CS475/CS675 - Computer Graphics

Lecture 16: Principles of Animation
Animation

The term animation has a Greek (animos) as well as Roman (anima) root, meaning “to bring to life.”

Ratatouille, Pixar Animation Studios, 2007.

Animation

• Series of pictures of objects/characters in motion
• Displayed at some rate
  – 25 fps, 29.97 fps, 30 fps, 60fps ....
• Examples
  – Flip Books
  – Stop Motion (Claymation)
  – Traditional Hand Drawn Animation (Cel Animation)
  – Computer-assisted Keyframing
  – Motion Capture
  – Simulation
Animation

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• Examples
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  – *Traditional Hand Drawn Animation (Cel Animation)*
  – Computer-assisted Keyframing
  – Motion Capture
  – Simulation
Character Animation

- Traditional
  - Cell Animation, hand drawn, 2D
  - Lead Animator for keyframes

http://animation.about.com/od/flashanimationtutorials/ss/flash31detanim2.htm
Character Animation

- Traditional, hand drawn animation
  - Lead Animator for keyframes and many secondary animators for the in-betweens

http://animation.about.com/od/flashanimationtutorials/ss/flash31detanim2.htm
Character Animation

• Traditional, hand drawn animation
  - Keyframing @24fps – how many drawings for a 2 hour movie?

http://animation.about.com/od/flashanimationtutorials/ss/flash31detanim2.htm
Principles of Animation

- Characters composed of living flesh do not move rigidly (muscle flex, skin sags, etc.)
- Preservation of volume is key
- Disney animators demonstrate it here with a half-filled bag of flour.

Principles of Animation

- Squash and Stretch

Weight is given to the ball using timing.

Add squash and stretch to further define the motion and show the speed of the ball.

A 2D representation of motion blur

Principles of Animation

- Squash and Stretch


Approximately maintain volume...but drastically change physical characteristics over time.
Principles of Animation

- Anticipation

  - Tell the audience what you are going to do before you do it.
  
  - Can be as simple as facial expressions or as broad as a body wind-up.
  
  - What is Donald about to do?
Principles of Animation

• Staging

A principle borrowed from the theatre stage.
Try to make actions to be clear in silhouette.
Character posing and placing the camera is the key.
Principles of Animation

- Straight Ahead and Pose to Pose

- Two ways to animate a scene.
- Start with an idea in mind and draw all frames until done. Good for frantic motion such as a character jumping around in excitement.
- Draw the key frames first. Fill in the in-betweens.

Principles of Animation

- Follow Through and Overlapping Action

- Everything does not have to stop once a pose is reached.

- The way the action is completed tells us a great deal about a character. In some sense this is the opposite of anticipation... tell the audience what happened!

Principles of Animation

- Follow Through and Overlapping Action

Principles of Animation

- Slow In and Slow Out
  - Animator specifies the primary or key frames which are most important.
  - In order to stress these frames, move slowly away from one key frame, quickly in the in-between frames, and slowly into the next frame.
  - Most time is spent on/near the key frames.

Principles of Animation

- **Arcs**
  - Motion in straight lines is often not *organic*.
  - Most human motion happens on curved trajectories or arcs.

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The Animator's Survival Kit, Richard Williams, Faber & Faber, 2002
Principles of Animation

- Arcs
  - Motion in straight lines is often not *organic*.
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Principles of Animation

• Timing
  • The number of drawings determine the amount of time it takes on the screen
  • no in-betweens: character hit with a huge force and his head is nearly snapped off
  • two: nervous tic, muscle spasm
  • five: Come on...hurry
  • seven: tries to get a better look at something
  • ten: stretches a sore neck
Principles of Animation

- Exaggeration

- Exaggerate to make the action more believable.
- Realism and believability are difficult to achieve.
- Convey emotions.

Cartoon Animation, Preston Blair, Walter Foster, 1984
Principles of Animation

- **Secondary Action**
  - Action aside from that of the primary character.
  - Must not distract the audience.

Principles of Animation

- Solid Drawing and Appeal
  - Characters are solid – have weight in the real world.
  - Appeal is what makes people want to look at a character.

How does all this lead to animation?
Principles of Animation
Principles of Animation
Principles of Animation
Principles of Animation
Character animation
Principles of Animation
How about 3D Characters?
The same principles apply.
Character Animation

• A character in 3D is just like us.

http://www.okino.com/conv/skinning.htm
Character Animation

• A character in 3D is just like us.

• Inside they have a skeleton made up of rigid bones.
Character Animation

- A character in 3D is just like us.
- Inside they have a skeleton made up of rigid bones.
- Outside is a skin.
Character Animation

- A character in 3D is just like us.
- Inside they have a skeleton made up of rigid bones.
- Outside is a skin mesh.
Character Animation

• A character in 3D is just like us.
• Inside they have a skeleton made up of rigid bones.
• Outside is a skin mesh.
• The skin mesh can be very detailed – has additional elements to capture look of the character.

http://udn.epicgames.com/Three/UT3CustomCharacters.html
Character Animation

- A character in 3D is just like us
- Inside they have a skeleton made up of rigid bones.
- Outside is a skin mesh.
- Parts of the skin are associated to the bones.
Character Animation

- A character in 3D is just like us.
- Inside they have a skeleton made up of rigid bones.
- Outside is a skin mesh.
- Parts of the skin are associated to the bones.
- We move the bones to move the skin.

[Image: Character Animation Diagram]

http://www.okino.com/conv/skinning.htm
Character Animation

- But how do we move the bones?
  - Manually
  - Mimic a performer