Maharaja Agrasen Institute of Technology
ETCS 211
Computer Graphics & Multimedia
UNIT 3
Animation

Objective

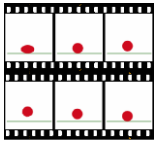
- **What is Animation?**
- **How Animation is Generated**
- **History of Animation**
- **Principles of Animation**
- **Animation Formats**
- **Animating via Simulation**
- **Q & A**

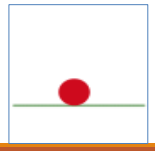
What is Animation?

- Animation is the rapid display of a sequence of images to create an illusion of movement
- The most common method of presenting animation is as a motion picture
- Humans require 16 HZ minimum; 24 Hz used for films; 30Hz used for TV

Animation

- Each frame is a photograph, drawing, or computer generated image
- Each frame differs slightly from the one before it
- Viewing the frames in rapid succession implies "motion"





How Animation is Generated

- Typical examples include:
  - Keyframing (specified by hand)
  - Data-Driven (motion capture)
  - Procedural (rules, flocks)
  - Simulation (laws of physics)

History of Animation

- Paleolithic (old stone age) cave paintings
  - animals depicted with multiple legs in superimposed positions to convey the perception of motion

History of Animation

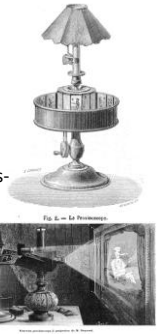
- Zoetrope
  - As the cylinder spins, one looks through the slits at the pictures
  - One sees a rapid succession of images, producing the illusion of motion
  - The earliest known zoetrope was created in China around 180 CE (may have existed in China even 300 or so years before that)

History of Animation

- Phenakistoscope
  - A spinning disc attached vertically to a handle
  - A series of drawings around the disc's center
  - A series of equally spaced radial slits
  - The user spins the disc and looks through the moving slits at the disc's reflection in a mirror
  - Invented by a Belgian physicist Joseph Plateau in 1841

History of Animation

- Praxinoscope
  - Improved on the zoetrope by replacing slits with an inner circle of mirrors
  - Invented in France in 1877 by Charles-Émile Reynaud
  - In 1889, he invented an improved version that allowed one to project the images onto a screen



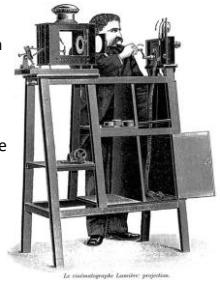
History of Animation

- Flip book
  - The first form of animation to employ a linear sequence of images, rather than a circular set
  - In 1868, John Barnes Linnett patented it under the name *kineograph* ("moving picture")

Click for movie

History of Animation

- Cinematograph
  - Fed the linear film through with a hand operated crank
  - Projected the images onto a large screen
  - Invented in 1895 by the Lumiere brothers
  - Took their "film projector" around the world, charged admission for movies
  - Original films were 17 meters long and lasted 50 seconds

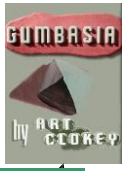


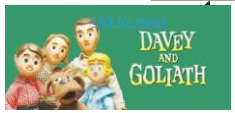
Hollywood

- First film studio established in Hollywood in 1911, followed by 15 more later that year
- Charlie Chaplin Studios established in 1917
- Silent Film Era until 1929
- 1st Academy Awards in 1929

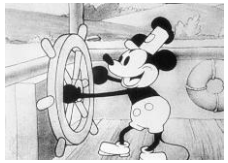
Stop Motion

- Gumbasia was the first clay animation
  A short film produced in 1953 and released on September 2, 1955
- Produced by Art Clokey, who went on to create the classic series "Gumby" and "Davey and Goliath" using the same technique





Cartoons

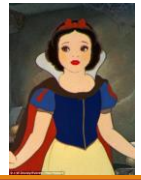


Produced in large numbers in the Golden Age of Hollywood; usually shown before feature films

First animated full length film: Snow White, 1937 (took 4 years to make)

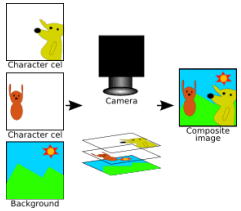
Moved to TV in the 1950's, when TV became popular

– Flintstones: first successful prime time TV cartoon



Cel Animation

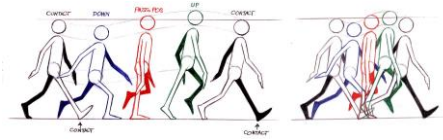
- The drawings are drawn in layers, and stacked before photographing them
- Saves time, since the background and static objects only need to be drawn once



- Can archive and reuse canned animation cycles (sequences of cels) for running, jumping, etc.

Key Frames

- Need to stay cost efficient
  - Advanced artists model a set of key poses or key frames for the characters
  - Beginner artists filled in the motion in between these key poses



Cartoon Computer Animation

- Traditional Animation was replaced with 2D Computer Animation circa 1990 while still using the concepts of static backgrounds, key framing, animation cycles, etc.

Arcade Games

- Space Invaders 1978; Pac Man 1980; Donkey Kong 1981
- Golden Age of Arcade Games 1978-1985

Game Consoles

- there were no 1st gen consoles – just dedicated hardware e.g. Pong 1975
- Atari 1977 (2nd gen); Nintendo 1985 (3rd gen); SNES 1991 (4th gen); Playstation 1995 (5th gen)

3D Video Games

- Nintendo 64 (5th gen) & Super Mario 64, both 1996, widely popularized 3D video games
- Playstation 2 2000; Nintendo Gamecube 2001; Xbox 2001 (all 6th gen)
- Playstation 3 2006; Nintendo Wii 2006; Xbox 360 2005 (all 7th gen)
- Playstation 4 2013; Wii U 2012; Xbox One 2013 (all 8th gen)

Nintendo Switch

3D Computer Animated Films

- Toy Story 1995, Pixar Animation Studios

3D Computer Animated Films

- 3D figures is rigged with a virtual skeleton
- The limbs, eyes, mouth, clothes, etc. are moved by the animator on key frames
- Positions in between key frames are filled:
  - Brute Force
    - Manually set values for every frame
    - Extremely expensive
  - Traditional Keyframing
    - In-between frames are specified by beginners
    - Still extremely expensive
  - Computer Keyframing
    - In-between frames are computer generated
    - Relatively cheap
- Finally, the animation is rendered

Principles of Animation

- John Lasseter
  - Animator, film director, chief creative officer at Pixar and Walt Disney Animation Studios, Principal Creative Advisor for Walt Disney Imagineering
  - Oversaw all of Pixar's films and associated projects as executive producer
  - Directed Toy Story, A Bug's Life, Toy Story 2, Cars, and Cars 2

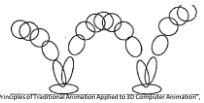
"Principles of Traditional Animation Applied to 3D Computer Animation", Computer Graphics, pp. 35-44, 21:4, July 1987 (SIGGRAPH 87).

Principles of Animation

- Squash and Stretch
- Timing
- Slow in Slow out
- Anticipation
- Follow Through and Overlapping Action
- Staging
- Exaggeration
- Solid Drawing and Appeal

Squash and Stretch

- Defining the rigidity and mass of an object by distorting its shape during an action
  - The volume should remain constant
- Very important in facial animation



"Principles of Traditional Animation Applied to 3D Computer Animation", SIGGRAPH 87

"Illusion Of Life" by Frank Thomas & Ollie Johnston, Hyperion Press, (ISBN 0786860707), 1981

"Principles of Traditional Animation Applied to 3D Computer Animation", SIGGRAPH 87

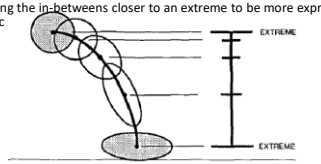
Timing

- Spacing actions to define the weight and size of objects and the personality of characters.

Timing for animation, Harold Whitaker, John Halas, Focal Press, 2002

Slow In Slow Out

- The spacing of the "in-between" drawings between the extreme poses
  - Mathematically, it refers to the second and third order continuity of motion
  - Grouping the in-betweens closer to an extreme to be more expressive or realistic



"Principles of Traditional Animation Applied to 3D Computer Animation", SIGGRAPH 87.

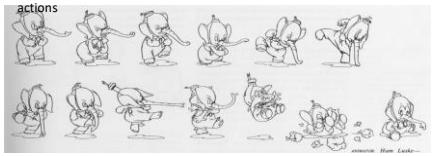
Anticipation

- An action has three parts
  - The preparation for the action - this is anticipation
  - The action
  - The termination of the action
- Prepare the audience for the next movement and direct their attention to a certain part of the screen

"Illusion Of Life" by Frank Thomas & Ollie Johnston, Hyperion Press, (ISBN 0786860707), 1981

Follow Through and Overlapping Action

- Follow through is the termination of an action
  - Actions are generally carried past their termination point
- Overlapping means to start a second action before the first action has completely finished
  - This keeps the interest of the viewer, since there is no dead time between actions



"Illusion Of Life" by Frank Thomas & Ollie Johnston, Hyperion Press, (ISBN 0786860707), 1981.

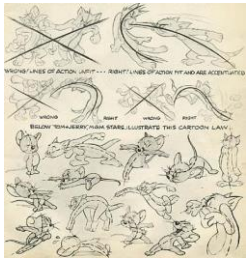
Staging

- The presentation of an idea so that it is clear
  - Lead the viewers eye to where the action will occur
  - Only one idea should occur at a time

Cartoon Animation, Preston Blair, Walter Foster, 1984

Exaggeration

- Exaggerate to make the action more believable and expressive
- Also done by stage actors (Along with many principles…)
  - of the other



Cartoon Animation, Preston Blair, Walter Foster, 1984

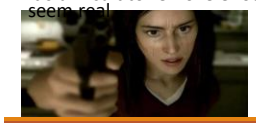
Solid Drawing and Appeal

- Solid drawing stresses the importance of three-dimensional shapes, accurate anatomy, and animation work that has a sense of weight, balance, light, and shadow
- Appeal is a quality of charm, pleasing design, simplicity, communication, or magnetism
  - E.g. In creating an appealing character pose, avoid "twins" where both arms or legs are in the same position doing the same thing

"Illusion Of Life" by Frank Thomas & Ollie Johnston, Hyperion Press, (ISBN 0786860707), 1981.

CG Humans are Hard

- As characters get more and more real, quality becomes extremely important
- But even state of the art animation, geometry, rendering, simulation, etc. can lead to disturbing zombie-like characters
- It's difficult to remove enough errors to make human seem real



CG Humanoids are Easier

- On the other hand, it seems quite easy to slap together a completely unrealistic robot, and make it endearing
- We respond quite positively to human like characters as long as they're not too human
- And we're quite forgiving of any lack of realism

Uncanny Valley

- Stay on the left side of the valley
- Don't shoot for real, shoot for "stylized"
  - Much easier than real
- Alterations to make less human
  - "Futuristic" humans
  - Military suits
  - Super powers

Animation in Multimedia

Common Animation Formats:

Animated GIF
SWF
MOV
AVI

Animation Formats

Animated GIF:

Pronounced je-if
.gif file extension
A bitmap file format often used on the Internet
A series of individual GIF frames joined together to create animation
Used for small animations and low-resolution film clips
Easiest way to create and view simple animations
Supports frame-based animation

Animation Formats

SWF:

Pronounced swa-if
swf file extention
The dominant format for displaying animated vector graphics on the Web
Used in programs and games with Actionscripting

Animation Formats

MOV:

Pronounced moo-v
mov file extension
Developed by Apple computers for Quick time video player
Also known as Quicktime movie or movie format
Used for streaming

Animation Formats

AVI:

Pronounced a-v-i
avi file extension
Developed by Microsoft computers for Windows media video player
Not good for streaming

Animating via Simulation

Describe motion using the laws of physics, biomechanics, and various other equations and rules

Then automatically generate animation by solving the relevant equations

If the equations are valid/adequate and can be solved robustly with minimal errors, then one can automatically generate realistic animations

Minimizing human time in the specification of key frames, while increasing the need for computational resources

- In fact, simulation can take an excessive amount of computer and wall clock time

One still needs to set initial and boundary conditions, various material parameters, geometric constraints, design algorithms and controls, etc.

It's definitely not a panacea, but has been invaluable for many aspects of computer animation

- Smoke, fire, water, explosions, destruction, clothing, flesh, hair, etc...

Animation vs. Simulation

Animation	Simulation
Active	Passive
controllable, expressive, stylized motion	automatic generation, no need (or less need) for by hand manipulation
hard to make look realistic, tedious to specify every detail	follows physics laws and equations, often easier to make look realistic

What can we simulate?

- One can draw a line between animation and simulation at various levels
- Take character animation as an example:

Animation	Simulation
Motion of the body	Passive motion of cloth
Motion of bones	Passive deformation of flesh
Signals in the nerve system	Responses of the muscles and passive motion of bones
Brain activity	Signals transferred in the nerve system

Q & A

What is animation?

How is animation utilized?

What are the types or categories of animation?

What are the types of animation file formats?

Editing features of animation software

Equipment used in digital animation

Q1. _____is basically a form of pictorial presentation
a) Photography
b) Animations
c) Drawing
d) Creativity

Q2. Multimedia elements are typically sewn together into a project using _____.
a) multimedia tools
b) authoring tools
c) audio tools
d) video tools

Q3. Every animation needs a starting and ending point. _____ are used to set these
a) Scenes
b) Key frames
c) Blank frames
d) Graphic symbols

Q4. In the Clip Art task pane, the standard extension of an "event" sound such as a door closing sound is _____.
a) .mp3
b) .wav
c) .midi
d) .ram

Q5. What does the abbreviation, FPS means?
a) Flick Per Scene
b) Frames Per Second
c) Frames Per Scene
d) Flick Per Second