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CAREERS in Computer Animation

- 3D Computer Modeler
- https://www.youtube.com/watch?v
- https://www.youtube.com/watch?v=W@g
- Animator
- Art Director
- Graphic Artist
- Interface Designer
- Multi Media Design Engineer







2D animation

3D animation

http://ftmk.utem.edu.my/ibrahim/rpg/

When it comes to jobs that require a combination of skill, boundless creativity, and passion, few can compare to animation.

Stop Motion

Animators are the ones who bring ideas to life so that others may enjoy stories and characters not possible in real life.

Animation has been around for a while now and many new types of techniques have been introduced, which means <u>animation studios and</u> <u>companies all over</u> the world are looking for talented individuals who have what it takes to master them.



Is 2D always better than 3D?

• NO!



Preliminary conclusion

- 2D & 3D play their roles better in their own fields
- 2D better in information visualization and mining
 - Deal with categorical, discrete variables, sparse sampling of real world
 - Focused on discovery of patterns, trends, clusters, outliers, gaps, etc
- 3D better in scientific visualization
 - Deal with continuous variables, dense sampling of real world
 - Focused on vision impression
- 3D better in first-person experience
 - Focused on simulation of real world



What is 2D Animation?



- > 2D animation is when scenes and characters are animated in a 2D space instead of a 3D environment.
- Today, artists use computer software to create everything in a 2D animation, including environments, characters, visual effects, and more.
- Although drawing skills are still required to be a 2D animator today, most of the work is done with the use of computer software.
- These programs often have a huge toolbox of features that help the artists manipulate the animation in a number of ways, including making it look smoother by fine-tuning important elements such as timing.
- Other advantages of 2D animation over the traditional way include being able to save and load work. Being able to do so proves very handy if something didn't work and you need to revert back to an earlier version of the animation.
- Being skilled in a particular 2D animation program also allows you to make good use of a vast library of visual effects.
- > Of course, every 2D animation software comes with its own learning curves, which only get steeper the better the program is.
- Knowing what each tool does and how to use it effectively is essential if you want to be a good 2D animator that isn't limited to a few techniques.

Notable 2D Animation Programs

Toon Boom Studio,Autodesk's SketchBook Pro,Anime Studio Debut,DrawPlus,FlipBook Lite,Adobe Photoshop
 The TAB Pro,CrazyTalk Animator,MotionArtist,Flip Boom Cartoon

Where is 2D animation used?

□2D animation is widely used in a number of creative industries and is still widely used despite the rise of 3D animation.

□Everything from cartoon series and Japanese anime to video games and full feature films are done in 2D. The fact that 2D animation is flexible enough to be done on a wide range of platforms it what makes it such a popular form for anything from entertainment and multimedia to broadcast video.

Television is where 2D animation is still used the most.

- The number of shows that have been made with 2D animation is near-endless, with some of the more well-known ones being The Simpsons, SpongeBob Squarepants, South Park, and Avatar: The Last Airbender.
- Anime, a style of Japanese animation inspired by their manga comics, also makes use of 2D animation.

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Puppetoon

- created using techniques developed by George Pal.
- In puppetoon animation the puppets are rigid and static pieces; each is typically used in a single frame and then switched with a separate, nearduplicate puppet for the next frame.
- Thus puppetoon animation requires many separate figures. It is thus more analogous in a certain sense to cel animation than is traditional stop-motion: the characters are created from scratch for each frame (though in cel animation the creation process is simpler since the characters are drawn and painted, not sculpted).



Clay animation or claymation

• Clay animation or claymation is one of many forms of <u>stop motion</u> animation. Each animated piece, either character or background, is "deformable"—made of a malleable substance, usually <u>Plasticine clay</u>.

Cut out Animation

 <u>Cutout animation</u> is a type of stop-motion animation produced by moving 2dimensional pieces of material such as paper or cloth. Examples include Terry Gilliam's animated sequences from Monty Python's Flying Circus (UK, 1969-1974); La Planète sauvage (Fantastic Planet) (France/Czechoslovakia, 1973); Skazka skazok (Tale of Tales) (Russia, 1979), and the pilot episode of the TV series South Park (US, 1997).

http://en.wikipedia.org/wiki/Animation#Traditional_animation

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3D animation is the manipulation of three dimensional objects and virtual environments with the use of a computer program.

- 1. Animators first create a 3D polygon mesh with various connected vertices to give it form.
- 2. The mesh is then rigged by giving it an armature, a skeletal structure that can be manipulated to make the object appear in specific poses.
- 3. After making other objects and environments, the artist then uses the software to create scenes that are much more lifelike than 2D animation.
- 4. This form, which is also called **computer-generated imagery** (CGI), is a fairly recent technique that only came into use during the 1990s.
- 5. Before that, the closest thing to 3D animation was stop-motion and Claymation, which involved using real-life objects and taking pictures to give the illusion of motion. Now it is arguably the most popular form of animation and is used in anything from TV shows, video games, and feature films.

What is 3-D Computer Animation?

- Computer animation consists of a series of individual images.
- These images are stored one at a time in the computer. They are viewed at the normal playback speed of 30 frames per second. The result is a moving picture, or animation.
- 3-D animation allows the viewer to move around the scene and change perspective over time.
 - An animator is required to ensure that the animation looks natural and believable.

Benefits Provided by 3-D Computer Animation

- A computer animation can graphically simplify complex concepts which are difficult to visualize.
- 3-D computer animation captures attention.
- It can communicate more information, at a faster rate, than an oral description can.
- Best of all, information presented as moving images is retained by the viewer for a longer time and with greater accuracy

Benefits Provided by 3-D Computer Animation

- A computer animation can re-create an event which is too expensive or too dangerous to reproduce, such as an aircraft accident.
- It can re-create a scene which has been altered or which no longer exists, such as a building which has been demolished.
- When used as an illustrative tool, computer animation can help the presenter maintain focus. It creates interesting presentation.

Some of 3D Computer Animation Software

- Maya
 - the industry standard high-end 3D computer program. Most of the popular computer games are made with Maya software.
- 3D Studio Max
- 3DS MAX
 - The world's most popular animation modeling, and rendering solution for film, television, games and design visualization
- Softimage,
- Lightwave
- Animator Studio









3-D Computer Animation is growing!

- 3-D Computer Animation is the world's fastest growing creative technology.
- 3-D dominates in the animated feature, game, special effect, interactive, and commercial industry
- Computer 3-D animation is taking over the film world
 - Computer Animated are breaking box office records
 Computers are used for many of the special
 - Computers are used for many of the special effects in live-action films, and digitized actors.
- The field of 3-D animated video, computer, and interactive games has grown amazingly

Principles of animation

 Animation is not easy. Each second of computer animated video has 30 separate images. The number of images that need to be generated to create even a very short film

Principles of animation

- Modeling: Building objects and creatures from primitive shapes, polygonal modeling, and/or sculpting with curves and points.
- Motion: Animating the objects and creatures you model using key frames, path and shape animation, simulation, deformation.
- Character Construction: Creating skeletons, attaching skins to skeletons.
- Color and Texture: Creating, importing, and applying multiple textures to objects/creatures; defining color, reflectivity, and transparency.
- **Rendering:** Lights, camera, compiling movies, adding sound.

Jobs: Motion Picture Production & Distribution

- Employment is projected to grow rapidly.
- Employment is centered in several major cities, particularly New York and Los Angeles
- Many workers have formal training, but experience, professionalism, talent, and creativity are the most important factors for getting many jobs in this industry

Jobs: Motion Picture Production & Distribution

Making a movie can be a difficult, yet rewarding, experience. However, it is also a very risky one. Although thousands of movies are produced each year, only a small number of these account for most box office receipts. Most films do not make a full return on their investment from domestic box office revenues, so filmmakers rely on profits from other markets, such as broadcast and cable television, videocassette and DVD sales and rentals, and foreign distribution

Some Example of Companies & **Computer Animated Films**

The computer animation at Pixar have been around since 1984

- Toy Story, A Bug's Life
- Monsters, Inc.
- Finding Nemo
- Disnev P Disney teamed up with Pixar to create films
- Dreamworks Pixar's main competitor Shrek

Some of the Computer Animated movies

- HARRY POTTER
- THE LORD OF THE RINGS
- THE MATRIX
- MEN IN BLACK
- MINORITY REPORT
- SCOOBY-DOO
- SOLARIS
- SPIDER-MAN
- STAR WARS

Example of 3 D Computer Presentation

http://3d.datausa.com/

Motion Picture Production & Distribution

- Directors and producers often work under stress as they try to meet schedules, stay within budget, and resolve personnel and production problems.
- Actors, producers, directors, cinematographers, and camera operators face the anxiety of rejection and intermittent employment.
- Writers and editors must deal with criticism and demands to restructure and rewrite their work many times until the producer and director are finally satisfied.
- All writers must be able to withstand such criticism and disappointment; freelance writers are under the added pressure of always looking for new jobs.











Motion Capture

 Motion capture (MOCAP) adalah salah satu cara / tool yang efektif untuk capture gerakan manusia untuk keperluan animasi







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Matchest Greek and Effort Varied

- 3 used Tomasi-Kanade
- 1 used Zhang's approach
- 2 used home-brewed methods
- Data collection
 - very important--getting good video makes all the difference
- Tracking was a challenge
 - Discrete search more reliable than Lucas-Kanade for some
 - Need to restart the tracker periodically
 - Took a lot of fiddling with parameters to get right
- Rendering
 - RenderX bugs
 - Some used openGL, java, but not required
- Calibration
 - nearly co-planar features a problem

Match Move Results

- Direct Linear Method
- Factorization
- Zhang's method





Hand Mocap

Capturing hands and fingers

- J. Rehg, T. Kanade, Model-based tracking of self-occluding articulated objects, In Proceedings of International Conference on Computer Vision, pages 612-617, Cambridge, MA, 1995. [pdf. 300K]
- Ying Wu and Thomas S. Huang, "Capturing Articulated Hand Motion: A Divide-and-Conquer Approach", In Proc. IEEE Int'l Conf. on Computer Vision (ICCV'99), pp.606-611, Greece, Sept., 1999.



Douglas DeCarlo and Dimitris Metaxas, Optical Flow Constraints on Deformable Models with Applications to Face Tracking. In *IJCV*, July 2000, 38(2), pp. 99-127. [PDF (695K)]

Human Body

• Focus of today

- Search over 3D pose
 - Gavrila & Davis
- 3D tracking
 - Bregler & Malik
- Single view motion capture
 - Leventon & Williams
 - Brand



• D. M. Gavrila and L. S. Davis, <u>3-D Model-based Tracking of Humans in Action: a Multi-view Approach</u>, Proc. of IEEE Conference on Computer Vision and Pattern Recognition, San Francisco, U.S.A., 1996.









Search for 3D body pose parameters

- Model body as segments (superquadrics), 22 DOF
- Discrete search over DOF's
- Metric: projected model should match edges
- Speedup: use distance transform of edge image

Divide and Conquer



Searching all pose parameters simultaneously is too hard



Stage 1: torso position







leg positions



3Det's start with tracking a single rigid object We know 3D position X, orientation R in first frame

• Solve for change in 3D position _____ and orientation _____

How?

• Our old friend: Lukas and Kanade!!!

$$\sum_{(x,y)\in F\subset J} \left[I(x+u,y+v) - J(x,y)\right]$$

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• But now (u,v) are functions of X and R

$$\begin{bmatrix} \sum I_x^2 & \sum I_x I_y \\ \sum I_x I_y & \sum I_y^2 \end{bmatrix} \begin{pmatrix} u(\dot{\mathbf{X}}, \dot{\mathbf{R}}) \\ v(\dot{\mathbf{X}}, \dot{\mathbf{R}}) \end{pmatrix} = -\begin{pmatrix} \sum I_x I_t \\ \sum I_y I_t \end{pmatrix}$$

- Problem: equation is not linear in X and R
- Solution (Bregler and Malik): use twist representation

















• Find most likely path through HMM, given input data





Motion Capture in 3D Animation



Motion Capture as a Tool

- Motion capture (MOCAP) is an effective 3D animation tool for realistically capturing human motion
- Outline
 - Rotoscoping
 - The MOCAP Pipeline
 - Limitations of MOCAP
 - The Future of MOCAP







The MOCAP Pipeline

- Calibration
- Capture
- 3D Position Reconstruction
- Fitting to the Skeleton
- Post Processing: IK Inverse Kinematics



MOCAP issues

- Issues: data inaccuracy, Expensive
- Optical: \$90'000 \$210'000
 - high res cameras, occlusion, no outdoors, more and more markers, cameras
- Magnetic: \$100'000 \$120'000
 - heavier sensors, body wires, 10x accurate < optical, smaller workspaces, sensitive to metal, EMI, flooring
- Mechanical: \$20'000 \$30'000 US

limited movement, heavy and cumbersome, must know rigid body at design time

MOCAP issues

- Resolution/range of motion
- Calibration
- Accuracy
 - Marker movement
 - Capture rate
- Occlusion/correspondence

MOCAP issues: Marker Placement

- Location should move rigidly with limb
- Stay away from bulging muscles
- Shoulders: skeletal motion not closely tied to skin
- Shoulders: not a rigid body chain

MOCAP issues: Marker Set



3D points -> joint angles It matters! So do assumptions about human kinematics











Fitting to the Skeleton

- Utopian approach
 10 20% length changes
- Markers on both sides
- Joint Displacement
- Use Rotation Angles
 Only

Post Processing

- Motion Editing
 - Cut, Copy, Paste
- Motion Warping
 - Speed up or Slow Down
 - Rotate, Scale or Translate
- Motion Signal Processing
 - Smoother Motions





Limitations of MOCAP

- Only realistic motion captured
 - Cartoony Animations not possible
- WYSIWYG (what you see is what you get)
 - Can't add more expression
 - Continally need to recapture motion







stick together a bit before opening. Farquaad's forehead wrinkles automatically.



than 750 controls to create Shrek's performance. Some controlled one joint or muscle, others controlled groups of several.

Eric Darnell, co-director of Antz

The main problem with motion capture associated with characters has to do with mass distribution, weight, and exaggeration. He says that it is impossible for a performer to produce the kind of motion exaggeration that a cartoon character needs, and the mass and weight of the performer almost never looks good when applied to a character of different proportions.

Richard Chuang, VP at PDI

The mapping of human motion to a character with non-human proportions doesn't work, because the most important things you get out motion capture are the weight shifts and the subtleties and that balancing act of the human body. If the proportions change, you throw all that out the door, so you might as well animate it.

MOCAP issues: Marker Placement

- Location should move rigidly with limb
- Stay away from bulging muscles
- Shoulders: skeletal motion not closely tied to skin
- Shoulders: not a rigid body chain

The Future of MOCAP

- Markerless MOCAP
- Cheaper MOCAP
- Retargeting and reuse of mocap data



Basic 3D Modeling Poly Mesh

Modeling Technique	
Mesh Modeling Curve Modeling Surface Modelin	ng



Modeling | Technique

Curve modeling





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