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VFX Pipeline

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Abstract : In this paper, we will discuss about the use of Visual Effects in films and the detail pipeline of creating a VFX movie. The goal is to make the students understand better how to move step by step while creating a VFX shot. In future it will inspire them to implement their ideas and create their own VFX shots on screen.

IndexTerms - VFX, FX, Matchmove, Chroma Shoot, HDR Lighting, Compositing, Previz, Set measurement data, Camera details.

I. INTRODUCTION

Visual effects are now the buzz word in film industry across the world. Every movie, TV commercial or even a television series has VFX in it. In this modern world of computers and high configuration rendering systems creating realistic visual effects is not a tough task because modern technology helps a lot to manage your time.

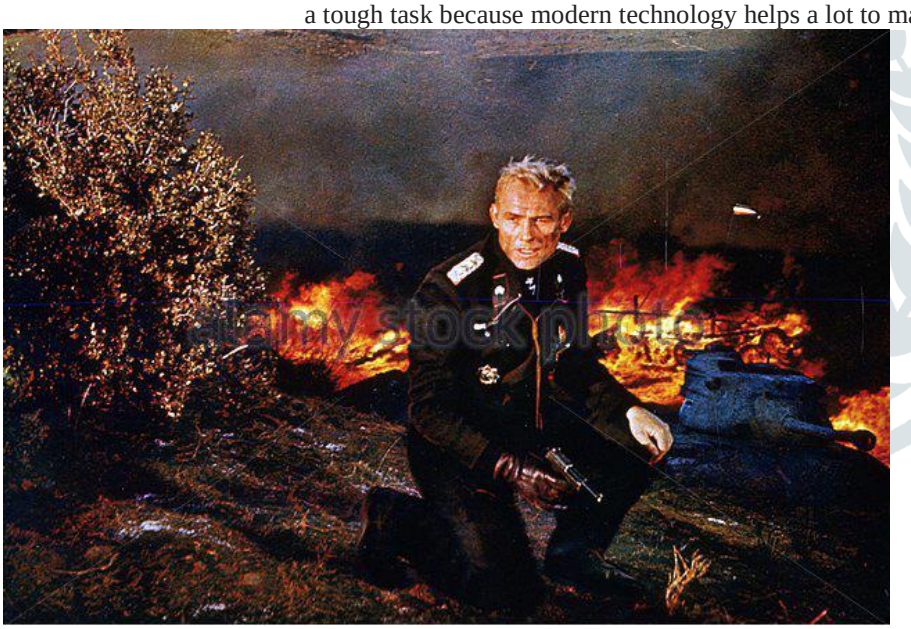

Image 1. Snap from the movie "Battle of the Bulge" 1965.

What is Visual Effects: Visual effects is a process of combining live action shoot with CGI (computer generated imageries) to create a output for film where everything will looks like they are in the same place and captured with the same camera. It's basically a process to blend real world with virtual world seamlessly. The use of computer and relevant software tools are also playing a key role to that.

Image 2. Example of VFX in one of the landmark Hollywood movie "Life of Pie"

Visual Effects Pipeline:

To create perfect visual effects shot or a full length movie with visual effects it is obvious that we have to go through a well organized pipeline. A pipeline *(Please refer to my previous article about animation pipeline) is* a flow of work going through different departments which are linked together.

In comparison with animation pipeline, the VFX pipeline is almost the same but, there is some differences according to the procedure because animation (*3d Animation*) is totally virtual (CG) but visual effects includes CG elements and as well as live action also.

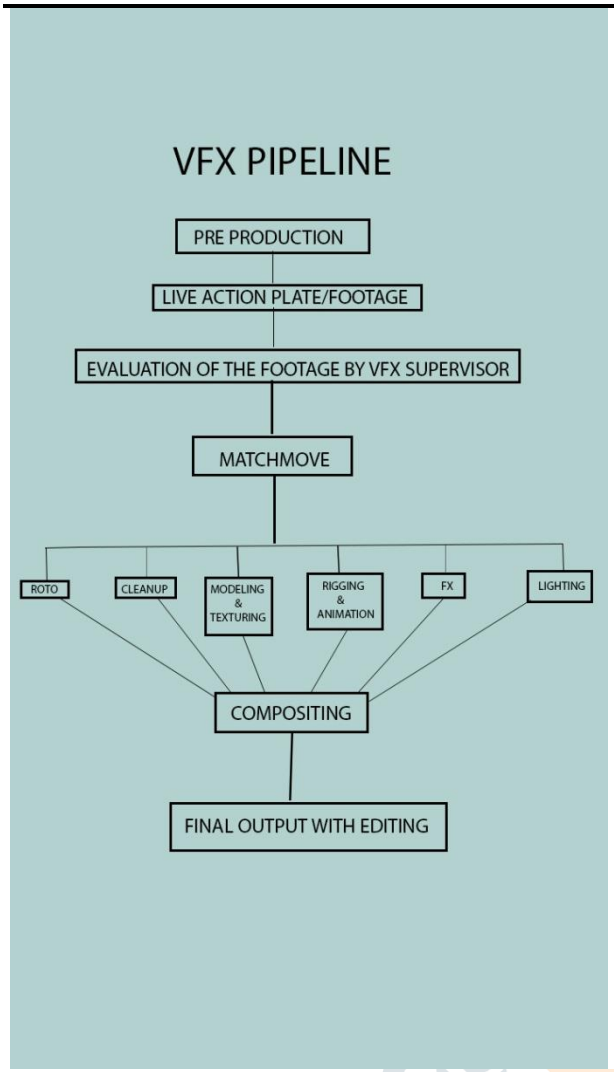

Image 3.Visual effects pipeline.

As shown in the reference image, it goes through 3 main departments: Pre Production, Production and Post Production just like animation pipeline and it is obvious that it has to go through like this but we will learn the VFX pipeline in a different way to understand the process better. Pre production is always the first and most important part but the difference in VFX pipeline is, it will not move to production immediately after pre production. The next stage after pre production is shooting & camera tracking.

Let's go step by step in details.

Pre Production:

Pre production part is very much the same as animation pipeline

It starts from an idea to story development and then it ends up with storyboard and Previz.

Image 4. Example of a storyboard for VFX shot.

After creating storyboard we create the Previz of the shot.

What is Previz: Previz is a process to digitally visualize the entire VFX shot before the final shoot.
Creating a Previz is always useful because, it gives a full flagged freedom of visualizing the shot to the director, cinematographer and above all the key man for visual effects, the VFX supervisor. Previz is basically a draft before we go for the final shoot. It gives a better idea to the crew members or the think tank of the film making unit for camera angles, camera motion, lighting and framing of objects in the shots.

It's not always necessary to maintain a high detail level in Previz. It's actually a dynamic representation of the storyboard.

Image 5. Example of Previz (*single snap*) from the famous Hollywood movie "Deadpool".

Shooting for VFX:

This is the next department immediately after preproduction ends. (After Previz).
This is the most important part of any VFX production. If this doesn't goes according to the plan the total production pipeline will be affected.

Things to remember while shooting:

1. Proper Chroma shoot (With proper Chroma screen)
2. Proper lighting
3. Note camera details like lens size, fov per shot.
4. Set measurement data.
5. Camera motion
6. Is it as per Previz?

******point 3, 4 & 5 is important for camera tracking department.***

Image 6. Example of a VFX shoot.

Chroma Shoot: This is a process of creating colour based transparency to create alpha channel (mask) for a foreground object or character and replace the background with another image or footage.

It's a digital process to replace the background of footage but keying out a single colour (chroma screen colour) from the shot. Letter the compositor will put any background in place of that and match the foreground element with the background to create the final composite frame.

Image 7. Use of Chroma screen for VFX shot.

Proper Lighting: This is also a very important part of a shooting. If the lighting is not proper the post production department will face huge problem to match the live action with CG and also it will be difficult for the VFX artist to remove the Chroma in the compositing software.

While doing Chroma shoot proper lighting means there will be no harsh shadow on the screen and also there should be even lights all over the screen. This will avoid difference of light intensity on the screen area which may lead to difficulty of removing Chroma properly.

Camera details & Camera Motion: All these things are equally important for Camera Tracking/Matchmove department. Camera details like: which lens size was used for which shot, what was the Camera movement (dolly, pan, zoom etc.). Because when we put the shoot into any camera tracking software we have to give exact data to the software for getting proper result.

Set measurement data: This is important for adding 3d (CG) elements into live action footage with proper scale. We usually put any dummy object in the place where we want our cg element will be for getting the exact placement. It is also important to take the measurement of the object so that we can give the exact size and proportion to the 3d element which will be added later by the help of 3d software. *(Please refer to Image 2. Use of VFX in one of the landmark Hollywood movie "Life of Pie")*

Is it as per Previz? : As obvious there is no need to say anymore that the shooting should be according to the Previz. Usually when ever a visual effect shot is filmed, the shot is directed by the VFX supervisor, because he is the person who can judge better that the shot is ok or not. He can only get an idea that this shot will not give any trouble in future while doing the visual effects part in the software's.
Usually the VFX supervisor matches the filmed shot with the Previz before giving the green signal that the shot is ok.
After the shooting part gets completed it moves to the next department and that is Camera Tracking or Matchmove department.

Matchmove: Matchmove is a process of integrating CG elements into live action shot with proper position, scale and orientation.
If you think you can find out that it is impossible for anyone to match the movement of a cg object with live action footage without getting the same camera movement for the cg object which has been used in the live action footage. Matchmove is a process which extracts a cg camera (software camera) from a live action camera and also creates depth points in the 2d live action plate. Creating depth points means it will create a 3d scene (for 3d software) from the live action plate with a 3d camera. Now take the 3d scene with camera to your preferred 3d software and put 3d elements in to it and then render out the images for further colour grading with the live action plate in any compositing software.
This is actually the beginning part or connecting part whatever you can say between shooting and the production department.

Image 8.Example of a Matchmove shot where 3d scene and camera is created from live action footage.

Production: After the completion of the Matchmove the production starts. The production part is almost the same as animation pipeline. From modeling and texturing of the cg elements to be used to rig setup and animation as per requirement.
But there is a difference in the lighting section. Instead of using aesthetical and conceptual lighting technique, we use photorealistic lighting method to match the cg elements perfectly with the lighting information of the live action footage. The technique of matching lights of a cg object with live action plate is called HDR lighting or image based lighting. But it doesn't mean that only HDR lighting is used. We can also use standard lighting techniques with HDR as per requirement.
Also there is a special department called special effects/FX department in VFX pipeline.
So let us discuss about special effects and HDR lighting section.

Special Effects/FX Department: This department is a core part of VFX. This goes under the production section. Whenever we need to simulate any real world incident like, fire, explosion, rainfall, water simulation or may be destruction of a city or few buildings etc. we need to get the help from this department. With the help of some advanced new age software's and high configuration systems.

Image 9. Use of special effects in the movie "2012".

Usually the FX department and all the other production departments completes their works and send it to the lighting department.

HDR/Image Based Lighting: Image-based lighting (IBL) is a process of generating photons from the colour and light information of a high bit depth image. It is helpful to simulate the exact lighting for CG elements as per the live action shoot.

Image 10. An HDR image file.

A HDRI (High Dynamic Range Imageries) file (when used in software's) can produce photons with the same colour of the image environment which helps the lighting artist to create the exact feel to the cg object that should be present while being inserted in to live action plate.

Image 11. Example of using image based lighting to match cg object with live action footage.

After all the production works (from modeling to HDR lighting) completes the render outputs are directly send to the post production department for compositing and editing part.

Post Production: The post production department is the final section for the completion of a VFX shot or film. Immediately after the lighting section has completed their job it comes directly to this section of post production.

Post production has two main departments to deal with:

1. Compositing 2. Editing (Audio and Video both)

Compositing: Compositing is the process of combining different elements from separate sources into a single composition. It will create the illusion that all those elements are parts of the same scene. This department is the final section of the pipeline which delivers the final output which will be delivered to the screen for viewing.

Compositing has various sections within itself:

1. Colour correction & Colour grading.
2. Chroma removal.
3. Rotoscopy.
4. Cleanup
5. Final Compositing

Colour correction & Colour grading: Colour correction means fixing the colour related problems in an image like noise, gamma, undesirable presence of any colour etc. This is the process of preparing your image for the final look and feel by fixing its problems.

Colour grading on the other hand is the process of creating the final image with desired look and feel according to the mood and most importantly the need of the shot. This is a process of enhancing the colour of your final image to be produced and creating cinematic look.

Image 12. Example of the flow from raw footage to final colour grading via colour correction.

Chroma Removal: As we have already discussed about Chroma in the shooting part of this article But that is mainly based on the process of Chroma shooting. In the compositing section we mainly work on software's. This is the digital technique of removing green or blue screen from the footage for further use of compositing to replace the background with another image.

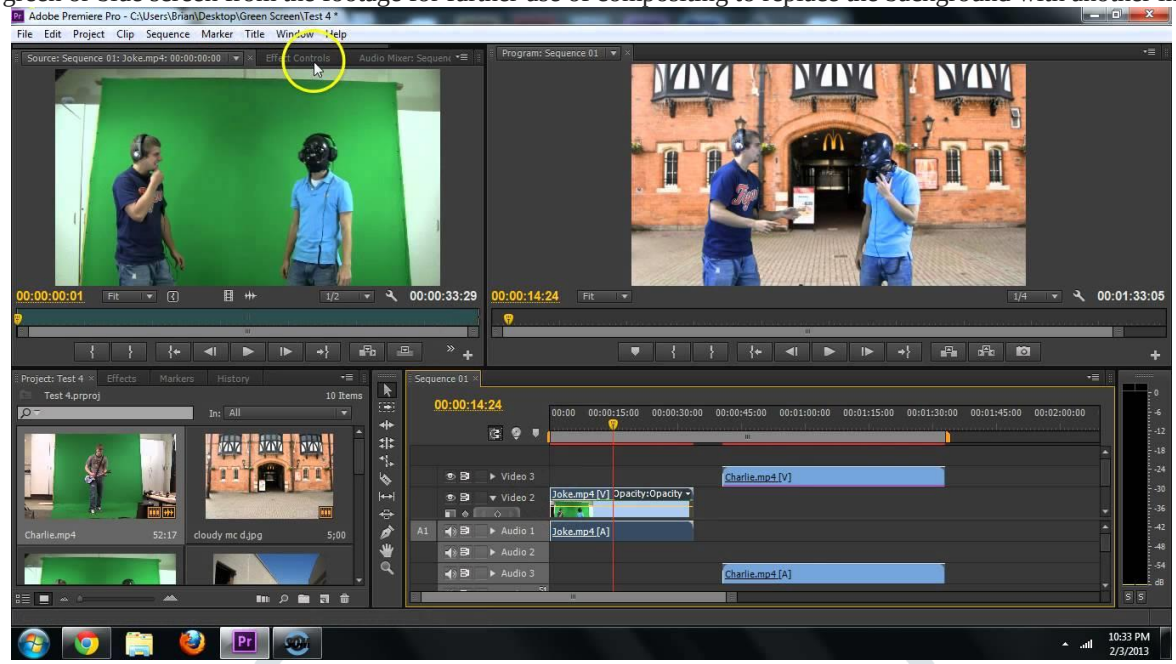

Image 13. Process of Chroma removal in software.

Rotoscopy: This is the process of creating alpha channel for live action footage by animating masks through different parts of the footage which we want to extract.

This process usually helps us to remove garbage's (light rigs, stands) and also to create overlapping mattes and colour correction mattes for live action footage.

Rotoscopy is divided into two parts. VFX Rotoscopy and Stereoscopic Rotoscopy. The above theory is applicable for VFX Rotoscopy whereas Stereoscopic Rotoscopy is used to create depth maps for stereoscopic shots.

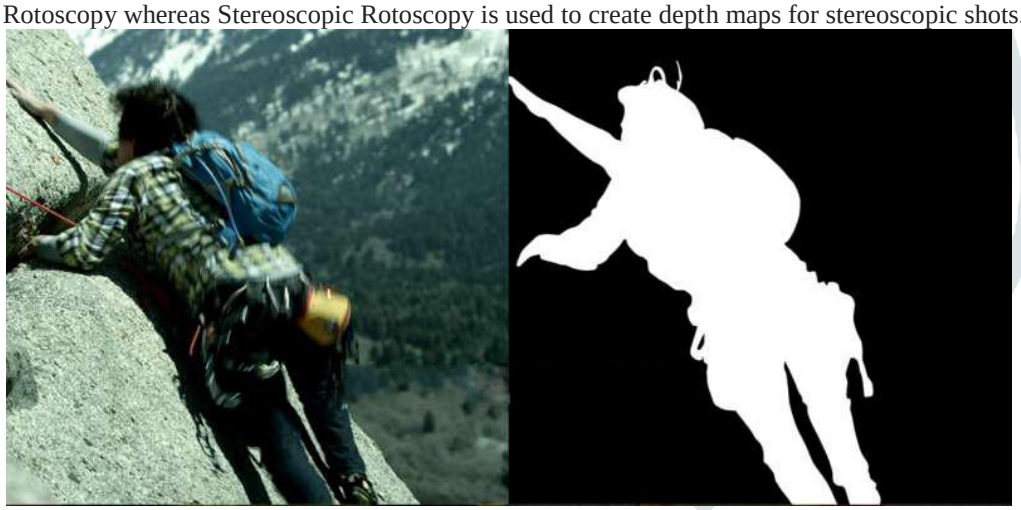

Image 14. Example of Rotoscoped frame.

Cleanup: This is a digital process of removing unwanted parts from a footage. Just like you may have the stands of a green screen or may be a wire which holds a flying character and so many stuffs. Clean up is a very important section which actually removes the garbage parts from a sequence.

Image 15. Example of using cleanup process to remove the camera from a footage.

Final Compositing: As oblivious this is the most important section in the final stages of a visual effects pipeline. Here we compose the final image or the final output by combining all the render outputs from all the other departments. This department collects render outputs from 3d department (Lighting render output and FX render output), Rotoscopy output, cleanup output, Chroma output and whatever it gets for final compositing.

This section creates the final image which will be shown in the big screen.

Image 16. Example of a final composited frame from the movie "Avatar"

Editing: This section is common in any kind of film making from live action to animated film or even a full flagged VFX movie. The final compilation of the movie is done here by adding sound according to the shoots and may be some little touch of effects at the end time. This is the process of creating the final audio visual presentation.

Image 17. Example of an editing room where the final editing is in progress.

I. RESEARCH METHODOLOGY

VFX film making requires high end systems. It cannot be done only with software's. Good software skill along with good aesthetics is must for creating stunning visuals on screen. Rendering is a time taking part and at the same time it is very important also, that's why good hardware configuration is must in VFX pipeline for creating professional output.

IV. RESULTS AND DISCUSSION

Visual effects is the need for film makers these days. It's really hard to find any movie these days which don't have visual effects in it. Not only movie but television, online web series and so many other sections are using visual effects. The reason behind this is very clear. Visual effects can help you to resolve the problem of time consumption to complete any project and as well as it is cost effective too. You don't need to construct big sets for your shoots or don't need to take permission from anyone to shoot in a particular place because that can be easily recreated in CG.

Visual effects is not only dominating the media industry but it is also giving jobs to so many young people around the world and providing entertainment so millions of people across the world.

II. ACKNOWLEDGMENT

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