Production pipeline in Visual Effects

Submitted by: - Geetanjali Barthwal, 09634002,

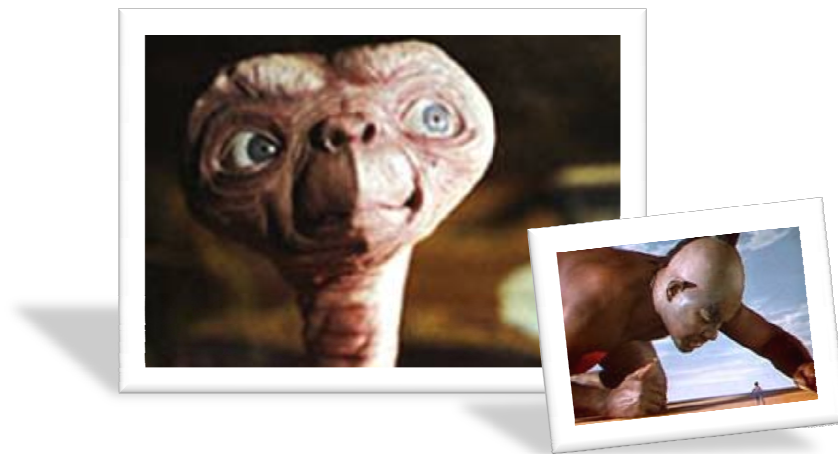Animation (09-11)   .

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Study of Production Pipeline of Visual Effects
AT BIG ANIMATION

Special project

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APPROVAL SHEET

The Design Research Seminar Project entitled "Study of production pipeline of Visual Effects" by Geetanjali Barthwal, 09634002 is approved in partial fulfillment of the Masters of Design Degree in Animation and Film Design.

Project Guide: *T. Phani*
(PHANI TETALI)

Date: 05/July/2011

Place: Mumbai

Industrial Design Centre

IIT Bombay

DECLARATION

I declare that this represents my ideas in my own words and where other's ideas and words have been included. I have adequately cited and referenced the original sources.

I also declare that I have adhered to all the principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in my submission.

I understand that any violation of the above will be cause for disciplinary action by the institute and can also evoke penal action from the source which thus not been properly cited or from whom proper permission has not been taken when needed.

Signature:

Name: Geetanjali Barthwal

Roll no: 09634002

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AKNOWLEDGMENT

ABSTRACT

Visual effects are used in many forms of entertainment such as movies and TV shows to create a more realistic and convincing atmosphere. They are used to portray something that is not possible in today's world. As cinema audiences and revenues all over the world continue to grow, today's film fan has never had it so good with cinematic imagery that is unrivalled in its wonder, quality and sophistication .The application of digital film technologies to film production has raised the bar of creativity and production value to level never previously experienced: today's filmmaker is at the forefront of the digital film revolution. They are also used as a matter of convenience when the cost of portraying an image may be too expensive, or too inconvenient - such as creating a five-minute scene on the top of Mt. Everest.

There are many forms of special effects that have developed over the years. Special effects include the flying image of Peter Pan hanging from a wire in a live-play, gruesome costumes of monsters, and even characters in movies that are completely computer generated.

In the whole document I have discussed how special effects are integrated into the pipeline of live action movies and what are the new technology that is evolved in the special effects.

OBJECTIVE

My objective is to study the Production pipeline in Visual Effects for films. Visual effects have always been the most exciting, adventurous and nerves breaking part in films where it takes over the normal filming. With visual effects the cinema has unrivalled in its wonder, quality and sophistication. The road to VFX has not suddenly appeared out of nowhere. The truth is that there has been a steady increase in the use of digital technology in film over a period of years that has led to Visual effects and during that time there has been much learnt by all those involved. I tried to understand and learn those technical or practical methods that are made for the visual effects and put them briefly in the report.

INTRODUCTION OF PRODUCTION HOUSE

BIG Animation is part of **Reliance Big Entertainment** – one of the largest entertainment groups in India. Big animation is one of the leading production houses of the country in 2d, 3d animation and VFX . With its latest state- of-the–art facilities equipped with hardware and software, production for Films, TV, animated shorts and logos etc the production house is creating commendable work in the field of animation.

VFX   In Big Animation:-

Mr. R H Sathya Narayanan, Technical Director - 3D pipeline / VFX Supervisor at Big Animation, Pune. Under his guidance many of the production pipelines functions.

Big animation is one of the leading production houses with state of the art facilities for animation. Big animation as a part of Reliance Big entertainment is also engaged in new media, film entertainment and TV broadcasting services. The company produces movies, animation films. The company provides music, sports and internet and mobile portals, as well as user –generated content. VFX is also done in the projects if required. Many of the works "little Krishna" "Bad Eggs-Short film", "Coffees of India – an advertisement for the Coffee Board of India", "Shaktimman"- a 2d animation TV series, "Big Bees Jr- Rhymes for kids" requires VFX which is done by the creative team and with the help of a proper production pipeline for the project.

INTRODUCTION: VISUAL EFFECTS

VISUAL EFFECTS IN FILMS AND ITS IMPORTANCE :-

VFX are actually the illusion used in the film industry to simulate the imagined events in a story. Visual effects may be called as "The fantasy cinema "where unnatural or magical things happen". Visual effects are conventionally separated into categories of computer generated effects, optical effects and mechanical effects or manipulation of image and what is in front of the camera. It is the manipulation of image on two factors extension of "Space and Time". Man riding on the bicycle to moon, fairy coming to earth, aliens dancing with people then destructive bomb explosions natural catastrophe, etc, are the simulation of imagined events in a story which were impossible to be captured by a camera in reality but VFX creates a world of fantasy may be suspended for temporary, a high quality entertainment. Today's visual effects industry is booming - with technological advances improving vastly by the week, the release of every new movie continues to impress all with the quality of visual effects.

The importance of Visual effects:-

1. Special effects in the movie industry are improving because of movie directors who are taking advantage of the additional assets they have been provided.
2. Movie budgets have increased with the support for creating the next thrill-packed film. The deployment of a relatively big budget and the use of relatively big screen, Panavision or cinevision, together with a show of serious ideas comparable to printed sci-fi, raised the status of the whole genre.
3. Apart from the straightforward effects (slow motion ,freeze frame art movies tend to fall outside this area, because by and large SFX , are expensive and time consuming ,whereas art movies of limited appeal tend to be made on relatively low budgets. The fact that it was intended to be profitable puts it in the domain of popular cinema.
4. Computer graphics are electronic in principle and are viewed on screens that are basically video screens and nothing to do with the traditional photographic technology of the cinema. There is no film –through the images can be transferred to film.
5. In optical effects and make up effects tend to maximize control and reduce risk, physical effects commonly full scale and shot as live action, can involve danger. Through stunt man artists and stunt coordinators are frequently used to asses and reduce such risks. Besides stunt people have their own limits and here technology is helpful device for making your work done.

6. Knowledge in transportation as well as a decrease in price, allow directors to find optimum locations around the globe (e.g. The Lord of the Rings in a remote location in New Zealand).

7. As the cost of individual special effects goes down, more money is available for research and development thus creating even more opportunity for the next step in special effects.

8. A new realm of special effects that is currently being developed are 3-D movies or Stereoscopic. Already, there have been a few less successful movies released in 3-D; however, these films require particular glasses, and therefore are not extremely popular with the main stream public as of yet. This is an industry that has much potential for popularity and growth.

9. One of the largest contributors to visual effects is the gaming industry. Both video games and films now use digital enhancement and other computer related effects. While video games have been improving their animated quality to be more realistic, Hollywood is increasingly relying on the "fake" to create an even more convincing reality.

10. With the current rate of technological advances in special effects movies have been successfully created with computer graphics - the quality is so high that they are able to closely resemble human actors! Techniques in this industry are perfected to create the most realistic and engaging of games, and this technology will be used toward movie making as well.

11. Already, many aspects of movie making are generated on the computer. Background locations, surrounding objects (e.g. a flying Tinkerbell), costume adjustments (or entire costumes, e.g. Gollum in the Lord of the Rings), and other effects. All of these are making movies more dependent on computer generated imaging - this not only lowers prices, but creates convincing fantastic and realistic images. With these changes, however, it is natural to wonder how many tangible items these computer generated images replace. Already, movies such as the Final Fantasy series have been completely computer generated and very successful.

12. It is clear that even today's industry of special effects is constantly changing and improving; each new release will only be the next step in the creation of movies that continues to be more convincing of reality.

Fantasy cinema is not always escapist or juvenile. It may also be a way of searching for alternatives and new visions.

WHAT IS VFX PIPELINE ?

Pipeline could be the flow of any kind of data, not just the description of CG work flow. The CG pipeline consisted of a multitude of different *classes* of pipelines that touched one another in places. The word "pipeline" replaced "workflows", which in turn replaced the terms "cg process" and "cg production phases" around 20 years ago. The change in terminology has both opened and constricted our thinking about visual effects production processes. The best form of CG production pipeline is the one that can best fulfill the production mission with the lowest investment in new personnel, tools and procedures. A CG pipeline divides a work-flow into separate and meaningful tasks assigned to two or more persons. A CG pipeline is malleable. They often co-exist. For example, a film CG production pipeline may be comprised of artists capable of producing within a specific style or genre, using the technologies currently owned by the company, organized according to function.

❖ **Work-flows** are the steps in a task done by one or more people, and

❖ **Pipeline**, the organization of personnel, tools and procedures to facilitate a work-flow.

A CG pipeline belongs to one of three classes:

- production (task)   *primary*
- material   (data)   *secondary*
- approval   (meta-data) *tertiary*

These coexist on a project, touching here and there to exchange information, but functioning in parallel, mutually dependent yet separate from one another. In a large company, with 30, 100, or hundreds of artists working on perhaps one project, specialization provides a convenient way to divide the work-flow.

The Production Pipeline:-

The traditional way of thinking about a pipeline is the production pipeline. This is essentially modeled after post-industrial assembly systems where workers specialize in a given task. The assembly line is a such a system where the work product moves past a series of work stations at a fixed speed, forcing each specialty to be constrained to a fixed duration and narrow set of skills. We

can take advantage of the phased nature of CG production --model construction, motion construction, lighting, shading, rendering and compositing to break up the work. It is not necessary that all work missions will support the same production pipeline profile because there are many factors which directly influence the pipeline. Working for a VFX project there may not be a simple path .There may be pipeline within a pipeline which are connected to one another. The main function is to work together in their own specializations to support each other.

> ### The Materials (Or Data) Pipeline

Every CG environment involves the delivery of a product, a shot, a sequence or a complete show. Along the way assets are gathered and intermediate assets or work products are constructed. Assets used as inputs may include footage, stills, and reference materials. One person's output becomes the next person's input. Hence there is again a pipeline for this. Managing the flow of materials through a shop is an important sub-pipeline; in fact it's really a corollary pipeline.

> ### The Approval (Or Metadata) Pipeline

A key material in any pipeline comprises the aggregate of direction and instructions about a particular work product (again, a shot or element of a shot at the finest level). Managing this data involves collecting, organizing and distributing the information to the right persons. Because it involves a decision loop, the approval pipeline is itself a looped pipeline with an iterative nature.

> ### Other Pipelines

Adjacent to these may be other pipelines, but these are the essential three. The first is labor; the second is the data used or made by labor; and the third is the metadata, the data about the data. Any other pipelines are special cases of one of these three. For example, a film-out pipeline is a special case of a production pipeline. A rendering pipeline is a part of the production pipeline. A material check-in procedure is a sub-set of a materials pipeline.

THE DIFFERENT TERMS :- SFX, DFX, VFX

SFX = Special Effects are the illusion used in film and television industry to simulate the imagined events in a story are traditionally called Special effects .Special effects are traditionally divided into the categories of optical effects and mechanical effects. With the emergence of digital filmmaking tool a greater distinction between special effects and visual effects has been recognized. With Visual effects "referring to digital postproduction" and Special effects "referring to onset mechanical effects and in –camera optical effects or effects created using the physical pyrotechnics and explosive devices". Physical effects is sub-category of special effects in which mechanical or physical effects are recorded. Physical effects are usually planned in preproduction and created in production.
Sub divided into four categories: - Explosion, Special mechanical rigs, Support system, Stunts actors

DFX = Digital Effects - DFX refers to effects created purely through computer means. Digital effects are the various processes by which imagery is created and/or manipulated with or from photographic assets. Digital effects often involve the integration of still photography and computer generated imagery (CGI) in order to create environments which look realistic, but would be dangerous, costly, or simply impossible to capture in camera. DFX is usually associated with the still photography world in contrast to visual effects which is associated with motion film production.

VFX = Visual Effects - VFX refers to effects created using either the digital or special effects or a combination of both. Visual effects (commonly shortened to Visual F/X or VFX) are the various processes by which imagery is created and/or manipulated outside the context of a live action shoot. Visual effects involve the integration of live-action footage and generated imagery to create environments which look realistic, but would be dangerous, costly, or simply impossible to capture on film. Visual effects using computer generated imagery (CGI) have become increasingly common in big-budget films, and have also recently become accessible to the amateur filmmaker with the introduction of affordable animation and compositing software.

DI AND THE DIGITAL FILM

In the film, the world intermediate describes the process that is one of the three major parts of the film scene-to scene operation. The other two parts are image capture and presentation, the latter including distribution, projection and transmission. The intermediate stage accepts the shot material and produces the deliverables of the finished 'film'.

Digital technology first came into many film makers' view in the late 1980s with the arrival of offline. A decade ago, film visual effects shots (VFX) started to be created digitally. This established a virtually lossless process for the film –to – digits- to – film path, the digital processes and power to produce good result in good times , as well as the storage technology to show live, full resolution digital film. As with offline, film makers have not looked back.

Digital VFX is now a necessity of every movie. Once digital effects reused it makes sense to stay digital throughout the post process. Continuing development of key technologies such as disk storage and processing power has allowed the economic storage of entire movies. Other technologies such as digital film scanning – making a digital representation of the film – and digital film recording (back to film) have developed in parallel so that, today DI is a viable , cost-effective proposition as an alternative to chemical film lab.

THE DIGITAL LABORATORY PROCESS

The key is to realizing a digital intermediate is to edit, grade and add VFX in the digital domain. The first step is to change the film into DI so that it is then be manipulated. This requires the negative to be scanned o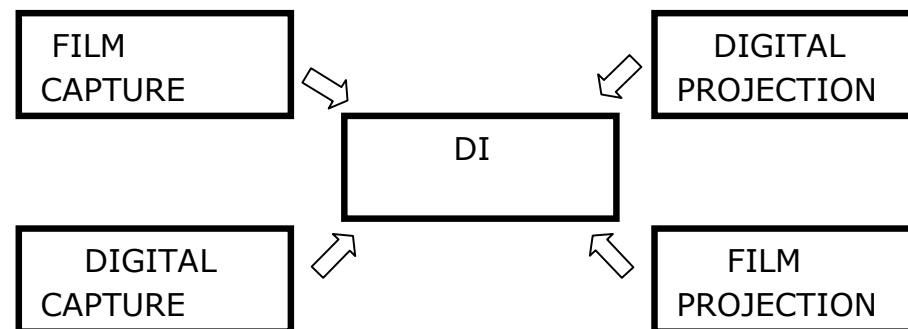nce depends (telecine /film scanning), but thereafter no further manipulation of the negative is required. Below is the typical workflow of DI lab process.

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┌─────────────────────┐        ┌─────────────────────┐        ┌─────────────────────┐
│        Image         │  ⇒     │    Intermediates     │  ⇒     │  Distribustion and   │
│  capture/Acquisition │        │                      │        │     Presentation     │
└─────────────────────┘        └─────────────────────┘        └─────────────────────┘
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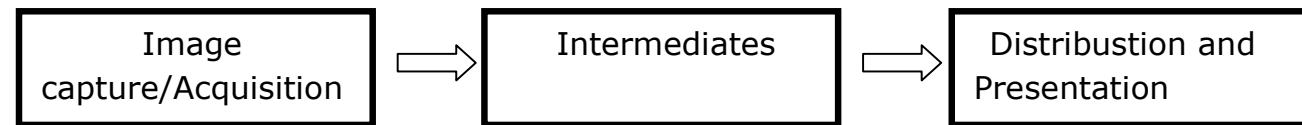
Intermediates: - Traditionally the intermediate stage has been performed by the film lab, cutting and splicing negatives, adding optical effects and printing to produce distribution copies. Recent advances in digital technology now allow the intermediate stage to be handled digitally- a digital lab producing a digital intermediate (DI).

DI is useful however the image is captured and whatever the image format is weather for TV or cinema films.

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┌──────────────┐                              ┌──────────────┐
│    FILM      │   ⇨              ⇦            │   DIGITAL    │
│   CAPTURE    │         ┌────────────┐        │  PROJECTION  │
└──────────────┘         │     DI     │        └──────────────┘
┌──────────────┐         └────────────┘        ┌──────────────┐
│   DIGITAL    │   ⇧              ⇧             │    FILM      │
│   CAPTURE    │                               │  PROJECTION  │
└──────────────┘                              └──────────────┘
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PRE-PRODUCTION:-

The supervisor works closely with the director to get a sense of what the director is looking for on each sequence and each shot. This is done by employing concept artists, storyboard artists and previs artists to create visual guides. The idea is to solidify the vision of the director and allow the supervisor to work out the technical aspects of completing the shot. The supervisor decides which techniques to use and what will be required when the live action is shot. This is usually done with involvement of the VFX departments and/or companies. If the visual effects supervisor works at a company he/she usually determines the key players (CG supervisor, sequence leads, etc) with the aid of the VFX producer. Most visual effects work happens after filming but some things such Research and Development (R&D) and model building (physical and computer graphics) can begin earlier. The supervisor will be overseeing this during pre-production. This can be time critical if the R&D will determine the best way to photograph a sequence. The pipeline may also be developed or adjusted for the type of project during this time. Pipeline is essentially the workflow through the facility and the software tools to help that process.

The supervisor works with the other film production department heads (Director of Photography, 1st Asst Director, Production Designer, Special Effects, Stunts, etc) to outline the VFX requirements during filming. This can cover blue screen, motion control, special lighting, etc.

PRODUCTION:-

The supervisor is involved in all the live action photography that requires visual effects. This can mean 6 months in a distant country or months on a sound stage. If multiple companies are involved with a large number of shots they each may send their own supervisor when one of their sequences is being filmed. On a large show it's common to have a 2nd unit. This can be a full crew with its own 2nd Unit Director to film action sequences or other sequences and shots that don't require a lot of the principals (main actors). This will require an effects supervisor as well if the work involves visual effects. Plate supervisors may be employed to help oversee this work depending on the volume of work and schedules. If there are issues with the actor's eyeline, timing, action with a creature to be added later, etc. It must have to be discussed with the director for him/her to guide the actor. This avoids problems with the actors getting multiple and contradictory instructions. This may seem like a lot of work but a huge amount of the success of a shot is based on it being filmed correctly to begin with. This means making sure the actors eyelines are correct, the lighting matches the

situation when possible, clean plates and information is gathered at the time of photography (lighting references, match move markers and data, etc).

POST PRODUCTION:-

Once the footage has been shot the film moves into post production. Ideally editing has been proceeding even during production and some sequences have been locked so visual effects work can begin even during production. As sequences are edited they are turned over by the director to the supervisor and the visual effects team. How the work proceeds and how it's structured is determined largely by the supervisor and producer. Sometimes it's best to rough in quick animation and composites for all the shots of a sequence. That allows the director and editor see a sequence in context and see if major changes are required before you final every shot. If the director has a difficult time visualizing the supervisor may have to wait until the shots are further along before presenting them to the director. Production may require reshoots months after production if there are editorial or technical issues with the footage. Additional background plates may have to be shot for sequences, especially if there has been a change from the original plan. Once again these would require an effects supervisor or plate supervisor.

 VFX studio have to have a lot of disk space .Typically each shot might have 5-32 layers .Each require different disk space and color manager.

Hierarchy System in a VFX Pipeline:-

A hierarchy system in every project depends on the project budget or the crew provided to a production house. It is a subject term which differed from project to project. The three main positions are discussed below with their responsibilities and skills.

1) Role of Director:-

- ability to see the entire project at an early stage
- complete flexibility for the change after the offline is finished
- Review changes instantly on a large screen
- Greatly improved color enhancement tool without going through the VFX pipeline
- Simultaneous multiple versions including the 'Director's Cut'

2) Role of Producer:-

- Reduce the time taken for the post production
- Reduce the cost associated with late changes
- Quickly produce multiple versions for audience testing
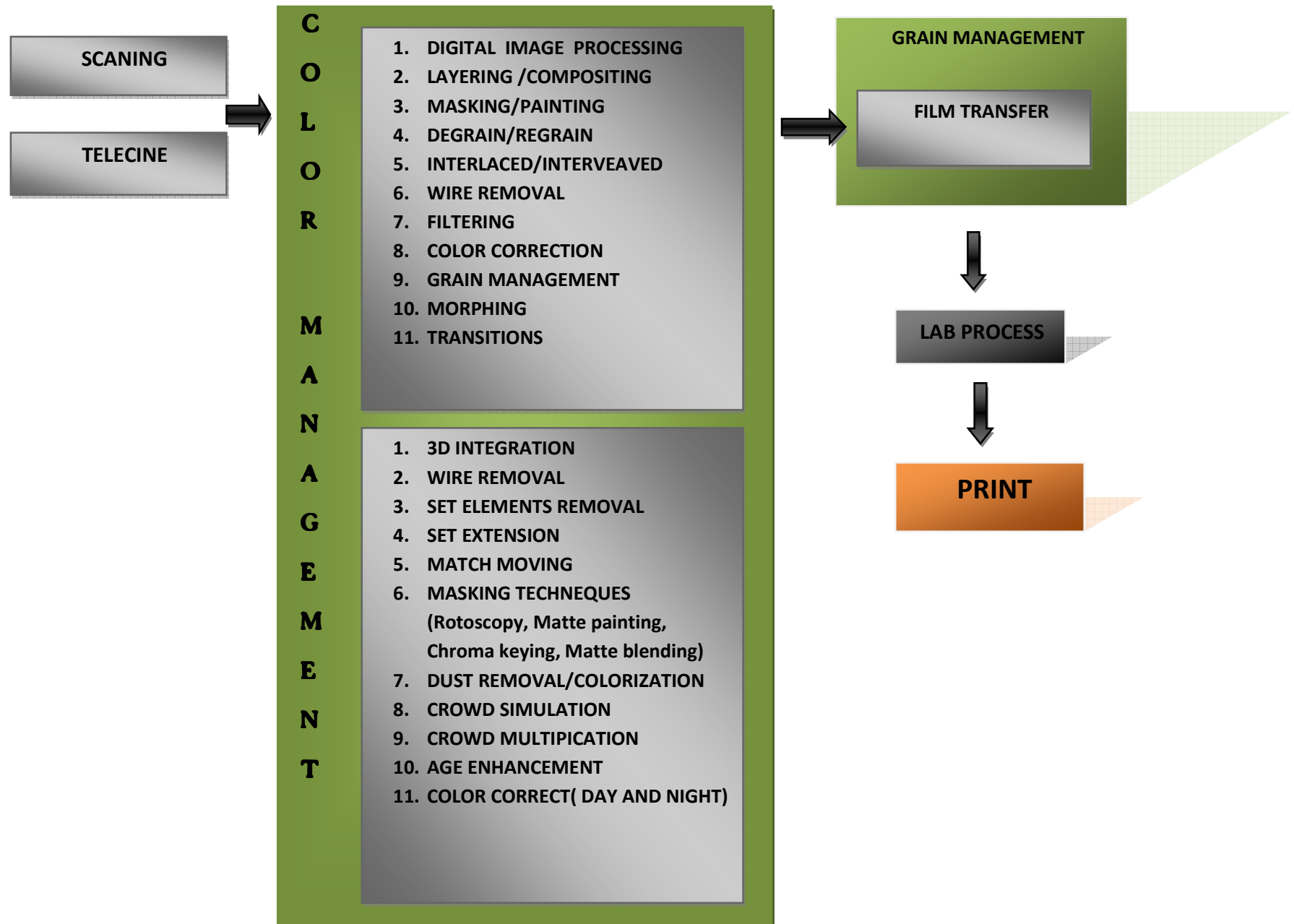- Quickly produce all the different format deliverables

3) Role of Visual Effects Supervisor:-

- Dealing with a number of different types of personalities on shot of visual effects and trying to keep everyone focused on the goal.
- Keeping an eye on large and small details that will make a shot finished.
- Organized, each shot has to be broken down into each element and how those elements are to be generated or filmed. The data management is one of the prior things a supervisor must do.
- Team work Film making and visual effects are both team efforts and will require everyone to work together. The supervisor has to take key responsibilities and at other times be able to delegate to key members of the team. He/she has to be open to listening to members of their crew.
- To look over budget and time. The supervisor has to keep in mind the budget and time when selecting the techniques and figuring out the pacing for the work. Meeting deadlines is one of the major responsibilities of the VFX supervisor.
- Creative eye. Knowing composition, cinematic design and animation timing.

- Understanding of photography and lighting. Knowing what's looks real and what looks cinematic.
- Good communication skills. Discussing a visual or technical issue with a director and also being able to turn around and discuss it with the technical team in a manner appropriate for the listener. Get in sync with the director's vision.
- Good working relationship with the director. The director has to have trust and confidence in the supervisor and the supervisor has to work for the director. The supervisor may provide his guidance and ideas to the director but at the end of the day it's the director's decision.
- Must have Problem solving ability. Technical, creative, logistic and scheduling.
- Thinking quickly. Time is money on a film set and when things change the supervisor has to step in make adjustments while keeping in mind the impact in the rest of the process.

A Visual Effects Supervisor is in charge of the creative and technical issues of visual effects on a project. This position starts in pre-production and continues through the completion of the visual effects in post-production. This can span 1 to 2 years on a large project. The supervisor typically works with a visual effects producer who focuses on the budget and schedule aspects of the work. If the project has a large amount of animation then there will be probably be an Animation Supervisor as well.

These days there's likely to be multiple visual effects supervisors on a visual effects film. If the film has a large number of shots then it sometimes makes sense to split up the work with each supervisor overseeing specific sequences to provide the attention required. In this case they may be referred to as co-supervisors. Associate Supervisor is sometimes a title given to someone who is moving up into the role of supervisor and who has a smaller number of shots compared to the other supervisor(s) on the project. Senior supervisor is sometimes used as an honorary title given to someone at a company who has been at the company a long time and who is able to step in if there are problems on a show.

SCANING

TELECINE

COLOR MANAGEMENT

1. DIGITAL IMAGE PROCESSING
2. LAYERING /COMPOSITING
3. MASKING/PAINTING
4. DEGRAIN/REGRAIN
5. INTERLACED/INTERVEAVED
6. WIRE REMOVAL
7. FILTERING
8. COLOR CORRECTION
9. GRAIN MANAGEMENT
10. MORPHING
11. TRANSITIONS

1. 3D INTEGRATION
2. WIRE REMOVAL
3. SET ELEMENTS REMOVAL
4. SET EXTENSION
5. MATCH MOVING
6. MASKING TECHNEQUES
   (Rotoscopy, Matte painting,
   Chroma keying, Matte blending)
7. DUST REMOVAL/COLORIZATION
8. CROWD SIMULATION
9. CROWD MULTIPICATION
10. AGE ENHANCEMENT
11. COLOR CORRECT(DAY AND NIGHT)

GRAIN MANAGEMENT

FILM TRANSFER

LAB PROCESS

PRINT

DIFFERENT STAGES IN OF PIPELINE:-

(Stage-1) Scanning and Telecine

Scanning is a process that converts prints or images on films –negative or slides –to digital format, i.e., and pixel (picture element). Telecine is the process of transferring motion picture film into video form. The term is also used to refer to the environment used in the process. Telecine enables a motion picture, captured originally on firm, to be viewed with standard video equipment, such as television, video cassette or computers. The telecine process is frequently used by filmmakers to transfer production footage to video, which can then be captured by various digital editing systems (e.g. Final cut pro, Avid etc)To convert the actual movie film to a "digital negative" series of files, one needs to scan the film negative. This is done in a scanner or a Datacine. So, the next step in the DI process is scanning.

(Stage-2) Visual Effects Applied:-

Image processing is a motion picture finishing processing which classically involves digitizing a motion picture and manipulating the color and other image characteristic. It often replaces or arguments the photochemical timing process and is usually the final creative adjustment to movie before distribution in theaters.

(Stage-3) Color management

Whether your images are from camera negative, print film, digital movie camera, HD video camera, stills camera or internet it is important to display them accurately for color grading and VFX work. Making the images look perfect is the most obvious thing to get right but is not at all the straightforward in practice.

Translation of on-set grading LUTs (look up tables) for later use in Digital Intermediate post –production grading.

(Stage-4) Grain management:-

It the most essential process to be done after the shoot is done and needful changes are over. Grains are sometimes added or subtracted to make or give them the look of the digital footage with the original film footage. Grains generally come during the on locations shooting or may be due to other changes. So it is essential to have grain management department to handle the whole footage.

(Stage-5)Lab Process:-

By this time all the changes to manipulate for the visual effects are done. So in this process the digital footage is then converted into film or for TV according to the formats.
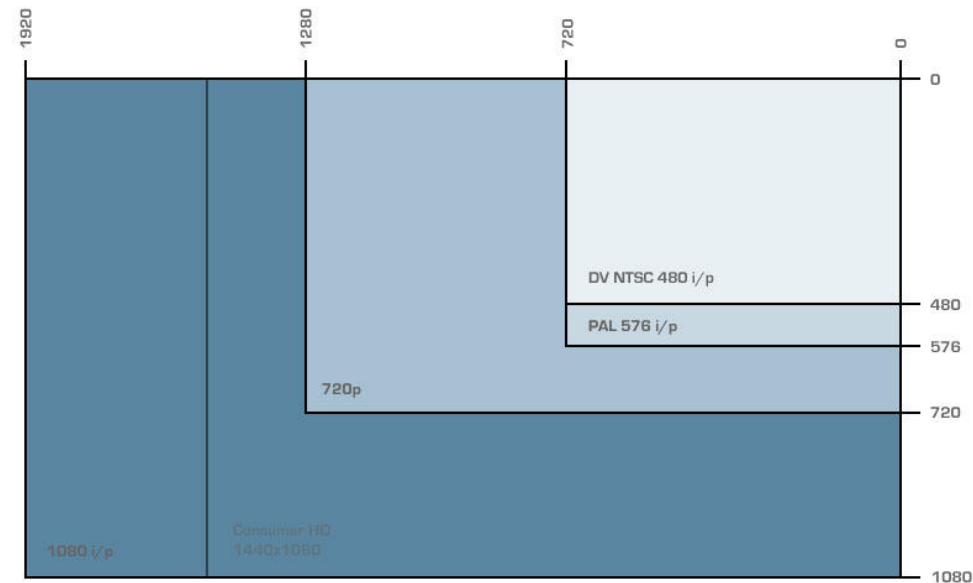
REQUIREMENTS FOR VFX:-

1) LAYERING/COMPOSITING:-

Digital compositing is the process of digitally assembling multiple images to make a final image, typically for print, motion pictures, or screen display. It is the evolution into the digital realm of optical film compositing.

Compositing is the combining of visual elements from separate sources into single images, often to create the illusion that all those elements are parts of the same scene. Live-action shooting for compositing is variously called "blue screen," "green screen," "chroma key," and other names. Today most, though not all, compositing is achieved through digital image manipulation.
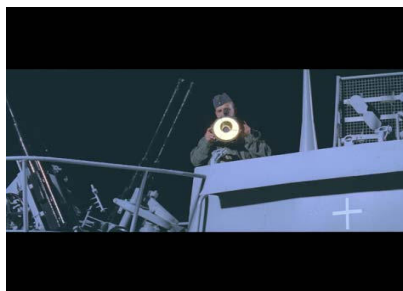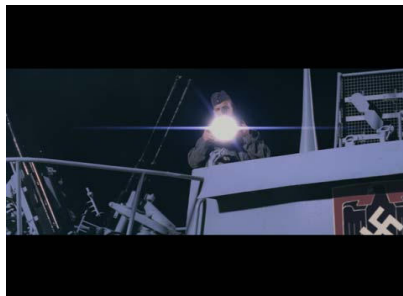
Digital matting has replaced the traditional approach for two reasons. In the old system, the five separate strips of film (foreground and background originals, positive and negative mattes, and copy stock) could drift slightly out of registration, resulting in halos and other edge artifacts in the result. Done correctly, digital matting is perfect, down to the single-pixel level. Also, the final dupe negative was a "third generation" copy, and film loses quality each time it is copied. Digital images can be copied without quality loss. This means that multi-layer digital composites can easily be made. For example, models of a space station, a space ship, and a second space ship could be shot separately against blue screen, each "moving" differently. (In such shots, it is the camera that moves, not the model). The individual shots could then be composited with one another, and finally with a star background. With pre-digital matting, the several extra passes through the optical printer would degrade the film quality and increase the probability of edge artifacts. Elements crossing behind or before one another would pose additional problems.

"During the world war, all German instruments of war bore the Nazi signage. (Germany has forbidden that now). For the sake of accuracy, Shyambabu wanted to use the Nazi signage wherever it was required. Samir Chanda the production designer had built the Nazi emblem which we stuck on the submarine. However the authorities insisted on having all Nazi emblems removed. So we marked the areas where the signage would have been stuck with 2 inch scotch tapes and later on composited the emblems and tracked them to the vessel" says Khandpur.

Software's for composting are:- After effects , Eyeon fusion ,Smoke, HoudiniHalo, Foundry Nuke.

CREDIT: Matte painting of the city; I over painted the city using a 3D render as the base. The 3D render, sky, and background mountains were done by the Meduzarts team. www.meduzarts.com | Meteor Studio "300" © Warner Bros.

2) MATTE PAINTING :-

A Matte painting is painted representation of a landscape, set or distant location that allows filmmakers to create the illusion of an environment that would otherwise be too expensive or impossible to build or visit. Matte painting is a constantly evolving art that gives film makers greater and wider creative choices. Sets, environments or worlds can be expanded or created entirely from your imagination and give your production visual power, subtlety, or dynamic beauty. Matte painters and film technicians have used techniques to combine a matte –painted image with live action footage. At its best, depending on the skill levels of the artists and technicians, the effects is "seamless" and creates environment that would otherwise be impossible to film. Using the gamut of techniques –digitally –painted images, photo composites, full –cg environment ,and hybrid"2-d"-We can help the filmmaker broaden the visual canvas in countless ways. The Invisible Art", is an appropriate title for the tried and true artistic technique that has been used since the beginning of film production.

 300 a film based on frank millers novel 300. The director Zack Snyder had used a narrative, which narrate the story. Through this narrative technique, various fantastical creatures are introduced, placing 300 within the genre of historical fantasy. The film was shot mostly with blue screen to duplicate the imagery of the original comic book. 300 were mostly shot indoors, against a blue

screen because all the backgrounds were added later using CGI techniques. Visual effects did really steal the show. The team of more than five hundred plus cg artists, animators and VFX professionals working in graphics studio around the world did a great job .Showers of blood , decapitations sequences and corpse lying everywhere in most of the shots, gives very 2d 'is comic like looks.

3) GRAIN MANAGEMENT: -

Film has grains as its characteristic artifacts. A Cg generated element needs to be "grained" to make it look integrated. Similarly a CGI object for TV should be field rendered to create interlacing artifact to give a integrated feel.

4) MORPHING:-

Morphing is the special effect used in live effects and animation that changes one image onto another through a seamless transition .Most often it is used to depict one person turning into another through technological means or as part of fantasy or surreal sequences. Image morphing, or metamorphosis, is a popular class technique for producing transitions between images. Part of the appeal of morphing is that the images produced can appear strikingly like and visually convincingly.

✓ **"Black and white" music video:-** The example is from "Black and White" Michel Jacksons music album where face morphing is used. The face is morphed from one person to other making it very interesting to see.

The creative people are exploring VFX which is keep on being exploring day by day .There are many more other ways of doing VFX than these. It is creative mind and challenge which keeps on giving new possibilities and wonderful results in VFX.

TECHNIQUES USED FOR

VISUAL EFFECTS

BASIC KINDS OF VISUAL EFFECTS USED IN FILMS:-

A) WIRE REMOVAL: - Wire removal is often used to create the sensation of a flying actor. The actor is placed in front of a blue screen, and later the wire is digitally erased frame by frame before finally adding in the preferred background. In this way, the viewer will not see the wire holding the actor. The shooting may be done in a studio or outside in a location.

B) MATCH MOVING:- Match moving is the name given to a number of different techniques used to bridge the gap between live action (what is filmed on the set) and a 3D Animation pipeline. is primarily used to track the movement of a camera through a shot so that an identical virtual camera move can be reproduced in a 3D animation program. When new animated elements are composited back into the original live-action shot, they will appear in perfectly-matched perspective and therefore appear seamless Visual-effects technique that allows the insertion of computer graphics into live-action footage with correct position, scale, orientation, and motion relative to the photographed objects in the shot. The term is used loosely to refer to several different ways of extracting motion information from a motion picture, particularly camera movement. Match moving is related to rotoscoping and photogrammetry. It is sometimes referred to as motion tracking.

C) MASKING TECHNIQUES:- Masking is the process of defining a part of the image ,to reveal the background. Masking is divided into other categories as well.
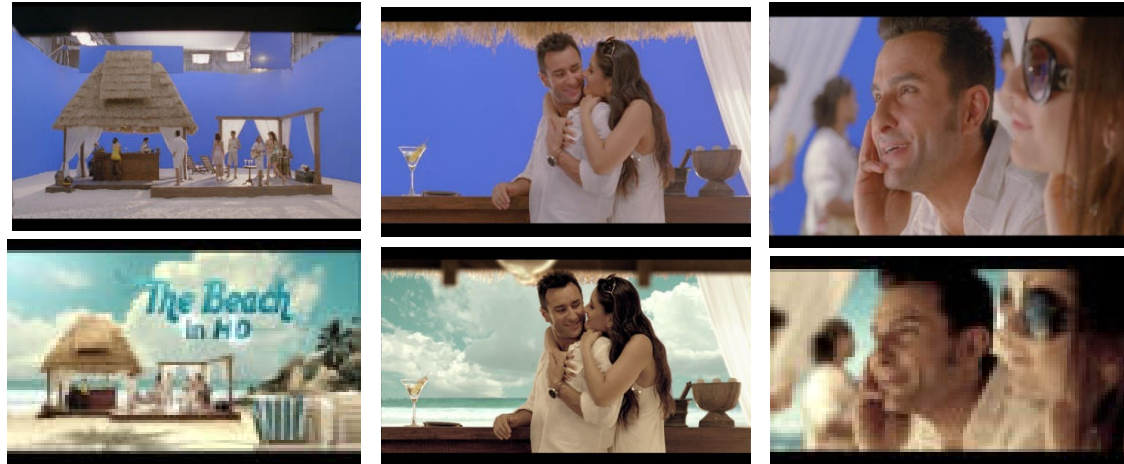
1) Chroma Keying:-

The blue screen is a technique that is used by having the actor stand in front of a solid colored blue screen, which is later replaced by the preferred scene. This is often used when the actual background cannot be achieved (due to expensive costs, non-existent realms, etc). With the advent of the digital age, this process has been greatly improved.

 Above is the add directed by Sunil Sippy and Sabu Jose as the Creative Head. "The Project was unique in that the whole ad was shot against a blue chroma back ground. The call to not shoot in a real beach location was taken by director, Highlight Films, as he wanted to go with a style that was meant to reflect a utopian reality, a place that looks familiar, yet is too perfect to actually exist." The Director guided Sebastian on the use of camera lenses and depth of field to help him gain the correct perspective for compositing. Sebastian Narsing, under Sunil's guidance, worked around the clock to conjure the scene. His artistic talent mingled with natural creativity lent the perfect combination to creating an original environment for the add. For the master shot, Sebastian used different layers for the sea, the sky, the rocks and the beach loungers. The sand was extended from the shoot. Even 'The Beach'supers were created and animated entirely on smoke. While compositing, Sebastian had to match the stock footage grade to the Telecine grade of the shoot. To

do this task and to achieve it he took many different passes for the foreground and background layers, as well as the chrome layer from Telecine. After the final composite he graded the film again, blending the layers together perfectly with a warm sunny tone. The interview was taken by Animation express.

1) ROTOSCOPY: -

Rotoscopy is an animation technique in which animators trace over live –action film frame by frame ,for use in animated films. It has been used as a tool in live action movies. By tracing an objects ,a silhouette is created that can be used to exact that object from a scene for use on a different background. Rotoscoping in the digital domain is often aided by motion tracking and onion-skinning software. Rotoscoping is often used in preparation of garbage mattes for other mattes –pulling process.

✓ **Juno:-** Juno's opening sequence is quite noted for its creativity. In the shot they have a cartoon-stylized scene wherein Ellen page seems to walking by her neighborhood. The whole movie is a live action based on the teenager pregnancy. The title sequence is rotoscoped.
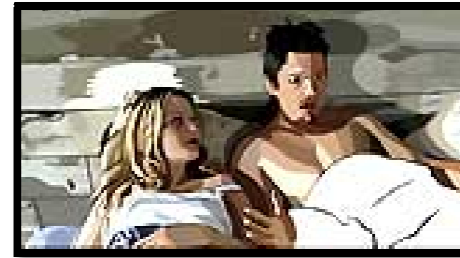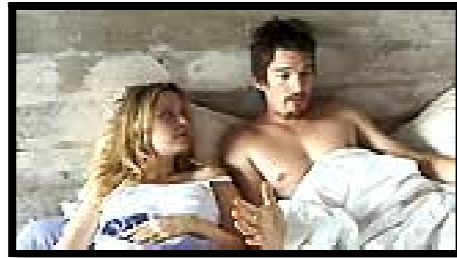
✓ **Waking Life (2001) :-** This animated, R-rated ground-breaking experimental film was first digitally shot on a mini-digital video camera as a live-action film, and then edited normally, complete with double-exposures and composited effects. In the next step, 30 artists graphically 'painted' the characters via computer (with a process called "interpolated rotoscoping") to create the illusion of a cartoon in motion. The animation was then transferred to celluloid, producing a hyper-real, and stylized comic-book look.

D) COLOR CORRECTION :-

The adjustment of color on film or video in terms of its contrast, hue, tint, brightness, saturation and density is referred to as color correction. Whenever the source material is film, many factors can play into making the color inconsistent .These include the film's temperature, age, exposure, and stock. In order to have color balance in a scene and between scenes, color correction therefore becomes a necessity. Projects that are delivered on video go through telecine for the purpose of color correction. Based on the project's color complexity, key scenes are selected and modified to match the intended color. Saving these scenes for reference, the colorist adjusts each scene one at a time. Throughout this process, the director or the specific team is present for giving inputs.

E) CROWD SIMULATION: -

It is the process of simulating the movement of a large number of objects or characters, now often appearing in 3D computer graphics for film. While simulating these crowds, observed human behavior interaction is taken into account, to replicate the collective behavior. The need for crowd simulation arises when a scene calls for more characters than can be practically animated using conventional systems, such as skeletons/bones. Simulating crowds offer the advantages of being cost effective as well as allow for total control of each simulated character or agent. Animators typically create a library of motions, either for the entire character or for individual body parts. To simplify processing, these animations are sometimes baked as morphs. Alternatively, the motions can be generated procedurally - i.e. choreographed automatically by software.

✓ **"London Dreams"- A Shoot:-** An interview to Animation Express ,Pixion CG Head Viral Thakkar said "The challenge was to create a CGI stadium with CG crowd applauding and reacting to the concert. The trick was to seamlessly merge the foreground live action with the background CG crowd. We concentrated on the various lights in the stadium and how it interacted with the crowd. The scenes were quite memory intensive with over 50000 CG people. The director was quite pleased with the output we delivered and it was sometimes hard to differentiate between live action and CGI people."One of the production houses "Pixion" has done the VFX work for the recently released Salman Khan and Ajay Devgan starrer 'London Dreams' directed by Vipul Shah. Approximately 600 shots have been worked upon by the Pixion team using their resources from Mumbai, Chennai and London offices. "London Dreams has some vast VFX work done where Pixion has created the Wembley Stadium,

generated CG Crowd for all the concert songs, CG bottle generation, created London City and some of the shots were completed in matte painting and also cleanups and set extensions were done.

F) CROWD MULTIPLICATION: -

It is one of the sub category of crowd simulation. It is used to multiply the crowd whenever needed a big crowd.

✓ **"All the best"- A Shoot:-** The Above example is from successful collaborative combination of Rohit Shetty and Mumbai based VFX major Pixion Studios with 'All the Best'.

G) AGE ENHANCEMENT:-

Age progression may also refer to several loosely related types of transformation, often shortened to AP, in which a character suddenly increase in age. The two main categories are child to adult transformation, and young adult into old age. Some overlap is possible: a child may become an adult, and then continue to old age. Age progression is occasional theme in motion pictures, cartoons and comics, literature and stage performances.

H) DUST REMOVAL :-

Line scratches are usually caused by film slippage during fast forwarding, rewind, fast stop, start etc. This deterioration is usually generated because of mechanical rubbing of film in the projector. In optical printing from negative films, many often use specular illumination which predominately shows scratches and other surface blemishes on the film. If one fills up the scratch with a material

that has the same refractive index as the film material, then the scratch won't be visible. Defects that can be handled by digital film restoration techniques are for example dust and dirt removal, noise reduction, image stabilization, scratch removal, flickering reduction, local color-shift reduction, and missing frame reconstruction

A scratch on the support of a negative film acts as a diffuser that scatters light. Light from the printer passes essentially in straight lines through the undamaged portion of the support and emulsion of the original. When light strikes the scratch, it is scattered and displaced from the straight-line path, reducing the light on the receiving emulsion.

I) ANIMATRONIC (MODELS) :-
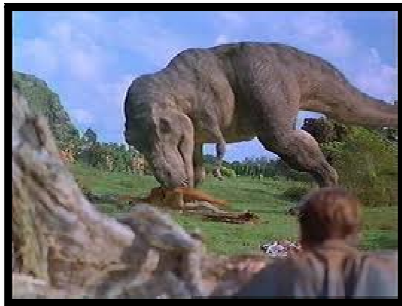
Animatronics is a cross between electronic and robotics. It is basically a mechanized puppet to simulate life. Animatronics are mainly used in movie making ,but also theme parks and other forms of entertainment .Its main advantage to CGI and stop motion is that it is not a simulation of reality ,but rather physical objects moving in real time in front of camera. The technology behind animatronics has become more advanced and sophisticated over the years, making the puppets even more realistic and lifelike. It is helpful to involve creatures in films or television to perform action, that may be too risky to performs by real actors or animals. Or the action could never be obtained by living person or animal. These applications today include computer controlled as well as radio and manually controlled devices. The actuation of specific movements can be obtained with electronic motors, pneumatic cylinders, hydraulic cylinders and cable driven mechanism .The type of mechanism employed is dictated by the character parameters, specific movements requirements and the project constrains.

✓ **E.T.: The Extra-Terrestrial (2002)**

There were numerous digital 'enhancement visual effects' made to the original 1982 version of this Steven Spielberg film, for the Millenium Edition, mostly rendering the friendly animatronic alien in the original as a computer-animated figure. This allowed ET to be seen underwater and blowing bubbles during a bathtub scene, among other minor tweaks. One notable PC change was that the guns in the hands of FBI agents were miraculously changed into walkie-talkies.

Prosthetic effects:- is the process of using prosthetic sculpting, molding and casting techniques to create advanced cosmetic effects. A mold of the body part is taken which will be cover. Life –cast molds are made from prosthetic alginate or more recently, from skin-safe silicone rubber. The most

basic of outward appearances is the costume - this is a basic of anything in the entertainment industry. More advanced versions of this include modern prosthetic makeup. Prosthetic makeup is used by creating a mold of a body part (usually the face) and molding it into whatever the artist chooses. This can create amazing appearances of wounds, or non-human features.

J) MINIATURE EFFECTS :-

Some of these techniques include matte paintings which create a foreground painted on a piece of glass that the camera films through. Also, miniature effects are created by using a small scale model that the viewer is unaware of. Where a miniature appears in the foreground of a shot this is often very close to the camera lens- ex when matte painted background are used. Since the exposure is set to the object being filmed so the actor appears well lit, the miniature must be over –lit in order to balance the exposure and eliminate any depth of field difference that would otherwise be visible. This foreground miniature usage is referred to as forced perspective. Another form of miniature effects uses stop motion animation.

K) 3D INTEGRATION OR COMPUTER GRAPHICS:-

© BIG Animation (I) Pvt Ltd.

Now the most prominent of special effects, computer generated images (CGI) are created on a computer through models, hand-drawings, or a filmed scene with live actors. With CGI, artists are able to create a variety of images, experiment with ease, and create movements and interactions that require much less effort and time. For 3d integrated work the whole 3d pipeline comes into play. It has its own modelers ,textures, riggers, compositors etc.

✓ **"Little Krishna-TV series":-** A family-friendly entertainment series, "Little Krishna" unfolds the chronicles of a beloved prankster and his metamorphosis into India's legendary heritage character. More than 300 characters are featured in the series. BIG Animation relied on its Maya-centric pipeline to efficiently build, animate and manage the signature characters and detailed scenery that make this program unique."Since Maya is our 3D platform we're able to recruit the industry's top artists. Maya is our lifeline for production. As well, product interoperability and the excellent support we receive from Autodesk are some of the main reasons we continue to rely on Maya, Smoke and Flame." The team researched backgrounds, art direction, color keys and all other elements, in order to have countless references from which to determine contemporary

styling. It was essential to convey not only the endearing nature of Krishna in the physical embodiment of the animated character, but also the authentic colors, flora and fauna of the Vraj region. Every time Krishna plays his flute, his surroundings react and move to the music. "Smoke and Flame were key finishing tools that allowed us to recreate the vegetation and color palette unique to Vraj," Ashish SK said. "As well, the seamless metadata exchange between Smoke and Final Cut Pro served us well in post-production."BIG Animation completed the series - from ideation to script to screen - in three and a half years. In this time, the team grew from 45 to 280 people. The series debuted on the Nick Channel in May 2009 and is currently one of the two top-rated children's programs in India.

# VFX DONE IN RELIANCE BIG ENTERTAINMENT

Spellbound Creations sub-contracted the work to a lot of facilities like Pixion, Reliance Adlabs, EFX, Image Devices, and freelancers to execute the work. They commenced work in 7KM with the Panther sequence; starting with the modeling, and at the same time watched a lot of stock references to better understand its behavior, like prowl, leap, etc. They did a rough rig and experimented a lot with the animation, before the shoot began. Once the plates were ready, the R&D work helped in refining the Panther. A lot of detailing on the fur, lighting, shadows, also added fog and foliage, to achieve better blending.

✓ **"Saath Khoon Maaf" Panther shoot:-** A crucial scene required VFX to show a black panther in a scene with the Major Sahab played by Neil Nitin Mukesh. It was not possible to shoot with a wild animal like this one, and Vishal Bharadwaj was against the use of stock shots for his film, as a result it was entirely created in CG, with highly accurate lighting, fur, shadows, and there was also foliage created to interact with the Panther.
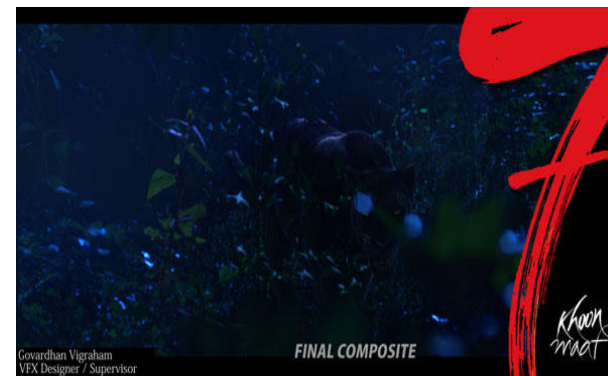
✓ **John's Body replacement-** There's the sequence with John Abraham's character as a drug addict. John is well known for his strong, muscular frame, but in some critical shots he needed to look weak, and fragile. After considering various possibilities, VFX was the final answer. Govardhan's first thought to himself was, "this is no ordinary stuff - if we didn't get it 100%

perfect, then it would be nothing short of a disaster". For this, he decided to shoot with a body double and have John's head motion-tracked over. They auditioned several suitable body actors, and finally settled on an actor who fitted Vishal Bhardwaj's imagination. Several initial tests were done with this double, and John, to better understand the challenges and limitations well in advance, before the shooting began. The VFX shots were then suitably designed without compromising the director's vision in any way. Spellbound Creations is currently in discussions on some very interesting projects (one from the south as well), with plenty of VFX expected.
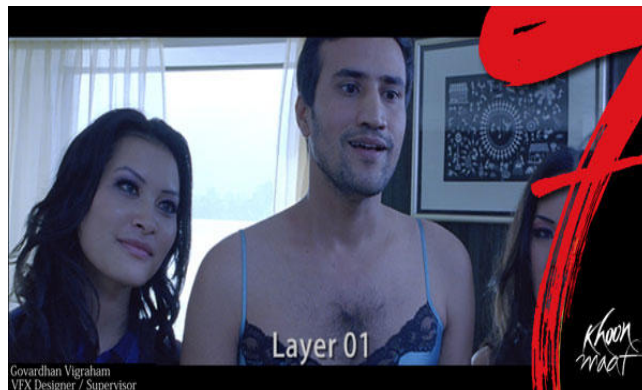
Film Title/Year and Description of Visual Effects: - Screenshot

Spider-Man 2 (2004)

Won the Oscar for Best Visual Effects .The most spectacular scenes were the struggle between Spider-Man (Tobey Maguire) and the tentacle major villain Doctor Otto Octavius ("Doc Ock") (Alfred Molina) on the side of a skyscraper during a bank robbery, atop the Westside bell/clock Tower, and then on the roof (and side) of a moving, runaway, overhead subway train that Spider-Man had to brake before it plunged over the end of the track. The conclusion in which Octavius decided to drown the reactor and himself to avoid a doomsday scenario for the city also required extensive CGI, live action, and model work.

King Kong (2005)

Peter Jackson's remake of the classic and tragic beauty-and-the-beast love story of the 1933 film featured a computer-generated Kong. The film was remarkable for having the largest number of special/visual effects shots in a single film, surpassing the previous records set by and Jackson's own trilogy of *The Lord of the Rings* films. The more than 3,200 final shots in the film were culled from 3 million feet of live-action footage and 2,510 visual effects shots. Andy Serkis (who performed the role of the CGI character Gollum in *The Lord of the Rings* trilogy) provided both on-set performance

reference and motion-capture performance for the title character of the giant ape King Kong.

Sin City (2005)

This Robert Rodriguez-directed, violent B/W crime-film noir was based on three of the 90s graphic novels by Frank Miller (who co-directed) - including "Sin City", a stylistic comic book adaptation (mostly noirish black and white and containing vibrant splashes of color). It starred Bruce Willis and Jessica Alba, and was shot completely with high-definition digital. This was the first big-budget movie with very photo-realistic, all-CGI backgrounds and live actors. See also *Able Edwards (2004)*, *Immortel (Ad Vitam) (2004)*, and *Sin City (2005)* - all 'digital backlot' films produced around the same time.

This meant that human actors were completely filmed in front of a green/blue screen with no background sets at all. Everything except the main characters was computer-generated.

## Wallace and Gromit: The Curse of the Were-Rabbit (2005)

Aardman Studio's second Plasticine stop-motion animated film with clay figures - after *Chicken Run (2000)* - also featured over 700 examples of digital effects, including CGI effects, such as the captured rabbits floating in circles in the glass chamber of mute canine Gromit's Bun-Vac, and a golden carrot shot like a bullet from a bazooka.

Pirates of the Caribbean: Dead Man's Chest (2006)

It won the Oscar for Best Visual Effects.CGI imagery had reached the point of becoming so convincing that the completely computer-generated Davy Jones (Bill Nighy), a monstrously Octopus-faced-and-tentacled villainous under-sea creature, was so realistic that some critics in their reviews mistakenly thought Nighy was wearing prosthetic makeup. In fact, although the actor wore a "motion capture" suit for the camera to provide a reference point, none of his real face remained in the final film - the animators even used CGI for Jones' eyes.

Visual effects artists at ILM used an instant (or on-the-spot) motion-capture-to-CG process, and an inventive technique called *sub-surface scattering* (to believably mimic the look of semi-translucent skin) to create the effect.
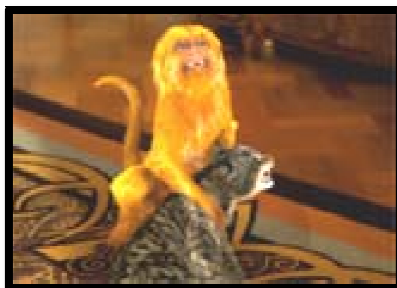
The Golden Compass (2007)

The Golden Compass won the Best Visual Effects Oscar. Remarkable CGI-imagery was employed in this fantasy film in the representation of one's soul - a daemon visualized as an animal. The daemon creatures were computer-created and animated, and incorporated into about 800 camera shots in the film. Two of the most prominent daemons were 12 year-old orphan Lyra Belacqua's (Dakota Blue Richards) shape-shifting Pan (voice of Freddie Highmore) - a ferret (or ermine), a wood mouse,

striped cat, a moth, or a bird, and the Golden Monkey daemon of villainess Mrs. Coulter (Nicole Kidman).In addition, Dust particles in the universe (representing intelligence) were visualized with fluid simulations. When a person was killed (especially in the film's climactic Battle of Bolvangar sequence involving flying witches, an attacking ice-bear, fleeing children, and Samoyeds), a daemon's dust particles disintegrated in a fiery sparkling cloud. Another phenomenal sequence was the realistic, totally CGI ice-bear fight - a monumental single-combat, vicious fight-to-the-death between armored warrior ice-bear Iorek Byrnison and king Ragnard Sturlusson with authentic-looking polar-bear fur, muscles, paws, and flying ice.

Transformers (2007)

Director Michael Bay insisted that the CGI (containing some of the most complex animations possible) for his robot-related live-action film was to be restricted to the robots and some background elements in the action sequences. In total, there were 60,217 vehicle parts and over 12.5 million polygons assembled into 14 giant, shape-changing automatons (each composed of thousands of moving pieces). For example, Optimus Prime that ILM created for the film had 10,108 parts and was 28 feet tall.ILM created about three-fourths of the special FX (450 shots), composed of intricate transformations of the 30 foot tall robots as they moved, and thousands of texture maps filled in additional details to the parts. Lengthy renderings were required to complete only one frame of movement. And to make the robots more realistic, ray-tracing (reflections of the surrounding environment on surfaces) was also used.

Wall-E (2008)

Pixar's and Disney's animated science-fiction love story, filmed like a live-action film, was set in the year 2805. It told about the title character - the last lone garbage-compacting robot on Earth named WALL·E. The ecological robot was composed of a pair of binoculars (for eyes), with a turtle-like body and tank treads for locomotion. His modern female robotic counterpart was EVE,a sleek, white-shelled probe droid-robot that was sent to check on the progress of the clean-up and to locate plant life.

The Curious Case of Benjamin Button (2008)
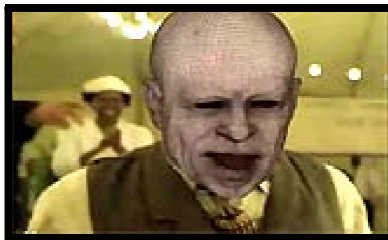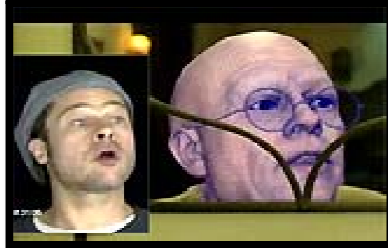
This film was the Oscar winner for various visual-effects, defeating *Iron Man (2008)* and *The Dark Knight (2008)* for its transformations of the main character Benjamin Button (Brad Pitt), born in 1918 at the end of the Great War, and suffering as a baby from arthritis, osteoporosis, and nearly blind from cataracts as if he was in his 80s. A computer-generated copy of Pitt's aged face was grafted by special effects experts onto various smaller bodies during Benjamin's growing-up (or growing-down) years, especially during the first third of the film. The breakthrough special effects were elaborate and seamlessly integrated, using a new facial performance capturing system called "Contour" to track an actor's facial movement in three-dimensional space. The studio, Digital Domain, admitted: "There's 325 shots - 52 minutes of the film - where there is no actual footage of Brad."

In his early years, at age 5 approximately, he appeared to be a short, frail, bald elderly man with glasses. He graduated from a wheel chair to a cane, and then in puberty grew hair, gained muscle tone, and looked healthier. At around age 17, he took a job on a tugboat, through the bombing of Pearl Harbor in 1941 and the war years. After the war, Benjamin appeared to be 50 years old, although he was only 26 chronologically. [Also, prosthetic make-up allowed Cate Blanchett to morph into a withered, dying old woman.]

By film's end, Benjamin as a minor 12 year old (with acne) (portrayed by a younger actor) was found living in a condemned building in New Orleans. Daisy cared for Benjamin, who didn't recognize her but felt like he should know her, was experiencing dementia and Alzheimer's disease. Eventually, he became an infant in Daisy's arms, where he died.

Avatar (2009)

Visionary director James Cameron's monumental work (his first feature film since *Titanic (1997)*) was this futuristic, epic 3-D live-action film, with ground-breaking, Oscar-winning special effects. Much of the film's reported budget of over $300 million was spent on CGI. (40% of the film was live-action while 60% was photo-realistic CGI). Over a period of years, Cameron designed dual-function cameras that simultaneously filmed in both conventional 2-D and state of the art 3-D. The film utilized motion performance-capture assisted CGI technology with actors on a stage to create the sympathetic Na'vi characters. The technique of performance capture involved putting actors into bodysuits covered with tiny dots, while about 140 digital cameras captured their body movements. Another tiny helmet-rigged camera was used for recording finer facial, eye, and head movements. And then the digitally-recorded data was used by animators to create the characters in their virtual

world environment. Various striking elements in the film included the visually-stunning alien planet of Pandora, the world of plants and aliens called Na'vi with the computer-generated, blue-skinned, primitive alien character of Na'vi warrior princess Neytiri (Zoe Saldana) - and human gone native Jake Sully (Sam Worthington) as a tall, lanky, long-tailed, blue-skinned creature/avatar, and the purple-skinned predatory creature Thanator with burnished black skin banded with stripes of yellow and scarlet, sharp teeth, armored head and tail, and ten 'sensor quills.'

A Christmas Carol (2009)
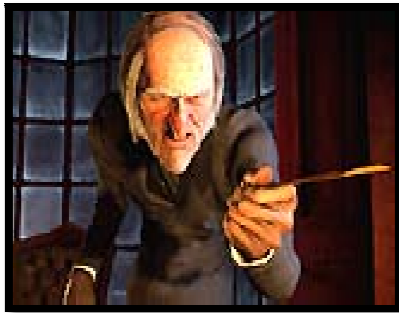
Performance capture-advocate Robert Zemeckis had previously experimented with the technology in his own *The Polar Express (2004)* and *Beowulf (2007)*, and used the technique in this film -- Disney's 3-D *A Christmas Carol (2009)*, an adaptation of Dickens' 1843 classic story, in which Jim Carrey played multiple roles, including old miser Scrooge (at different stages of his life) and the three Christmas ghosts. Performance capture (or motion capture) refers to a digital blend of live performance and animated elements. Actors wore heavy, dot-sensor-covered spandex body suits and a helmet, and initially acted out their scenes in isolation from other sets, props, costumes, or actors. Expressions and movements were first recorded by digital cameras as 3D "moving data points" - and afterwards, the digitally-recorded performances were translated and embellished by key-frame artists and integrated into an exclusively virtual environment (Victorian London).
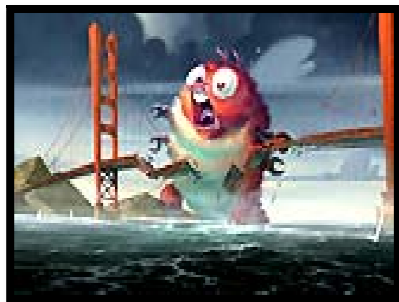
Monsters vs. Aliens (2009)

The DreamWorks sci-fi spoof of 50s monster B-movies, *Monsters vs. Aliens,* was the *first* computer-animated feature film to be shot directly in stereoscopic 3-D -- dubbed the Ultimate 3-D. Previously, 3-D CGI films were made in a non 3-D version and then dimensionalized. Other 3-D computer animated films would also debut in the new format: 20th Century Fox's and James Cameron's *Avatar (2009)*, Fox's *Ice Age 3 (2009)*, Disney's motion-capture *A Christmas Carol (2009)*, and Pixar's *Toy Story 3 (2010)*.

Watchmen (2009)

In this filmed adaptation of Alan Moore's graphic novel (a 12-issue publication by DC Comics between 1986 and 1987) by director Zack Snyder, the photo-realistic, all-CGI character of the all-

powerful, blue-glowing "atomized" scientist Dr. Manhattan (Billy Crudup) was created with the process of motion capture. Dr. Manhattan's character appeared in approximately 38 minutes of the entire film.

Crudup wore a specially-designed motion capture suit covered with pattern markers and face markers - he was filmed with two to four HD "witness" cameras to capture his overall full-body movements and facial expressions. All the cameras were synced so animators could then triangulate Crudup's performance in-frame. The number of black facial markers on the suit was a record 165 spot points, allowing the animators to track his expressions through video and then use that data as a jumping-off point to hand-animate Manhattan's face. Crudup's suit was also equipped with 2500 LEDs to create Manhattan's diffuse blue glow.

Inception (2010)

Christopher Nolan's mind-bending suspense thriller about invading people's dreams won four technical Oscar awards, Best Visual Effects, Best Sound Mixing and Sound Editing, and Best Cinematography. A dream manipulator named Dom Cobb (Leonardo DiCaprio) and his team entered the multi-leveled psyche of an energy tycoon (Cillian Murphy) to implant an idea about how he wouldn't follow in his father's footsteps.

Some of the most astonishing, surreal and ground-breaking special effects were seen in the various dreamscapes where the laws of logic and gravity didn't hold.

- the Parisian bistro scene (a dream itself) when slow-motion fire-less explosions (created with high-pressure nitrogen) popped all around Ariadne (Ellen Page) and Cobb; then as they strolled down the street, an entire block in the city (with people, cars, etc.) folded in upon itself above them, and they walked from one plane to another
- a zero-gravity fight scene, set inside a 100 foot by 30 foot long revolving hotel corridor; also other scenes of being suspended or floating down shifting or spinning hallways and rooms
- the image of a Ford van falling ever so slowly off a bridge, with the actors suspended in the van
- the scene of Arthur (Joseph Gordon-Levitt) taking five bodies, stacking them and wrapping a cord around them, and floating them down a hallway into an elevator
- various city-scape transformations, and the vast expanses of buildings and architecture in Limbo City crumbling into the sea like icebergs
- the fiery explosion/destruction of the massive concrete hospital fortress (a miniature) on the edge of a snow-covered mountain

Spider-Man (2002)

This blockbuster comic-book hero feature film included the extensive use of digital body doubles (a computer-generated superhero), and the digital removal of wires, cables and rigs from many shots. Almost every car in the original film shots had to be removed and replaced with digital models. In the CGI-enhanced Costume Montage sequence that lasted about a minute, over 40 live-action and graphic elements were combined as Spider-Man (Tobey Maguire) brainstormed to create a costume for himself.

Segments with Spider-Man required shooting in front of a greenscreen, while the villainous Green Goblin (Willem Dafoe) had to be shot in front of a bluescreen. Also, in the final battle scene in an abandoned building between Spidey and the Green Goblin, to ensure a PG rating, digital effects transformed the red blood from the hero's mouth into clear liquid spit.

And in respect for the 9/11 tragedy, the shot of the World Trade Center's Twin Towers, between which Spider-Man had spun a web to snare the maniacal Green Goblin and caught a passing helicopter instead, was removed from the final cut of the released movie (in its final reel), although the image remained in one of the film's trailers.

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