments in order to stay in the business for a longer period. The aspirants and followers of the skill training curriculum must possess this quality passionately to develop such an attitude while learning and enabling the skills into their capabilities.

**Various Frame Size and Rates for Multiple Digital Formats**

Frame size or aspect ratio is a proportional relation between the height and width of a frame. The universally expressed way of this is two numbers separated by a colon, e.g. 16:9.

**Common image aspect ratios are as follows:**

<table>
<thead>
<tr>
<th>1:1 Square</th>
<th>1.20:1 (6:5) Fox Movietone aspect ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.25:1 (5:4) Early television and large-format computer monitors</td>
<td>1.33:1 (4:3) Traditional television and computer monitor standard</td>
</tr>
<tr>
<td>1.375:1 (11:8) Academy standard film aspect ratio</td>
<td>1.41:1 √2:1 ~1.4142:1, ISO 216 paper sizes (A4)</td>
</tr>
<tr>
<td>1.43:1 IMAX motion picture film format</td>
<td>1.5:1 (3:2) Classic 35 mm still photographic film</td>
</tr>
<tr>
<td>1.6:1 (16:10 or 8:5) A common computer screen ratio.</td>
<td>1.6180:1 (16.18:10) The golden ratio</td>
</tr>
<tr>
<td>1.85:1 A common US widescreen cinema standard</td>
<td>2.35:1 or 2.39:1 A current widescreen cinema standard</td>
</tr>
<tr>
<td>2.414:1 The silver ratio</td>
<td>2.76:1 Ultra Panavision 70</td>
</tr>
</tbody>
</table>

Almost all the digital formats for audio-visuals or Digital Cinema [DC] are stored in Digital Cinema Package (DCP) for further streaming of audio, image and data. DCP is actually compilation of digital files or/and Digital Cinema [DC] contents organized into a number of multi-gigabyte size Material Exchange Format (MXF) files that are used to store audio and video streams along with auxiliary index files in XML format separately.

The MXF track files contain image and audio essence that are compressed and encoded in order to reduce the huge amount of required storage. Encryption is an optional solution and is used to prevent unauthorized use. The image track file contains compressed JPEG 2000 essence and the audio is a wrapped 24-bit linear PCM multichannel WAV file. The adopted (optional) encryption standard is AES 128-bit in CBC mode.

Society of Motion Pictures and Television Engineers (SMPTE) ruled confirming the recommendations among different tool vendors and producers. Interop, the legacy DCP standard, is still required to be supported by DCP players. However, the DCP root folder (in the storage medium) archives has many image and audio contents and uses to manage and organize the whole playlist.

**Picture MXF Files**

Picture contents may be stored in one or more *reels* corresponding to one or more MXF files. Each reel contains pictures as MPEG-2 or JPEG 2000 essence, depending on the adopted codec. MPEG-2 is no longer compliant with the DCI specification. JPEG 2000 is the only accepted compression format.
• Supported frame rates are:
  • SMPTE (JPEG 2000)
  • 24, 25, 30, 48, 50, and 60 fps @ 2K
  • 24, 25, and 30 fps @ 4K
  • 24 and 48 fps @ 2K stereoscopic
  • MXF Interop (JPEG 2000) – Deprecated
  • 24 and 48 fps @ 2K (MXF Interop can be encoded at 25 frame/s but support is not guaranteed)
  • 24 fps @ 4K
  • 24 fps @ 2K stereoscopic
  • MXF Interop (MPEG-2) – Deprecated.
  • 23.976 and 24 fps @ 1920 × 1080
  • Maximum frame sizes are 2048 × 1080 for 2K DC, and 4096 × 2160 for 4K DC. Common formats are:
  • SMPTE (JPEG 2000)
  • Flat (1998 × 1080 or 3996 × 2160), ~1.85:1 aspect ratio
  • Scope (2048 × 858 or 4096 × 1716), ~2.39:1 aspect ratio
  • HDTV (1920 × 1080 or 3840 × 2160), 16:9 aspect ratio (~1.78:1) (although not specifically defined in the DCI specification, this resolution is DCI compliant per section 8.4.3.2).
  • Full (2048 × 1080 or 4096 × 2160) (~1.9:1 aspect ratio, official name by DCI is Full Container. Not widely accepted in cinemas.)
  • MXF Interop (MPEG-2) – Deprecated
  • Full Frame (1920 × 1080)
  • 12 bits per pixel precision (36 bits total)
  • XYZ colorspace
  • Maximum bit rate is 250 Mbit/s (1.3 MBytes per frame at 24 frame/s)

**Sound MXF files**

Sound contents are stored in reels, too, corresponding to picture reels in number and duration. In case of multilingual features, separate reels are required to convey different languages. Each file contains linear PCM essence.

• Sampling rate is 48,000 or 96,000 samples per second
• Sample precision of 24 bits
• Linear mapping (no companding)
• Up to 16 independent channels.

**Asset Map File**

List of all files included in the DCP, in XML format. Composition playlist file defines the playback order during presentation. The order is saved in XML format in this file; each picture and sound reel is identified by its UUID.
Digital video comprises a series of orthogonal bitmap digital images displayed in rapid succession at a constant rate. In the context of video these images are called frames. We measure the rate at which frames are displayed in frames per second (FPS). Since every frame is an orthogonal bitmap digital image it comprises a raster of pixels. If it has a width of W pixels and a height of H pixels we say that the frame size is $W \times H$. Pixels have only one property, their colour. The colour of a pixel is represented by a fixed number of bits. The more bits the more subtle variations of colours can be reproduced. This is called the colour depth (CD) of the video.

An example video can have a duration ($T$) of 1 hour (3600 sec), a frame size of 640x480 ($W \times H$) at a colour depth of 24 bits and a frame rate of 25 fps. This example video has the following properties:

- pixels per frame $= 640 \times 480 = 307,200$
- bits per frame $= 307,200 \times 24 = 7,372,800 = 7.37 \text{ Mbits}$
- bit rate (BR) $= 7.37 \times 25 = 184.25 \text{ Mbits/sec}$

video size (VS) $= 184 \text{ Mbits/sec} \times 3600 \text{ sec} = 662,400 \text{ Mbits} = 82,800 \text{ Mbytes} = 82.8 \text{ Gbytes}$

### 3.2 Storyboarding and Compositions

Storyboarding lets you take an idea and transform it into a visual story that will become a complete production, whether animated or live-action. Developed in conjunction with expert storyboard artists, Storyboard speeds up production planning and enables studios to reach new heights with increased production integration. One can take the help of software like Toon Boom Storyboard Pro, Frame Forge 3D, Movie Storm, Storyboard Quick and Storyboard Artist Studio to create an entirely digital storyboard. However, there are freeware and online storyboarding platforms to create storyboards these days. It truly completes the production pipeline. Nowadays some cloud-based storyboarding software allow the animation and game makers to modify the scenes even after the final production and testing stage.

Composition in storyboard is the major factor that determines the scene continuity or/ and time or spatial jump in order to plan, execute and produce things in more meticulous and cost effective manner.

The term “storyboard” first came into use at Disney Studios between 1928 and the early 1930s where the typical practice was to present drawn panels of basic action and gags, usually three to six sketches per vertical page. By the 1930s, storyboarding for live action films was also common and a regular part of studio art departments.

#### 3.2.1 Storyboarding Visualization and Design Process

Storyboard itself is a pre-visualized handbook for any animation project to make the production pipeline simplified and well organized. Yet to visualize animated script into a storyboard format is really a challenging job and becoming more professional and accurate every day. With growing professionals more specialized as storyboarding artists make this process more authentic and give the feel of a final film’s look and tale pattern.

Storyboards can be visualized in many forms, from highly polished drawings to stick figures with an ultimate objective of making it simple and clear for visually communicating to the entire production team. As every department in animation is important and specialized in their own trait, storyboard however rules as a common handbook for each one in the pipeline.

But the big question arises how a storyboard artist aspirant can start grooming himself/herself for the job. There are a few preparatory stages and prerequisites before someone actually starts visualizing the storyboards.
**Prerequisites of a Storyboard Artist/Aspirant:**

- An artistically and creatively visualizing mind
- Sense of cinematic frame limitations
- Sense of cinematic optics [Visualization through various kinds of lenses from Fish-eye to micro level]
- Sense of visual compositions and photographic compositions
- Learning the film language
- Being conversant with the terms and terminology frequently used in filmmaking

While aspiring to become a storyboard artist, the candidate must prepare himself/herself as a mini-director taking the responsibility of having thorough control over the creative content, visualizing and improving the conceptualized idea or script. With all these responsibilities the artist also enjoys immense creative freedom. Staying at the top of this creative food chain such a rare breed of artists actually rules the entire creative process in the production pipeline. Whatever animated object you are about to create or develop, storyboarding it first will always help to plan your work, which is vital to figuring out the staging of all your characters and backgrounds and how the camera will frame these elements.

**Essentials of Storyboarding**

1. Clear visibility of action in the scene/shot
2. Film language or story driven camera angle
3. Exclusive number of characters or/and props should be there in the form. Avoid distractions by adding up unnecessarily ornamental characters, gadgets or props.
4. The board must present the geographic position, present position and where is the scene heading.
5. Justified staging. More details of staging would be practised during principle practicals.

**NOTE:** Some more important essentials lie with the animation principle practice that would be studied and practised in the later chapters in this unit. However, the storyboard artist can learn it in a non-linear way as it is a constantly evolving trait in the profession. An aspirant or storyboard student must learn the entire animation production process to a thorough idea about how he is going to rule the rest of his creative team posing all the above essentials of storyboarding.

**Terminology**

**Extreme Long Shot:** This can be taken from as much as a quarter of a mile away, and is generally used as a scene-setting, establishing shot.

**Long Shot:** This is the most difficult to categorise precisely, but is generally one which shows the image as approximately "life" size ie corresponding to the real distance between the audience and the screen.

**Mid Long Shot:** This shot is also called as three quarters shot. Here the shot is taken till the knee level

**Mid Shot:** Contains a figure from the knees/waist up and is normally used for dialogue scenes, or to show some detail of action

**Mid Close-up:** Frames a subject's head and cuts off around mid-chest. The focus is on the subject.

**Close Up:** This shows very little background, and concentrates on either a face, or a specific detail of mise en scène.

**Extreme Close Up:** As its name suggests, an extreme version of the close up, generally magnifying beyond what the human eye would experience in reality.

**Wide Shot:** This shot is used to show an object in a wide setting.
**Point of View Shot:** This shot is used to show a particular object in a emphasized manner

**The Bird's-Eye View:** This shows a scene from directly overhead, a very unnatural and strange angle.

**Low Angle:** A low-angle shot, is a shot from a camera angle positioned low on the vertical axis, anywhere below the eye line, looking up.

**High Angle:** Not so extreme as a bird's eye view. The camera is elevated above the action using a crane to give a general overview.

**Eye Level:** A fairly neutral shot; the camera is positioned as though it is a human actually observing a scene, so that eg actors' heads are on a level with the focus.

**Oblique/Canted Angle:** Sometimes the camera is tilted (ie is not placed horizontal to floor level), to suggest imbalance, transition and instability (very popular in horror movies).

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*Fig 76: Anatomy of a Storyboard (Source: Flickr)*
3.2.2 Film Language Narrative and Script Break-Up

Contextually Film Language Narrative here hints at the cinematic or/ and animatic visual literacy. Normal visual literacy, visual literacy from various artistic and creative individuals’ perspective vary significantly. But when we are talking about Film Language Narrative, we mostly refer to the established visual story telling pattern in cinema. Similarly in animated films we get aid from the same populist or universally accepted visual story telling pattern in the live action films though here we have some further exaggerated forms like character or prop elasticity, super humanly behaviours, sound effects, comical effects at times being inspirex by comic strip visual presentations, etc. As animation used to give more freedom of expressions in the earlier cinema making experience, the language of narrative also have some more fantastic elements in it.

Of course with the advent of CG and VFX into live action format these days, now both the formats are on the same plane as far as the film language is concerned. This part of the study is also an analysis of historical, technical, and cultural significance of the film language, language of animated films and of course language derived from various forms of graphic novels and comic books.

To understand film language more profoundly, no film school can provide the complete study on this as the medium is constantly evolving and a new set of paradigms is set every hour in this medium. The aspirant film or/and animation professionals must watch, study films of all genres and format, critically appreciate, discuss and exchange ideas with the filmmaking or/ and animation fraternity to understand as many interpretations or points of view to finally work on his intuition to command over his/her craft of visual tale.

Of course, in such studies one has to prepare himself/herself getting gelled into the established forms like interpretations of various forms of shots or sequences or even a complete scene. She/he has to understand the meaning of every camera angle and movement that takes place in the cinematic narrative.

Components of grammar in film language that guide making a film syntax:

- Shot Size
- Composition
- Camera Position and Angle
- Movement
- The lens
- Light and Colour
- Sound
- Continuity
- Editing

In case of non-narrative cinema which is hardly used in animated films, the maker must also understand the relation between non-narrative and narrative visual tales.

With all these preparatory or self-grooming process the aspirant can exercise or/and keep practising interpreting various scripts, simplifying further with her/his kind of craft in structuring it in a visual sequence. This process is called Script Break-Up. In short, the maker tends to break it unto various scenes, their timings and locations significantly mentioned in it which paves the way for the next stage called Shot-Division.

3.2.3 Shot Division, Board Designs and Drawings

A shot is the smallest unit of a scene in movies. Though there are various lengthy shots of more than minutes in films, yet the shot is considered as a measuring unit of a movie. This part of producing a movie is the most creative and ultimate artistic expressive stage for the maker or the craftsman. The cinematic screenplay is of visualizing the shots that cling to one another to make a great scene and tale.
As explained above followed by subsequent practice and contact hours with the skill mentor, the Board Designs will evolve with the finesse of the storyboard artist, his/her volume drawing sense, camera angles as interpreted in the script since the beginning of the visualization of the entire cinematic tale structure.

It will take several hours, days and months of practice, referral studies, watching real life and cinematic life story telling pattern, understanding camera lense distortions that might be required in the plot, understanding of film language and the unusual viewing sense of the same thing escaping from the real view. The drawings for animation storyboards need more precision, accuracy and correct geometrical portrayal of shots to scene maintaining the continuity and several other components mentioned above in the film language section.

3.3 Science of Motion, Basic Principles of Animation and Practice

Without understanding and studying the motion in physics, it is really difficult to figure out how animation replicates the real life movements and further exaggerations. In the earlier days of animation in the West, several legendary animators have developed mechanisms of re-creating the life like movements on the animation medium. These mechanisms are formulated further as basic principles of animation for future generation animators or animation aspirants. These eventually have been evolving everyday to various more authentic and scientific formulae of movements of various types in nature and physical cosmos.

Such principles are simply based on the theory of physics and its applications on the imaginary or realistic characters and set-ups. Let us study them with passion, a scientific and kinetic engineering bent of mind and practise them with committed hours of hard work to possess the rarest of rare skills on the earth ever discovered by human beings.

3.3.1 Practicing Principles of Animation as Per the Laws of Motion and Animatic Exaggerations on Cross Platforms from 2D, 3D to Stop-Motion

Traditional art and animation school practices don’t give the applied physics sense to the aspiring students of animation. But without this basic sense of Physics like laws of motion, gravity, understanding of weight and mass and their direct relationship with the movements in real life, the practical animation training is incomplete.

Hence, this particular path of practising animation principles is unique and absolute as everything can only be fundamentally derived from these parts of physics. Such practice can only make the animators technically sounder than just fine art students. You may name these classes animation engineering classes. There is no surprise in studying science of motion, timing and spacing while basic practising of animation art which is also an advance form of practical science.

As this integrated skill training is irrespective of technology and platforms, we tend to give all options to the students to practise major acceptable animation formats from 2D, 3D to Stop-Motion. The student may later in her/her professional career choose the best form of animation which suits his/her capability, talent and passion.

In animation, the impact of gravity on a body, its volume, mass and weight cannot be shown properly neither the rigidity nor elasticity of the same unless animators exaggerate while creating a sequence of motion. Normally this principle practice is done through practising a bouncing ball. So such bouncing ball exercises would visibly determine the volume, mass and weight of the ball and the impact of gravity on it. Exercises can vary or make comparable practices of heavy iron balls to highly weightless balloons.
The momentum changes once a ball hits a surface and its impact is also visibly portrayed in animating balls of various weights and mass. This mechanic is simply the study of Newton’s Second Law of Motion in its practicality.

This action gives the illusion of weight and volume to a character as it moves. Also squash and stretch is useful in animating dialogue and doing facial expressions. How extreme the use of squash and stretch is, depends on what is required in animating the scene. Usually it is broader in a short style of picture and subtler in a feature. It is used in all forms of character animation from a bouncing ball to the body weight of a person walking. This is the most important element you will be required to master and will be used often.

Practice in all platforms

This is full of contact hours with animation mentors available in the classroom or online to brush up students’ skills in 2D, 3D and stop-motion animation techniques. You may get the help of OER resources through various referral video links and blogs.

Anticipation - Weight-Gravity vs Energy-Force

This particular principle of animation is of holding back on weight from gravity preserving the force within the character to be shown in a lateral energetic movement. Archery is a best example of such an exercise. However, creating this in a character with expression is really challenging.

This movement prepares the audience for a major action the character is about to perform, such as, starting to run, jump or change expression. A dancer does not just leap off the floor. A backward motion occurs before the forward action is executed. The backward motion is the anticipation. A comic effect can be done by not using anticipation after a series of gags that used anticipation. Almost all real action has major or minor anticipation such as a pitcher's windup or a golfer’s back swing. Feature animation is often less broad than short animation unless a scene requires it to develop a character’s personality.

Practice in all platforms

This is full of contact hours with animation mentors available in the classroom or online to brush up students’ skills in 2D, 3D and stop-motion animation techniques. You may get the help of OER resources to various referral video links and blogs.

Staging-Studying Focal Dynamics and Film Language

This principle is all about practising the moving or static object to a shot composited with backgrounds, overlays with camera movements. Staging directs the audience's attention to the story or idea being communicated via animated visuals. Care must be taken in background design that it does not obscure the animation or compete with it due to excess detail behind the animation. Background and animation should work together as a pictorial unit in a scene.
While doing this practice, the animator must possess a geometrically correct image building skill in placing all the layers of composition in the right place. This is all about having a perfect understanding of optical illusion and focal dynamics specifically. However, uses of various kinds of shots, camera angles, lens distortions and camera movements the students must have understood in the earlier chapter of understanding film language.

Cinematic storytelling and visual relations between the scenes, shots and sequences depends on the perfect staging in animation. The genre of the story also depends on the final pattern of such staging which differs from one kind of content to another.

**Practice in all platforms**

This is full of contact hours with animation mentors available in the classroom or online to brush up students’ skills in 2D, 3D and stop-motion animation techniques. You may get the help of OER resources through various referral video links and blogs.

**Straight Ahead and Pose to Pose - Defying Physics vs Physics**

Based on the styles of earlier sets of animators since the cell animation era, this principle is derived and practised keeping a sensible eye on the creative freedom of the animator and also organizing her/his craft abiding the laws of physics.

**However, this principle evolved out of three different ways of animating.**

- The first one is Straight Ahead which provides a lot of creative space and freedom to animators to animate in their own style and free style you may say. Most of the time the animators are so engrossed in free flow movement drawings that they are not even aware of what the objective of the movement should be. It is almost like a child drawing on a slate randomly without any specific aim to draw a certain thing or shape. Yet, this does not mean the animator/s lose focus in the process. Many great animators of the past have evolved with this as a specific style or craft of their own which had given them a profound identity in the industry for making magic into animation. If we talk about scientific approach in moving characters in this kind of animation, mostly animators love to defy basic laws of physics in it. This is actually the fun of animation and that gives a hilarious surprise since the Tom and Jerry days till date.

- The second one is however a more mechanical and disciplined way of animating. Like the Straight Ahead method, this one also has its share of advantages and drawbacks. Though this method gives a scene a clear and neat conclusiveness, it lacks that magical and vitality factor than earlier. It is following the animation director’s instructions more exactly and accurately. Nicely drawn with clarity this method of animating is more structured, calculated and logical. It is lot of hard work, overlapping actions and absence of magical touch of the animator. This process is also quite time consuming and expensive. Most senior animators hate to do such stuff though with the advent of CG animation, such animators heave a sigh of relief reducing a lot of work. It is quite literal, cold-blooded and with no surprise left for the viewers as a truly animated stuff and so sometimes may look unnatural visibly. Creative animators prefer to avoid such a mechanical way of animating. While having a positive approach, animation director and animator in particular is more sensible towards the laws of motion and basic physics lesson that moves the real world.

- However, the third and most convenient method is the combination of both the styles of animating. This somehow zeroes down all the disadvantages of the earlier styles and further strengthens the advantages of both the crafts. With more planned and structured way of animating, the animator too has the freedom for his natural animating style and craft that are quite free flow as in Straight Ahead. A perfect balance between cold-bloodedness and passionate animating is often the practice that helped the next generation animators to make the best out of their talent, skill and creativity.
Practice in All Platforms

This is full of contact hours with animation mentors available in the classroom or online to brush up students’ skills in 2D, 3D and stop-motion animation techniques. You may get the help of OER resources to various referral video links and blogs.

Follow Through and Overlapping Action - Principle of Inertia, Other Laws of Physics and its Application

Initially while animators start doing such actions like continuity of motion certainly has a stop or freeze for a moment or few frames which was not looking natural neither was following the Principles of Physics and motion in particular. So Walt Disney, the founder of Disney Studios had marked it significantly to make a point that there must be two major ways to correct these conditions and that are Follow-Through or Overlapping Action. Follow through is also called Drag.

However, if we see from the physics point of view, it is the Principle of Inertia from which actually this principle is observed and practised. Like even when a vehicle moves and stops the passenger or objects on it take some time to synchronize that motion but initially it goes in the opposite direction of the movement. For example, if a bus suddenly stops, the passengers standing on it move forward and stop. A few seconds later the bus stops. Similarly if the bus accelerates suddenly the passengers move backwards and even sometimes the standing passengers fall backwards if they could have not managed to settle or adjust immediately to the speed of the bus. Overlapping action can be taken from the passenger’s long skirt or hair which still moves even if the character stops and vice versa.

The Wave Principle is also derived from here observing the wind’s effect on comparatively lighter objects like hair, fur, liquid turbulence, viscosity of various degrees of dense liquid and the like. Animators throughout the years have developed certain easy formulae to adjust this wave effect to their craft more efficiently and perfectly.

Practice in All Platforms

This is full of contact hours with animation mentors available in the classroom or online to brush up students’ skills in 2D, 3D and stop-motion animation techniques. You may get the help of OER resources through various referral video links and blogs.

Slow in and Slow Out - Kinematics and Biomechanical Limits

When a character gets animated, his/her movements particularly change of gestures, expressions or even extreme action poses gets a timing that adds up to the smoothness in such action transits. However, there can be exceptions where some gags are added to such actions to achieve surprise, shock or/and a startling revelation of his/her actions. But anyway this is slow-in and slow-out which has to be practised properly. Though some of these movements are now controlled digitally to accelerate the animators’ work.

Here, we actually make a walk cycle combining Stretch And Squash and Anticipation. These three principles make a perfect walk cycle but there are differences in the timings proportionate to the speed of the walk or run, style and expressions. Along with these the knowledge of basic kinematics are required to have walk cycles. However, one also has to understand the biomechanical limits of a creature whether he/she is biped, quadruped and the like. This will make the animators more disciplined and cautious about his animating limits. Straight Ahead animators may have to be organized for life like believable actions. For example, our knee and leg movements have some limited arch moves and get locked after a certain point. Similarly, in other creatures too, there have to be some limits in case of realistic characters or for semi-realistic and surrealistic ones the flexibility can be more or rigidity can be more depending on the characterization the story or the content demands.

Here is how you will time the walk and run.
Timing
2’s - Staggers and vibrations - a character shivering, a diving board up and down movement
4’s - A really fast run, a fast head shaking “no”.
6’s - A fast run
8’s - A normal run, a really fast walk, 1/3 beat (three beats to the second)
10’s - Jogging pace, a quicker than normal walk.
12’s - A marching step, two steps per second, a run in which the high point is held slightly
16’s - A typical walk cycle with an attitude
18’s - A deliberate walk cycle
24’s - A slow, tired walk or a sneak

NOTE: The numbers indicated above are the number of frames per second and can be the benchmark for the animators to follow all the time.

Practice in All Platforms
This is full of contact hours with animation mentors available in the classroom or online to brush up students’ skills in 2D, 3D and stop-motion animation techniques. You may get the help of OER resources through various referral video links and blogs.

Arc - Parabolic Trajectory
Movements of most living creatures are in a slightly circular path with a few exceptions like that of woodpecker due to extreme skeletal rigidity. There are also similar exceptions in the insect world for sure. However, some arcs come back and forth in the path of a sleeping figure 8.

Imagine an arrow arched in air. It goes straight as long as its force continues to defy gravity but when it loses the force, it falls down slowing in its motion in a trajectory. Most of the bouncing ball exercises in the very first principle Stretch and Squash, the ball moves in arcs only following its trajectory.

Practice in All Platforms
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Secondary Action - Corollary of the Law of Inertia
Normally it is the corollary of the Law of Inertia or an action is supplemented to support and define the main action more convincingly e.g. a sad person wipes his tears is the secondary action, whereas his main action is expressing the gloominess in his face. A correct use of this principle will add richness to the scene without any doubt on the viewer yet sometimes this secondary action also becomes the main action because of its dominance in expressing something which is not very clear in the primary action.

Practice in All Platforms
This is full of contact hours with animation mentors available in the classroom or online to brush up students’ skills in 2D, 3D and stop-motion animation techniques. You may get the help of OER resources through various referral video links and blogs.
Timing - Speed as Per Laws of Physics, Weight, Impetus

As mentioned different numbers of frames per second earlier regarding the various walks, run and sneaks in Slow In and Slow Out, here the animator must practise it with most of the actions to register the exact expression, a decisive gesture or act she/he wants to achieve through his/her characters, incidents or/ and collective act of both.

As we study a separate principle which defines nine major appeals in human expressions, the appeals of various degrees actually depends on the timing. However, other principles too get permuted or combined most of the time in many cases which must be a spontaneous artillery in the skills of the animator with rigorous practice of all the principles, their combinations and permutations. With perfect timing an animator fine tunes her/his actions in the character, object or incidents. This refinement though will not work if the extreme key frames are not perfectly drawn or digitally created.

The sense of exaggeration also gels well with timing. Timing directly hints at the number of in-between frames to be added between extreme keys. Here are a few examples of the timing and number of in-betweens.

No in-betweens
The character has been hit by a tremendous force. His head is nearly snapped off.

One in-between
... has been hit by a brick, rolling pin or a frying pan.

Two in-betweens
... has a nervous tic, a muscle spasm, an uncontrollable twitch

Three in-betweens
... is dodging the brick, rolling pin, frying pan.

Four in-betweens
... is giving a crisp order, “Get going!” “Move it!”

Five in-betweens
... is more friendly, “Over here.” “Come on-Hurry!”

Six in-betweens
... sees a good-looking girl, or the sports car he has always wanted.

Seven in-betweens
... tries to get a better look at something.

Eight in-betweens
... searches for the peanut butter on the kitchen shelf.

Nine in-betweens
... appraises, considering thoughtfully.

Ten in-betweens
... stretches a sore muscle.

Practice in All Platforms

This is full of contact hours with animation mentors available in the classroom or online to brush up students’ skills in 2D, 3D and stop-motion animation techniques. You may get the help of OER resources through various referral video links and blogs.

Exaggeration - Certain Level of Restraint and Defying Laws of Motion and Gravity

The idea of exaggeration had been coined in the Walt Disney Studio when Walt wanted to animate characters realistically while he himself did not like the result. Actually his idea of realism is making caricatured actions look believable. The animators however made this principle a classic one with this uniqueness that sounds out more profoundly in animation film genre. Even much later, live action fantasy movies imitated a few actions and scenes based on this principle. Some professionals even don’t hesitate to say “Animation is the medium of exaggeration”.

Yet, while exaggerating, animators have applied the laws of motion and gravity cautiously to make the acts hilarious too though they have delayed, held or an impact to make it that way. The objective overall is to make the animation look natural maintaining a balance between theatrical and animated expressions at the extremes.

Practice in All Platforms

This is full of contact hours with animation mentors available in the classroom or online to brush up students’ skills in 2D, 3D and stop-motion animation techniques. You may get the help of OER resources the various referral video links and blogs.
Solid Drawing - Volume, Weight, Anatomy, Balance, Light and Shadow

The basic principles of drawing form, weight, volume solidity and the illusion of three-dimension apply to animation as it does to academic drawing. The way you draw cartoons, you draw in the classical sense, using pencil sketches and drawings for reproduction of life. You transform these into colour and movement giving the characters the illusion of three and four-dimensional life. Three-dimensional is movement in space. The fourth dimension is movement in time.

The animator must maintain the volume, weight, anatomy, balance with light and shadow to make it realistic motion. The most difficult and challenging part of animation which was always a great job for the earlier animators more particularly those who were doing classical animation. Today, the advantage of CG animation actually makes this job easier for animators and accelerates the production process. CG animation is actually a boon for those artists and animators who fail mostly in this particular difficult part of animating a character or object. It actually becomes really difficult while you are creating the illusion of the third dimension in the movements and actions. However with the 3D animation due to digital technology, this actually has freed the animators to a greater level by making them more productive.

Practice in All Platforms

This is full of contact hours with animation mentors available in the classroom or online to brush up students’ skills in 2D, 3D and stop-motion animation techniques. You may get the help of OER resources through various referral video links and blogs.

Appeal

There are a few major appeals in human expressions, actions or performances. The appeals are:

- Wonder/anticipating
- Happy
- Valour
- Scary
- Ugly/shocking
- Pity/guilty/sad
- Love/tender-emotion
- Anger
- Hope/Content/peace/blessing/bliss/acceptance

Again these appeals have degrees of expressions depending on the demand of the scene or act and accordingly the animator uses her/his craft to express more accurately and perfectly. For this the animator has to be an actor in disguise. Most animators use a mirror in front of them to bring such appeal in the character they are animating.

A live performer has charisma. An animated character has appeal. Appealing animation does not mean just being endearing and cuddly. All characters need to have appeal whether they are heroic, villainous, comic or cute. Appeal, as you will use it, includes an easy to read design, clear drawing, and personality development that will capture and involve the audience's interest. Early cartoons were basically a series of gags strung together on a main theme.

Over the years, the artists have learned that to produce a feature there was a need for story continuity, character development and a higher quality of artwork throughout the entire production. Like all forms of storytelling, the feature has to appeal to the mind as well as to the eye.

Practice in All Platforms

This is full of contact hours with animation mentors available in the classroom or online to brush up students’ skills in 2D, 3D and stop-motion animation techniques. You may get the help of OER resources through various referral video links and blogs.
3.3.2 Visual Effects: Recreation of Living World Phenomena Observing Motion Physics

Sooner we realize that physics is the basis of living world phenomena, the better we would explore those scientific applications to recreating it digitally or in a virtual medium. Visual Effects [VFX] today is more of the real-world physics that is a thorough understanding of the behaviours of fluids, particle collisions and light reflections to be reproduced in computer simulations more authentically and accurately.

Many European and American film production houses are hiring senior physicists and scientists for making their production right with a strong commitment to produce reality or believable reality. Today, VFX is not a post production affair but meticulously planned even at the time of pre-production and storyboarding level.

The Visual Effects that we are going to practise in this skill learning is mainly in two parts. One is about particle dynamics and the other is multi-dimensional compositing, i.e. Motion Tracking and Match Moving.

Particle Dynamics: Application of Properties of Matters

Studying all the behavioural actions and movements of the major matters of Physics is the key to recreate or simulate those digitally. Once we thoroughly understand these things more particularly in various kinds of Liquids, Solids and Gases, it will be easier to apply through various tools and techniques of digital interfaces in software.

While animating liquid across all platforms the applications and implementing tools must be thoroughly practised. These tools can actually create life like:

- Cohesion and Adhesion
- Viscosity, Buoyancy and Density
- Evaporation
- Volatility

Similarly animating gases the tools must be practised that control and show off:

- Pressure and Volume
- Compressibility and Expandability
- Turbulence
- Diffusion on the screen.

And in animating solids, the tools that control and show off virtually must be the applications of:

- Solid Mechanics [Elasticity, Plasticity, Tensile Strength, Compressive Strength, Shear Strength, Fracture Toughness, Ductility and Indentation]
- Thermal Behaviour in Actions [Kinetic Molecular Motion, Thermal Conductivity]
- Electrical Behaviour (Visually to be shown) [Conductivity, Resistance, Impedance, Capacitance and Super Conductivity]
- Optical and Pyrotechnical Effects

The contact hours in this chapter are more of these hinted theoretical guides. The aspirant VFX artist must create and practise these simulations in various software like Maya [Dynamics], AE, Houdini, Nuke, Fusion, Blender, etc. There are layer based and node based software and the aspirant must choose the best one to suit his working style, practice and suitability. She/he must also take expert advice for choosing the software from the mentor who will recommend the best industry practised software.

Multi-Dimensional Compositing

This section of VFX deals with mapping the camera movements of produced content and then compositing the computer generated objects or moving character/s or and gadgets in the real depth of the field in which the scene is happening.
Mapping the camera movements and depth of the field is called motion tracking, whereas that same map is applied to CG objects or moving character/s or/and gadgets to be matched later which is called match moving.

The post production works are common in almost every film whether it is a live action film or animated film. However in the case of animated contents this process is somewhat easier as all the scenes are created digitally these days. And so the mapping of camera movements is not necessary more often without a few exceptions. For animated films motion tracking is almost unnecessary unless there is a combination of live action and animated sequence or characters in the scene.

The earlier mentioned same sets of software also enable the artist to become a compositor. We will study and practise this skill more in Unit 4 of this integrated skill course.

3.4 Animation Direction, Animatics and X-Sheet Preparations

3.4.1 Animation Direction

Unlike live action movie direction, Animation Direction is more of micro-managing every aspect of filmmaking whether it is acting, camera movements, character and gadget movement detailing, voice modulation, throw and elasticity or the limit of showing off or exaggerated actions. Though the broader filmmaking stages and process remains the same as live action, animation somehow gets more meticulous from end to end.

Basic Ingredients of Animation Direction

The major components of Animation Directions are those aspects of animation production that define intricacies of characters, scene building and whole content packaging in the most effective way.

Such Ingredients of Animation Direction are:

• Defining a Genres:
  General perceptions all over regarding animated films are of comical or funny contents. However, it certainly is not. There are several serious contents like “Corpse Bride”, Action Adventure like “Spirit, The Stallion of Cimarron” made in animated format and well justifies the medium chosen by the directors of the films. So before finalizing the script, the director defines her/his treatment style in the form of genre she/he wants to tell the animated tale.

• Pre-determining Rule Books:
  Every filmmaking process has a rule book set by the producer/director, that everyone follows to achieve the exact shot or sequence the director is intended to achieve. More often the basic three rules are common in these rule books. They are clarity, simplicity and positioning the viewer’s perspective as a central observatory.

• Bi-focal Management:
  Every good director is obviously a good manager at two directions. One: external management that is deals with the demands of the producer. Second: internal management that is managing the entire crew from pre-production to post-production level. It is like making a delicate balance while managing the front room and back room simultaneously.

• Creative Decision Making
  A strong direction is also a great creative conviction to implement whatever is visualized and conceived even from the level of storyboarding, character designing, costume and gadget design, sets [Location/BG and Layout] to production to final compositing to selection and production of the music, sound effects and dialogue/song compositions.
• Packaging

You may call it video one-liners. Ultimately the show is going to succeed if it is well packaged and perfectly presented before its viewers. Show packaging is a great job undone in most of the great films that failed at the box office due to poor show packaging. Nowadays there is a special breed of makers or agencies doing jobs more specialized to attract the attention of the perspective viewer even before she/he decides to consume the show or not. So teasers, promos and trailers have become an inevitable part of any good direction team these days. Earlier these were only produced to impress the distributors or/and exhibitors. Due to the dominance of internet and various video portals, the number of hits for such promos decide or compel the distributors or/and exhibitors to make it marketed, exhibited or aired.

Role of an Animation Director

Like the captain of a ship, an animation director is a lone ranger at the top cabin sailing through a painstaking journey but enjoying every thrust of the engine i.e. her/his studio simultaneously keeping a panoramic eye all around to give her/his ship [The content she/he directs] a pinpointed direction to reach the shore, i.e. her/his desired number of audience to anchor till the last shot of the climax. Let us be more specific as this skill training is ultimately intended to enable the aspirants’ capabilities as an Animation Director. So the practice of such aspirants must follow these steps more religiously from the beginning of her/his maiden direction.

Crew Briefing: Every director must brief her/his crew about the entire tale or in part to achieve exactly as visualized. Exclusively animation directors give partial or some specific briefing more often as various departments handle various parts of production at one time. In animation, minute detailing is more important as everything is being produced in a more controlled environment unlike live action production. More witty and go getters normally play their HR skills to make his/her crew work with passion for a masterpiece and a lifetime credit attached with it. Nevertheless, as I said earlier, like a captain she/he must possess a certain amount of leadership quality to direct an awesome film at the end with the stipulated timeline.

The LEICA Reel: A moving storyboard or animatic is what the director must produce with limited pre-production core team and show before the rest of the team to convince viewers how the final film will look. More of LEICA reel is a coloured storyboard that is moving with a kind of sequential flow to give a feel of final movie. Even the crew has some suggestion/s at this stage; the reel can be modified accordingly if it gels well with the film’s objective pre-visualized by the director. Once everyone is fine with it, there is no possibility of changing the animation later. This somehow saves a lot of time, money and energy of the resources and the producer as well. A good director always prefers to go with a LEICA Reel and an Animation director should do so as well.

Characterization: Irrespective of format or medium, a storyteller actually makes the story flow through its characters and their actions. In most of the animated films or TV shows, the character is dominant and so characterization is the most important aspect of animation show direction. In the superheroes shows or features, it is the protagonist driven tale and so the major character has to be worked upon as per the content and the script. Animation Direction happens in exactly the opposite way of the live action film direction where the order goes in like “Light! Camera! Action!!” as in the earlier, the order goes in like “Action!! Camera! Light!”. Because in animation, preferably the director focuses more on the character’s expressions, gestures and actions as the remaining action is easier in this medium compared to the live action film production.

The director also makes it very clear about her/his characters, their appearances, body language and gestures, costumes, hairstyles and other specific attires that sound distinct from one another in the animated tale. The director also defines the flexible realism regime of the character depending on the script and screenplay. This means whether the character has to be realistic, semi-realistic or surrealistic and of course their body elasticity and limits and action flexibility and limits. For example, in *Kung Fu Panda* the bodies seem to have the teddy toy look as well as the flexibility of such teddy toys’ nature while acting, fighting and other gestures. Similarly in the Tom and Jerry show the characters seem
immortal with their immense elasticity and liquidity. On the contrary, the animated feature *Beowulf* has the most realistic characters ever created digitally and also animated realistically.

**Animating Resources:** An industry exposed/experienced director knows best which kind of animator fits her/his job and where these resources can justify in producing the content. So casting these animators knowing their potentials and limits and further exploring and exploiting those talents and skills to produce the best output for the film is one of the great responsibilities of an animation director. Preferably for the opening, closing and important scenes, the director picks her/his best person for the job to be done with perfection. It is more of a specific, specialized job of an Animation HR [Human Resources] Manager.

**Creative and Artistic Freedom as Goodies:** After briefing the crew and assigning the animators their job, the director allows everyone their own creative and artistic space to showcase their individual talent and skill. Until the animators voluntarily expect a certain amount of directorial inputs into the shot or scene, the director must not interfere in their work. This is one of the best assets of a good director for quality production. A good director must also be open to the ideas and opinions of the crew. Such an animation production ecosystem would work as a blessing in disguise for wonderful animation productions. It certainly reflects in their output and level of work.

**Audio:** We will practise this role more often as the audio part is the most important aspect of animated filmmaking. The audio adds up to the ultimate impact of the film whether it is the voice of the characters, music, sound effects or even the portrayal of ambience. The technology today has given more freedom to the directors to observe and give final consent synching live in the studio. Today’s theatre going experience also tremendously changed with the more real-life ambiophonic theatre system due to DSP [Digital Signal Processing].

**Hook-ups:** Matching up shots and sequence in animated talent is a major challenge and most of the amateur animation directors do it back and forth till they achieve perfection in building the sequence. These hook-ups are like continuity of action, the character’s gesture, behaviour or matching, juxtaposing the shots. The more experienced a director is and working in a planned vision, the less would be the hook-up problems in the production which eventually will save a lot of man hours, money and energy level of the crew.

**Research:** The most important factor before finalizing the screenplay is the research part. Most of the successful directors have a thorough understanding of the story idea and all aspects of it to show in visual logic. When we say visual logic, it is also applicable with cinematic logic as we have already established many norms in filmmaking and experience for more than a century. So a whole lot of acceptable film language would also fit into the tale making the production seem healthier and with relation to the viewers’ experience.

**Role of an Editor:** The director is also an editor at par whether it is live action film or animated film. Editing holds the key to the director’s storytelling ability. It is all about putting it all together in a more perfect way to gift your audience the way a lover gifts his precious collectible properly packaged to his beloved. A single moment of respite, if any noticed by the viewer is actually a failure for the director. Many filmmakers from the past have actually been elevated from being an editor.

**Religious Faith:** The completion of the production is not everything but having a religious faith and confidence to the tale is the level of commitment the director must possess. Her/his conviction is the basic and most effective force behind the success and appreciation of the film. So believing in the produced content by the director herself/himself is a greater asset than the content itself.

**Review:** This stage, though not included in the production process, but reviewing it time and again is a must for the director prior to the theatrical, TV or Web release. Review most of the time works wonders and gives some space for the director to think, rethink, correct or further shape the final cut to yield the maximum impact.
3.4.2 Animation Direction Process
Like any other kinds of film production, the process of animation direction starts from the conceptual stage to pre-production, production and post-production. However in Animation the Pre-Production which involves characters and basic asset designing and creation process which we have practised earlier in this module is very important. Nevertheless, storyboarding is the most creative part of animation filmmaking where the director puts her/his best heart and creativity forward along with her/his experience, artistic talent and skill and cinematic uniqueness through her/his craft.

The process however goes like this in following order:

```
STORYBOARD
↓
ANIMATICS
↓
PLANNING
↓
AUDIO PRODUCTION, BG LAYOUT AND ANIMATION DIRECTION
↓
ANIMATION
↓
STAGING
↓
COMPOSITING and VFX[IF ANY]
↓
EDITING
↓
FINAL MIXDOWN
↓
REVIEW
↓
FINAL CUT
```

3.4.3 Theatrical / Exhibition Format Conversion
There are various types of practices these days due to the growing demand of animated content to be produced faster and many co-productions are happening worldwide. However the animated content told in which style is also a decisive factor in choosing the process. As 2D Tradigital, CG[3D] and Stop-Motion Animation formats are predominantly present from mainstream theatrical releases to TV shows in various channels to Webcasters, the process most of the time is pre-determined due to the suitability of the production type and the timeline within which the production is supposed to be finished.

Various big studios rule their own custom-designed production pipeline process to fall in line for the various in-house and outside directors to work on the projects. Some even develop their own custom developed cloud-based software to monitor the process on the move.
Introduction

Digital Compositing, as we are going to discuss it, attempts primarily to deal with the process of integrating images from multiple sources into a single, seamless whole. While many of these techniques apply to still images, we will be looking at tools and methods which are useful and reasonable for large sequences of images as well.

As you will see, the skills of a good compositor range from technician to artist. Not only does one need to understand the basic 'tools of the trade', which can include a variety of software, one must also be aware of the visual nature of the process.

Remember, the bottom line is that all the technical considerations are unimportant when confronted with the question of "Does it look right?" Obviously this is a subjective judgment, and a good compositor able to make these decisions will always be in great demand.

4.1 Digital Compositing

4.1.1 Understanding Basic Layering

Compositing is the creative process of assembling and combining filmed or rendered elements from multiple sources, to create a final lifelike illusion or fantastical visual effect, delivered as a set of still or moving pictures.

There are two different types of compositing: node-based and layer-based. In this unit we will focus on understanding layer-based compositing.

Layer-based compositing represents each media object in a composite as a separate layer within a timeline. These layers are then progressively rendered one on top of the other.

Fig 79: Layers explained in Photoshop
All the layers are stacked, one above the next, in any desired order; and the bottom layer is usually rendered as a base in the resultant image, with each higher layer being progressively rendered on top of the previously composited of layers, moving upward till all the layers have been rendered into the final composite.

4.1.2 Digital Compositing Basics and Understanding Various UI

Although all digital compositing systems share the same basic concepts and algorithms, the method by which a user interacts with the system can vary widely. This interaction is primarily determined by the user interface that is provided with the software in question. These days, this user interface is typically a graphical front end to the tools, and hence is usually referred to simply as the GUI, the graphical user interface.

Some Basics
(a) Image Manipulation

Also referred to as photo manipulation, images are altered with the use of computer software. Photos are retouched to correct or perfect shots, with refinements, such as removing blemishes or moles, brightening eyes, whitening teeth and smoothing wrinkles. Lighting filters, contrast enhancement, brightness, sharpness and various other tuning adjustments are also common types of photo retouching.

(b) Mattes

Mattes are used in photography and special effects filmmaking to combine two or more image elements into a single, final image. In film and stage, mattes can be physically huge sections of painted canvas, portraying large scenic expanses of landscapes.

(c) Tracking

When photographing an element to be used for visual-effects work, one sometimes has the ability to specify that the camera be unmoving, or 'locked-off' for the duration of the shot. However, it is often not possible, or even desirable, to do this. Multiple shots without camera moves can become boring and lifeless. In situations where the need arises to composite together elements which were shot without identical camera moves, one must resort to tracking.

(d) Preparation of Elements

The best composites are those whose elements were planned and photographed with the explicit intention of creating a composited image. Preparation includes

(e) Element Repair

The usual situation in this business is that by the time you received the elements for your composite, there is no longer the opportunity to re-shoot anything to correct faulty plates. At this point, your only option is to manually fix the problems. It includes Wire Removal, Checking Plate Instability, Fixing Mismatched Action, Lighting and Cameras.
(f) Maintaining Efficiency

Compositing scripts have an uncanny ability to grow excessively, and unless great care is taken to simplify whenever possible, you will end up with a script that is not only incomprehensible, but also full of image-degrading problems. Avoid excessive layering of similar effects. Consider the following simple flow-chart.

![Flow Chart for Maintaining Efficiency](image1)

**Fig 81**: Flow Chart for Maintaining Efficiency

![Interface in Adobe After Effects](image2)

**Fig 82**: Interface in Adobe After Effects

4.1.3 Practice in Traditional UI Software vs Node-Based Software

Traditional UI means using layers, i.e. compositing layers of video on top of each other. Node-based softwares, as the name suggests uses nodes which is anything that changes a signal. If a video enters a node, and you tweak a value (colour, resolution, whatever), the video signal that leaves it will be a whole new person.

The cool thing about nodes is that you can bring in or take out as many signals as you want. The power of a node-based workflow is to forego the NLE-type workflow (timeline and layer-based) for greater control over your nodes and signals.

When you are working on a shot-by-shot basis, with each shot taking hundreds of nodes to get that perfect finish, nothing beats a node-based work flow. On the other hand, when you need only a few effects nothing beats a layer-based application like After Effects. The decision is not whether to use layer-based or node-based applications. The decision is: when to use what.

4.1.4 Advanced Motion Tracking and Matchmoving

Matchmoving, which is also referred to as motion tracking, is important for any VFX artist to understand. Without it there would be no way to incorporate 3D data into live action footage. There are many different softwares with matchmoving capabilities.
4.2 Editing

On its most fundamental level, film editing is the art, technique, and practice of assembling shots into a coherent sequence. A film editor must creatively work with the layers of images, story, dialogue, music, pacing, as well as the actors' performances to effectively "re-imagine" and even rewrite the film to craft a cohesive whole.

4.2.1 Practice in Editing Software, Tools and Techniques

Some Techniques

(a) Match Cut/Match Action:
Match action (or match cut) is a technique where an editor will cut from one visually similar scene to another. Typically match actions need to be planned out in advance — but when done correctly, you can create a captivating sequence by simply cutting together two similar shots.

(b) Cutting on Action
It is a technique used to create a more interesting scene. The concept is simple… when you cut in the middle of an action, it will appear less jarring and more visually interesting. This applies to just about every scene. Cut when your subject is moving and not when they complete the action and your scene will seem much more fluid.

(c) J and L Cut
J and L Cuts are an essential tool for tying two scenes together. In a nutshell, a J or L cut is an overlap of either audio or video onto the next scene. They are named for the shape they make in your editing timeline.
This is an example of a J Cut
A J cut is where you hear the audio before you see the visual. For example, if you were to hear a train horn and then cut to video of a train, this would be considered a J Cut.

An L-Cut on the other hand is where you see the video before you hear the audio.

(d) Montage
A montage is a sequence of shows that shows the passage of time. While you may be familiar with the idea of a montage, it is important to remember that a montage is a tool that can progress your story. One such example is the Rocky training sequence where Rocky trains for his big fight and ends up running up the stairs at the Philadelphia Museum of Art. Not only does that scene pass time, but also develop Rocky’s character so that we can see his inner transformation.

(e) Jump Cut
A jump cut is a cut that allows the editor to cut out portions of time. A jump cut can preserve visual interest without the audience having to watch boring fluff.

Editing Softwares
Complete beginners should start with Iskysoft Video Editor to get the feel of the video editing process. Then move onto advance programs like Camtasia, CyberLink PowerDirector and Adobe Premiere Pro.

4.2.2 Editing for Animation (Special Lesson)
The role of an editor in animation is a hot topic. First, one needs to know that the editor’s job on an animated film lasts for the entire film, and is just as intense up front as it is in the end. An animated film is “pre-edited.” The story is tied down with story sketches to set the timing of the film before animation even begins. It is usually done sequence by sequence as opposed to the entire film being done “early. That means the editor steps up and begins timing out the sequences, putting scratch SFX and music into the reels to create the closest thing to the final film as possible.

Once a sequence is approved for animation, the editor will start cutting in the actual animation, production dialogue, etc., that will eventually become the final film.

The first six chapters have been devoted to analysing in terms of the sight alone, the film’s artistic version of the four-dimensional space-time continuum re-created on the cinema screen. But, besides this, there is the world of sound, another dimension, another aspect of reality, the most significant thing about it perhaps being that it comes to us through a different sense organ which determines the nature of our experience of it.

Next to sight, hearing is the richest and most complex of our senses. Sound is the basis of one of the greatest of arts, music. As speech it forms a medium for thought, and is the most important means of communication among human beings.

As one can imagine, those who hoped the cinema would create a total illusion of reality were not likely to be satisfied with sight alone, and from the very beginning of the cinema every effort was made to incorporate sound. The history of sound in films is broadly similar to that of colour: early attempts and failures; the realization of the silent film was a valid art form and acceptable to audiences; technical progress in, and eventual perfection of, workable sound systems.

4.3 Audio for Animation
According to Michael Geisler, “Sound effects play an important role in conveying action. Music helps express emotion.” This goes to show that adding sound effects to our animation gives life and meaning to the characters as they move, talk, cry, shout, scream and the like. A lot of development has been done, sounds are given attention in a way that when this will be in sync with the animation it would bring the audience into the story. Not just by merely looking at the pictures moving but also with the sounds it creates for us to feel the mood and the atmosphere of the animation.
Sounds are essential to animation works for it facilitates every action that each character plays. Having appropriate sound effects gives soothing experience to watch an animation be it in 2D or 3D animation.

It also makes it easy for the viewers to watch and listen to the story as it shows its animation incorporated with sounds/audio. Compared to an animation without an audio, it would really be a boring one. And its a fact!

Talking about how important this would be, I can say that without music in animation there would no life supporting it. So as to enliven the history of music in animation, this will serve as our symbol for creating, renovating, and improving the world in animation.

(Ref: http://soundsupervision1.blogspot.in/)

**4.3.1 Understanding Ambience and Ambiophonics**

Ambiophonics is a comprehensive sound recording/reproduction methodology which uses hardware/software to bring the “you-are-there-realism”. Ambiophonics combines crosstalk-free speaker pairs surround speaker ambience derived from measured hall impulse responses via convolver (Ambioolver) and room/speaker correction/treatment to generate a binaurally correct sound field similar to wave field synthesis.

Ambience refers to the sounds that are present in a given physical environment or surrounding. In filmmaking, it is added to make the scene feel more realistic with respect to the given geographical region. For example, for a scene placed in the mountains, whistling sound of winds can be added to make the audience feel more connected.

**Foley Art**

Foley Art is basically the process of recreating Sound Effects inside a studio called Foley Studio, in order to enhance a scene or a visual by adding quality and realism to it. The person who does it is called a Foley Artist.

"Foley art" is named after Jack Donovan Foley, who worked in Hollywood and was the first person to make movies seem real by adding everyday sounds.

When a film is shot, the actors’ dialogues are recorded, but other sounds such as Footsteps or the feeble rustling sounds of an actor's clothes can get lost or may seem wrong while shooting. Foley artists fill in those missing sounds.

In animation, where every visual has been virtually created, the need for Foley is even more. Foley artists even recreate actual movements in an enhanced way. That includes everything an actor/character touches or effects, and these sounds are known as Specifics.

For example, in a movie with a sword fight, a Foley artist may add the sounds of footsteps, sounds of swords whooshing or clanging together, the sounds of clothes, especially armour, etc.

Foley artists get creative to make the audio of a film better than reality. Some common sound effects that an audience may actually hear are walking in snow, thunderstorm, fire, horses galloping, etc.

**4.4 Voice for Animation**

It takes more than a talented animator to bring a character to life. Once the animation has been completed, a soundtrack and voice actor need to be selected. The right voice will keep audiences interested while a poor voice distracts them from the animation on the screen. Good voice acting is important to engage and entertain your audience.

**4.4.1 Narration Styles for Animation**

The various narration styles in filmmaking can be classified on the basis of the perspective in which the story is told. Some common narrative styles used are:
First-Person Narrative

The first person narration uses a pronoun “I”. Here the narrator is a main character in the story or a less involved observer. In this case the inner plots and thoughts of other characters are revealed through what the reader chooses to tell the audience.

We see this style in the movie *Spirit: Stallion of the Cimarron* (2002) where the story is told by the main character itself in his own words while speaking about his life and personal struggle.

Second Person Narrative

This is a kind of less common type of narrator which uses the second –person pronoun, ‘you’. The use of this device can be seen in adventure books like *If On a Winter’s Night* by Italo Calvino.

Limited Third Person

This narrator is similar to the first person in that only what the narrator perceives is made available to the viewer. The only difference is that here ‘he’ or ‘she’ is used rather than ‘I’. A famous example would be of J.K Rowling’s *Harry Potter* series.

Filmmaker's/God's Perspective Narrative Style

This kind of narrative style is also known as ‘Omniscient Author’ because here the narrator has access to the emotions and thoughts of the character. The story is unfolded from the filmmaker’s point of view who has all the freedom to choose how he/she wants to tell the story.

Multiple Characters or/and Element’s Perspective Narrative Style

Multiple narratives uses techniques such as multiple narrators, telling a story within a story or bringing together many story arcs. There are several strategies that can be used for multiple narratives, and they can help to enhance the theme, or deepen characterization.

4.4.2 Dialogues for Animation

Dialogue of a character plays an integral role in making it believable and relatable to the audience. Besides visual cues such as movement of hands and body language, dialogue conveys the emotions and what it feels in the course of the story.

General Character Specific Dialogues in Humanistic Style Even for Animals and Birds

This is a common style used in many animated movies where the story belongs to the world of species other than the humans. For example, the movie *Finding Nemo* uses human voices even for aquatic organisms to tell the story through them and make them relatable to the audience.

Mimicry Style Dialogues for Animals, Birds and Surrealistic Characters Imitating Closely their Voice Modulation

This style can be better understood through the example of Donald Duck where the dialogue is a combination of voice modulation that is similar to that of a duck and the language of humans. This style is rarely used and the major objective is to give the character a unique style of its own and for the simple cause making it sound funny.

4.4.3 Lip Chart Production

The art of animated lip sync narration, requires the artist to create the illusion of speech patterns that are commonly attributed to a particular language. In order to accomplish this, facial expressions and mouth movements are illustrated and coordinated with word pronunciations. Special attention is given to the synchronization of these auditory and visual components to produce an animation that emulates human characteristics.

Understanding Phonetic Pronouncing Lip Poses for Lip Chart

Animated lip sync narration usually incorporates the audio and visual properties of phonemes and viseme.
A phoneme is a sound that represents a letter of the alphabet. It represents the positioning of the lip and other properties of mouth specific to a particular sound. Artists prepare a phoneme chart which helps the animators later in animating the mouth while characters deliver a dialogue. These charts may be same for all characters belonging to the same sketch or may vary from one to other.

Phonemes are units of sound, but to establish it visually in animation viseme library must be produced before animating the dialogues and verbal reactions. Visemes are simply representing the sounds visibly or you may call them visual phonemes. Each viseme represents a mouth shape: the animation controls on the face are positioned to create the correct mouth shape for one phoneme.

**Lip Chart Production with Gesture as Per the Character Traits, Attitude and Need of the Scene in the Narrative**

This section of lip chart production is directly linked with the character design bible. So this particular lip chart or viseme library is exclusively prepared by the character designer himself/herself. Again the loudness and softness of dialogue delivery with the mood of the scene must be considered specifically to have extra or additional number of lip poses. As the character designer knows best about the characters’ attitude, behaviour, body language, she/he knows best what kind of lip poses best suits the personality keeping in mind the context and demand of the scene.

**Special Lip Poses While Extreme Movements of the Characters and in Singing, Shouting or Crying Situations**

Sometimes extreme emotion such as crying or shouting requires special attention from the character animator to make the action look believable. This needs the artist to develop a special viseme that is separate from the general lip chart of the character which has to be unique for every character.

### 4.5 BGM for Animation

Most of the animated films and shows have songs, musical scenes or/and melodramatic sequences. No doubt this incredible part of any movie narrative pierces the hearts of viewers to achieve the moods created over screen. So scoring the background music is the most important part of animated filmmaking. Evolution of several software with high precision digital sound equipment worldwide have given enormous possibilities in making this portion of filmmaking easier and faster yet quite challenging to establish unexplored areas so far not represented over the popular media or theatre viewing trends.

#### 4.5.1 Songs and Melo-Sequence Production

Most of the time in animation production, these are finalized and scored much before the animation production happens. Director with her/his crew along with the music director’s crew spend hours together in the studios to produce various songs and melodramatic sequences in the studio.

However, though animation professionals need not be conversant enough with the various software and hardware interfaces to mix the music but understanding the whole process is an advantage to her/his career path in the future.

#### 4.5.2 Thematic or Signature Music Scoring

Every great tale today has a theme music or song that moves the story along with its characters to give viewers a great aural treat. The signature music sometime becomes a great cinematic memory for the greatest animated tales told ever on the screen, e.g. Hakuna Matata and Circle of Life in Lion King being the song by Elton John which was composed, scored and mixed quite well. Similarly in *Spirit, The Stallion of Cimmarron*, Bryan Adams thrills the audience and takes the viewer to a completely emotional space the viewers could never have got without. *Beauty and the Beast* is another classic in such perspective to watch and hear.

#### 4.5.3 Background Music for Mood and Scene Build-Up

Last but not the least, even in the seriously narrated animated tales too need background music to build up the scene and create the mood for the audience. Most of the time background music actually adds to the impact of any shot or scene which cannot be achieved only through the animation excellence or startling visual ecstasy.

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4.6 Sound Effects for Realistic/Exaggerated Feel and Impact
Sometimes making the audience feel that they are inside the world of the story is very important. Hence, sound artists use the technique of realistic sound effects to give the audience that feel. In the scenes involving extreme action, sound effects like that of banging, crashing or a loud thud provides that extra impact required to keep the viewer on the edge of his seat.

4.7 Mixing and Ambiophonic Layering
Ambiophonics, Panorambiophonics, and Periambiophonics are related surround sound paradigms that reliably deliver up to full 360-degree spherical localization for both direct and ambient sound via two, four, or six DVD/SACD/MLP/DTS/Dolby/ADAT coding/media channels. They reproduce old or new, standard, 2, 4, 6, or ITU 5.1-channel music discs with unprecedented spatial realism and binaural-like localization accuracy via direct sound radiating front/rear/overhead stage-producing Ambiopoles and virtually any desired number of ambience surround speakers.

Alternatively, superior acoustic recordings can be made using the described Ambiophones (or using algorithms if fabricated) to capture images of startling depth and presence for music in the round, 3D movie sound tracks, virtual reality, or electronic music soundscapes. Six-channel Periambiophonics adds elevated direct sound to the fully spherical hall ambience vectors already provided by basic Ambiophonics which drives essentially any number of hall ambience speakers regardless of their positions. All the versions of surround Ambiophonics easily deliver a “you-are-there”, psychoacoustically correct, home listening experience, via home theatre media, albeit best limited to one or two listeners.

Ambiophonics is a comprehensive sound recording/reproduction methodology, that like or unlike stereophonics, Ambisonics, THX 5.1 or Wavefield Synthesis, prescribes hardware/software that scrupulously insures that the well known tenets of human binaural hearing are rigorously catered to so as to achieve psychoacoustic and physiological verisimilitude for one or two home listeners/viewers who seek and value “you-are-there” realism.

It combines cross-talk-free speaker pairs (Ambiopoles), surround speaker ambience derived from measured hall impulse responses via a convolver (Ambiolver) and room/speaker correction/treatment to generate a binaurally correct sound field similar to wavefield synthesis. Ambiophonics creates a concert hall stage and hall from just two media channels as found on CDs, MP3s or LPs feeding a single Ambiopole.

Panorambiophonics requires four media channels as provided by multichannel DVDs or SACDs each pair feeding its own Ambiopole. Periambiophonics uses six media channels as in DVD-A, DTS-EX, etc. feeding three Ambiopoles. In each type of system additional hall ambience surround speakers may also be driven via a single Ambiolver and this is strongly recommended where music is concerned.

A single Ambiopole in front easily produces a stage of about 160-degrees in width. A single Ambiopole to the rear of the listener produces a similar rear stage width. A remarkable property of the Ambiopole software we have developed is that when both front and rear Ambiopoles are working together, they blend and the front and rear stages widen to the full 180-degrees. Thus, 360-degrees of horizontal localization becomes easily attainable for recordings made with Ambiophones or synthesized. A third or even more Ambiopoles can be elevated over the front and/or rear Ambiopoles to add full width stages high in the air and again there is a vertical fill between the stages although the extent of this phenomenon has yet to be fully investigated. The most basic Ambiophonic theory is meant to allow previously recorded two channel media such as CDs, MP3s, and LPs to be reproduced without the well known limitations of the traditional 60-degree stereo triangle to deliver an uncompromised full width direct sound stage from two center-front speakers (an Ambiopole) and to provide real diffuse but still directional hall ambience to almost any number or location of surround speakers including elevated speakers.
It became obvious in the early development of Ambiophonics that existing stereo microphone techniques could be revised to produce better two channel recordings. Thus, on the recording side, the Ambiophone, a novel, baffled microphone arrangement, takes advantage, when recording, of the knowledge that the playback will be Ambiophonic. (not via the stereo equilateral triangle although Ambiophone recordings are actually backward compatible and sound quite normal in standard stereo) The Ambiophone also assumes that both the amplitude and the directional attributes of the early reflections and reverberant tails of the hall will be properly directed to the appropriate frontal Ambiopole and surround speakers. (Indeed, this is possible even in the case of non-Ambiophone recordings if the recorded or added reverb, unfortunately mixed into the direct frontal sound, is not too intrusive.) After a brief review of the basics, this paper is devoted to advanced versions of Ambiophonics which take into account the 5.1, 6.0, 7.1, Dolby/THX and DTS coding/media/speaker arrangements. Special matrix coding developed by Robin Miller of Filmmakers Studios allows two or four media channel Ambiophonics/Panoramiophonics recordings to be played back via the 5.1 speaker arrangement with clearly superior, if not ideal (compared to Ambiophonics) verisimilitude over such ITU systems. In reverse, standard 5.1 discs may also be played Panoramiophonically in a manner analogous to the Ambiophonics' playback of ostensibly stereo CDs or LPs, but, in this case, using front and rear Ambiopoles and surround ambience speakers driven by a hall impulse response Ambiovolver. Most 5.1 movie and music DVDs or music SACDs reproduce exceptionally well this way especially when compared with the ITU 5.1 standard speaker arrangement Panoramiophonics, described below, uses four channel coding/media such as Dolby, DTS, SACD, or DVD-A to deliver an easily localizable 360-degree direct sound stage as in movies, or, for concerts, a very wide front stage that, if in a hall, automatically includes horizontal 360 degree hall ambience. A four channel recording mic, the Panoramiophone, has been designed to make such recordings. Only four speakers (two Ambiopoles) are used in Panoramiophonics reproduction to reproduce all horizontal plane direct sound and horizontal hall ambience with full circle normal binaural localization physiology. Where the direct sound recording has been made in a dry or small studio, it is possible to enhance the reproduction of these front and rear direct sound fields by adding ambience surround speakers driven by a hall Ambiovolver as in standard Ambiophonics.

Periambiphonics adds a third elevated Ambiopole to Panoramiophonics to provide for a full direct sound stage in all dimensions including some height. The elevated Ambiopole can be used for direct sound reproduction or ambience. In the latter case this allows a concert-hall direct sound performances to be recreated in a home with just three speaker pairs and no surrounds. Using three direct sound Ambiopoles allows movies, virtual reality, games and soundscapes to sound more like the live experience. Furthermore, Periambiphonics can combine six channel Periambiophone recording, and the front, rear, and elevated Ambiopoles, with an Ambiovolver to add virtually any desired number of surround speakers so as to deliver physiological verisimilitude of a concert hall experience that also includes rear or overhead direct sound sources to a home listener via standard DVD/SACD media. Clearly, both Panoramiophonics and Periambiphonics are well suited to capture, create and reproduce 3D electronic music or virtual reality projects. This paper reviews the theory, techniques, and features, of the hardware and software required to make these various kinds of Pan/Peri/Ambiophonics recordings and to reproduce these as well as stereo CDs and the various multichannel surround media.

**Chnl Ambiophonic Recording**

While for many people, with large CD collections, basic Ambiophonics will sound as good as they wish, others will find enjoyment in the improvement that can be achieved by making recordings specifically meant to be played back over Ambiophonic systems. The Ambiophone recording microphone assembly was designed to make this feasible. The derivation of the Ambiophone has been described in detail in the earlier referenced papers. Basically it is a head shaped ball with two omni-directional microphones mounted flush where the ear canals would be. The microphone is baffled. That is it faces forward and is shielded from sound originating from overhead, the rear or the extreme sides. Ambiophone prototype by Robin Miller before placement of omni capsules within the head. The microphone is placed first to fifth row center depending on taste. The perspective one hears during reproduction is the same as if one were at the mic position during the recording session.
The usual considerations of hall radius or ratios of direct to reverberant sound do not apply here since the mic is baffled. Since all hall ambience will be generated from this or other great hall impulse responses, it is not necessary to record hall reverb during the recording session. The Ambiophone must also collect horizontal frontal or proscenium ambience since this indirect sound should emerge from the Ambiopole with the direct stage sound. The head shape of the Ambiopole provides the Interaural Level Difference for sounds from the stage sides. Otherwise, the Ambiopole, being centred in front of the home listener, would not provide this.

The Ambiophone captures both correct ILD and ITD compared to coincident microphone techniques, spaced omnis, spot mic mixing, etc. The Schoeps KFM-6 turns out to be a good match for an Ambiophone, if baffled during use.

4.8 Production Management
Project Management is a specialized science with various facets. If you break down the life cycle of any project, there are multiple stages such as initiation, implementation, completion, delivery and closure with active monitoring as a common factor across the entire process chain. Each of these stages can be extrapolated into many individual tasks and for each task a defined process or method can be created. In this way an effective system can be designed that ensures complete control over the processes and the execution of the tasks in a time bound manner.

4.8.1 Decisive Factors for Strategic Process Planning
Type of Production
Technical Complexity
Shots and Production Flow
Creative Flow
Budget, Schedule and Resources

4.8.2 Optimising the Limits in Time, Money, Resources
Time and money are important aspects in any process, filmmaking included. Budget, in general, refers to the sum of money allocated for a specific purpose. In this case it refers to the money used for film-making equipment, hiring artists, marketing/promotion and many other expenditures. Scheduling is the process of arranging, controlling and optimizing work and workloads in a production process or manufacturing process.

4.8.3 Implementation of Production Pipeline
Today, the major great studios do not follow their own set of rules in setting up and implementing a particular production pipeline used to be practised for years before the 1990s. Rather these intelligent studios upgrade themselves with the technology as well as customize their production pipeline driven by the animated tale they are producing. Production houses like Pixar sets up its production pipeline as per the demand of the script and the timeline set to release the show.

Though these studios follow the fundamental process of traditional pre-production like drawing and sketching but the technology enables these artists further to produce these great artworks with perfection digitally drawing over the screen with the help of digi-pen tablets. This actually accelerates the artists’ work with perfection in quality production. With the blade server networked systems, any resource can access any data at any point of time from any particular place. Most of these places of work become interchangeable. This also gives a greater possibility for co-production with many studios across the continents. This gives access to cross-animation-cultural practices for the professionals to be conversant with many kinds of pipeline and work process. Production managers and show directors can monitor and such pipeline from anywhere, anytime even if the show is being produced at many studios simultaneously. All these studios are perfectly in sync with the sourcing production pipeline set by the core studio or/and the producer of the show.