KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY, KUMASI, GHANA

COLLEGE OF ART AND BUILT ENVIRONMENT

FACULTY OF ART

DEPARTMENT OF COMMUNICATION DESIGN

PERSPECTIVES ON VISUAL EFFECTS: CHALLENGES OF CGI AND LIVE ACTION INTEGRATION IN THE GHANAIAN FILM INDUSTRY

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(BA. Communication Design)

PERSPECTIVES ON VISUAL EFFECTS: CHALLENGES OF CGI AND LIVE ACTION INTEGRATION IN THE GHANAIAN FILM INDUSTRY

A thesis submitted to the Department of Communication Design in the
Faculty of Art,
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MASTER OF COMMUNICATION DESIGN

By

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CERTIFICATION/DECLARATION

I, Samuel Owusu Agyeman-Duah, declare that this submission is my own work towards the award of Master of Communication Design and that, to the best of my knowledge it contains no materials previously published by another person nor material which has been accepted for the award of any other degree of the University, except where due acknowledgment has been made in the text.

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Signature

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Date

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ABSTRACT

Visual effects are essential components of film production. The advent of new technologies has laid a strong foundation for artists to be able to create scenes which could only have been imagined. Many production houses endeavour to compliment productions by integrating live action footages with Computer-Generated Imagery. Nevertheless, in the case of local film production in Ghana, many of the visual effect audiences see on screens are not able to stimulate the intended effects. Visual effects techniques that are being employed are done amidst many setbacks. This study therefore sought to examine visual effects in the Ghanaian film industry with the intent to identify the challenges of integrating live action and CGI footages. It also sought to understand in particular the implementation of Matchmoving techniques in production workflow in the Ghanaian movie industry. Approaching the study from a qualitative perspective, it makes use of a single case study technique utilizing interviews and observation to gather subjective data. Thematic analysis was used to generate themes that help to analyse the data and to achieve the findings from the study. Major findings indicate that the industry is braved with lack of knowledge and expertise, limitations in available technology and inefficient production processes. The study is of interest to practitioners in the local film industry, educational and training institutions, policy makers and researchers. It concludes that VFX implementation in film production has had a good impact on the industry amidst the myriads of setbacks; and also recommended a full inclusion of the visual effects artists, supervisors and directors in the whole filmmaking process.

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF PLATES

CHAPTER ONE

INTRODUCTION

1.1 Overview

This chapter presents the background history of the study, statement of the problem, objectives of the study, research questions, delimitation and limitations of the study. Other significant areas covered include: definition of terms, importance of the study and organization of the rest of the chapters.

1.2 Background to the Study

Filmmaking started in the 1890s to present day 21st century. It has been going on for over a hundred years. During the early era of filmmaking, the films were without sound. This period was known as the silent era. Sound was introduced into films during 1927 and from there advancements came to allow films to be made in color. (Nowell-Smith, 1996).

The introduction of computers gave birth to digital filmmaking. Filmmakers migrated from the use of traditional analog systems to more advanced digital systems in their productions. But for the best quality, some still start their production on traditional film before finishing on digital systems.

Computer generated images (CGI) came with the digital age and their introduction helped the filmmaker to make more complex and appealing films. Computers are used to create images that are nearly impossible to create by hand. The advent of this age helped in the film industry a lot by expanding the creative capabilities of the film maker. With the current trends, nothing seems impossible to create and with daily advancements come more creative ideas.

According to the national media policy (National Media Commission, Ghana, 2001) by the National Media Commission, film exhibition in Ghana started in 1925 when the very first cinema was opened in the capital city Accra. Actual film production started in 1948 when the government spearheaded it by creating the Gold Coast Film Unit. The media policy also states that the Ghana Film Industry Corporation was established to provide an institutional base for film development. The Corporation, for the next 28 years, developed film extensively in the country and this also affected growth in other sectors of film production like distribution and exhibition.

One of the significant growths was when the private sector took an outstanding leadership role in film production and this happened during the electronic and technological revolution. The private sector took charge of film industry from production through to exhibition and distribution. There was an influx of electronic equipment with advanced technological features during the electronic and technological revolution. The revolution has aided in so many people now being able to perform various degrees of film production which would not have been possible in the years before the revolution. The film industry was a much more direct beneficiary of this revolution since they were able to improve on the films that they were doing at that time.

Early CGI in the Ghanaian film industry started when computers were introduced in the 1990s. Those times, computers were being used mainly for editing and creating title graphics as they were being used alongside the analog systems. This progressed on until now full characters are being used as in recent films like *2016* produced by Ninja Productions in 2012.

CGI has come to stay in the film industry therefore care is being taken to really improve integration of live action and CGI. The Ghanaian populace has taken to some amount of CGI along with a good storyline in their films according to a personal interaction with Samuel Nyamekye the owner of Miracle films when the researcher was doing an internship at Miracle Films, this was prior to the researcher deciding to undertake this study.

1.3 Statement of the problem

Since the advent of filmmaking in Ghana, the quality and production methods of most films are great in relation to the storylines which relate to our daily lives as Ghanaians. The introduction of CGI in some movies such as *Ghost Tears* produced by Hacky Films in 1992, shows that CGI in filmmaking greatly improved the story greatly. However, a critical observation made by the researcher is that with the introduction of computers in the early 1990s came some challenges.

Based on these observations made with regards to CGI and live action integration, using Matchmoving techniques, many movies being produced these days in the Ghanaian film industry come with a lot of CGI elements in them. It is evident that these integrations are not efficiently made to create the needed effects in the production. There is therefore the need for research into CGI and live action integration to identify challenges of VFX artists and movie-makers in the Ghanaian Movie Industry. Answers to these problems could aid artists and directors/producers by proposing solutions to address issues that arise from the using the Matchmoving techniques.

1.4 Aim of the study

The aim of the study was to identify the challenges of integrating CGI with live action footages and to understand the implementation of Matchmoving techniques in production workflow in the Ghanaian movie industry.

1.5 Objectives

1. To identify the state of CGI and live action integration in the Ghanaian movie productions.
2. To examine how local VFX artist integrate live action footage with CGI footage.
3. To identify how CGI and live action integration be improved.

1.6 Research Questions

1. What is the state of CGI and live action integration in the Ghanaian movie productions?
2. How do practicing local VFX artists integrate live action footages with CGI footages?
3. How can CGI and live action integration in Ghanaian movie productions be improved?

1.7 Delimitation

The research is geared towards exploring the use of Matchmoving techniques by visual effects artists in the local film industry. For this reason, the research will be done in Ghana and will focus on the technique of Matchmoving. Modeling and

animation of Computer-Generated Image(s) during the production stage will not be the focus, however some aspects of post-production like modeling, texturing and animation that impact on effective Matchmoving would be discussed.

1.8 Limitations

1. Literature on Matchmoving techniques available in dissertations, papers and other publications is quite limited. Amends were made for the scanty literature by taking snippets of information from videos available online.

2. Visual effects in Ghana has not been a well-researched area compared to special effects. Information pertaining to visual effects was virtually non-existent.

3. Due to the competitive nature of the film industry, visual effects artists are not willing to divulge information about how they go about their work processes. Their trust has to be gained before they will be willing to talk to the researcher.

1.9 Definition of Terms

CGI: Computer generated images or Computer-generated imagery (CGI) is the application of the field of computer graphics or, more specifically, 3D computer graphics to special effects in art, video games, films, television programs, commercials, simulators and simulation generally, and printed media. The visual scenes may be either dynamic or static.

Blue/Green Screen: It is the colours of the backgrounds that are used in cases where the subject is to be placed in another environment using Chroma keying technique (explained below).

Chroma Key: Chroma key compositing, or Chroma keying, is a special effects / post-production technique for compositing (layering) two images or video streams together, used heavily in many fields to remove a background from the subject of a photo or video - particularly the news casting, motion picture and video game industries.

Matchmoving: In cinematography, Matchmoving is a visual-effect, cinematic techniques 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 to loosely to refer to several different ways of extracting motion information from a motion picture, particularly camera movements like panning, tracking and zooming in. the data extracted is used as a guide in modeling applications like Autodesk Maya to model and animate CGI for integration.

Matchmover: A Matchmover is any person who performs Matchmoving procedures in a production.

Background Plate: This is the base on which all other elements are placed. The background plate may be a still shot or a motion picture.

Tracking Markers: They are points in the scene, by which the tracking software uses to decipher camera data from the footage. They are either made and placed in the scene by the VFX director or artist or derived from the scene itself by the tracking software.

Solve: This is a process in which camera data is successfully extracted from footage with the use of software. This is the data by which CGI is matched with the plate.

Workflow: this consists of a sequence of steps that a VFX artist undertakes to finish a shot or a scene with effects in it. It applies generally to any work environment or process that requires a series of sequential steps to accomplish a task.

Pipeline: A pipeline in Visual effects are the stages that are used in the post production of the film. Example being the addition of muzzle fire to a firearm during the firing sequence.

Pre-vis: It is the short form of Pre-visualization. This is a mock-up of how the actual scene will look like. It normally contains animations of how the actors will interact with the environment and the CGI in there.

1.10 Abbreviations

CGI: Computer Generated Imagery

VFX: Visual effects

NAFTI: National Film and Television Institute

POST: Post Production

VES: Visual Effects Society

1.11 Importance of the study

1. The research would provide some solutions to the challenges in live action and CGI integration in the local Ghanaian film industry to help improve the quality of films with visual effects being produced.

2. The research would be used as reference material for other researchers in academia for further studies in CGI and live action integration so as to develop better curriculum for film studies. This will churn out better visual effects graduates for the film industry

1.12 Facilities available for the study

- The Prempeh II Library, Kwame Nkrumah University of Science and Technology (KNUST).
- Faculty of Art Library
- Private libraries of lecturers and professionals in filmmaking.
- National Film and Television Institute (NAFTI) Main Library
- ICT centres in Accra and Kumasi.
- Production Houses in Accra and Kumasi.

1.13 Sources of Information

- Selected post production houses in the film and video industry in Ghana
- Library sources

- Internet sources

1.14 Arrangement of text

Chapter one deals with the problem and its setting. It gives a background history of visual effects in films produced in Ghana and its relevance to the socio-economic development of the nation.

Chapter two provide discussion on related literature regarding the study. It sets out the direction of the research by reviewing relevant documents in order to identify knowledge gaps.

Chapter three describes the research design and approach of the study, sampling techniques and methods for data collection as well as the data analysis plan.

Chapter four presents findings the data from the Matchmoving experimentation projects. It further discusses the results of data analysis.

Chapter five summarizes, concludes and presents some recommendations for the study.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1 Overview

This chapter dwells on available literature on the history of filmmaking in the world. History of film making in Ghana from the time computers were introduced in the industry to aid film production. Visual effects production from the time it began will also be reviewed with respect to Ghana, the developmental processes it has gone through and the various ways through which it is implemented. There is also review of literature on advent of Matchmoving, the developmental phases and how it being used in modern day productions.

The production processes that is, pre-production, production and post-production will be discussed in relation to visual effects productions. This would include the entire production pipelines being used in the industry and where Matchmoving fits in.

Computer Generated Imagery (CGI) creation and integration will be reviewed as a process after Matchmoving has been accomplished. Software and hardware related to Matchmoving will be discussed, special attention will be given to the recommended computer requirements needed to operate them.

2.2 Introduction of Visual effects (CGI) in film making

CGI elements are now an integral part of the films being produced today such that even non VFX films like documentaries (documentaries try to keep the story in the purest unadulterated form) do use some amount of CGI to sell the story even more.

VFX is all about creating photorealistic imagery within the context and environment where they are placed and not because the audience have seen such images before (Creative Skillset, 2014).

Since the first use of CGI in the movie *Futureworld* (Directed by Richard T. Heffron in 1976), advancements have come such that it has graduated from just being used in movies to broadcast television as well. Matchmoving has made all this possible. The Visual Effects Society Handbook of VFX edited by Jeffrey A. Okun and Susan Zwerman (2010) states that one of the first matchmove was done in the movie Citizen Kane in 1941. The director Orson Welles asked his compositor Dunn to give him a much richer shot that portrayed his vision as a filmmaker. Dunn with the help of his crew built a miniature of the Thatcher statue with the dome in which it was housed and then they were photographed at an angle to match the live action shot. Dunn then match moved the camera frame by frame to make it seamless with the photographed elements. This shows that Matchmoving helps to make the story more believable.

2.3 Filmmaking History

Manley (2011) states that the history of film cannot be credited to just one person but rather several individuals contributed to this awesome phenomenon. These individuals were basically inventors who built upon the inventions of others culminating for the entire art and industry. Film History can be basically divided into

two the silent era and the sound era. The silent era began from about 1895 to 1930 when sound was introduced into films (Nowell-Smith, 1996).

2.4 Evolution of Film (The History)

According to Allen and Gomery (1985), film history evolved as a serious academic discipline during the 1960s following the development of cultural studies and particularly, the elevation of cinema from a so-called cheap side-show entertainment for the masses to becoming a part of important cultural phenomena worth serious study. Sobchack (2000) has also argued that within the academy, during the 1960s, Film Studies had sought to legitimate itself as a serious field of academic enterprise and cinema as an aesthetic and historical form worthy of serious scholarly attention.

Over the years, the evolution of film has undergone several stages of development. These stages are the ages of film history as stated by Ewing (2014).

1. Pioneering age: this age is from 1896 – 1912, when people were discovering motion pictures as an art form.
2. The Silent Age: From 1913 – 1927, films were made without sound and this was the same period Hollywood was beginning.
3. Transition Age: 1928 – 1932 when sound was introduced into films amidst the difficulties of recording sound and picture at the same time.
4. The Hollywood Age: 1932 – 1946, this was the age of studio productions when various studios handled the productions and films were about World War Two.
5. The Internationalist Age: this age was from 1947 – 1959 when television was gaining roots in the lives of the people. This age affected the studios

a lot in their productions as more people preferred to stay at home rather than go to the cinemas.

6. The New Wave Age: This age which is from 1960 – 1980 brought about technological advancements and innovations in film production. Also, social and political values were being derived from the films being made.
7. The Mass Media Age: From 1980 to present day, this age has made film as part of the global entertainment and communications media. Then again digital production of films began during this age and has been constantly advancing to cope with the imagination of the directors and storytellers.

2.5 Filmmaking in Ghana

The history of film in Ghana started from the Gold Coast era when the Gold Coast Film unit was set up in the Information Services Department. The Ghana Film Industry Corporation was created in 1971 for the production of black and white films. The corporation was divested with a majority of the share equity going to some Malaysian interests as far back as 1996. Before being divested, the corporation had stopped the production of black and white films from the 1990s (Filmbirth.com/Ghana, n.d).

Ghana is well known for its prowess in storytelling. Filmmaking is another form of storytelling and expressing oneself in another medium. There have been some highly-recognized filmmakers in Ghana, with Kwaw Ansah being the most famous amongst of them all. He has many films to his name notably Love Brewed in an African Pot (1980) and Heritage Africa has chalked him more than 12 awards.

2.6 Visual Effects

According to Okun and Zwerman (2010), visual effects is the term used to describe any form of imagery created, manipulated, or enhanced for film or other moving media that cannot be accomplished during live action shooting. Plate 2.1 shows an example of a CG character holding a live human being

Plate 2. 1: Sample VFX scene taken from the film The Sponge Bob Movie Sponge out of Water where the CGI character is holding the live action character.

Visual effects are therefore basically computer-generated imagery that are added to live action video footage or to another CGI. Also, they can be described as enhancements added to video or still footage to make the story more believable.

Another visual effects online school also stated that visual effects is digitally manipulated live action footage or the use of computers to add/remove any element that was not originally in the shot. This means that even if it is a simple line or dot that is added to the scene then that is classified as a visual effect.

James Cameron, one of the leading and award-winning filmmakers conceived an idea for a film which involved complex Computer-Generated Images (CGI)

integration which was not achievable at that time (almost thirteen years ago, from the time the film was released). This was made known in January 2013 in a declaration at the Central District of California's District Law Court when the originality of his story was challenged by one Mr. Mowraski an acquaintance of his. He waited until technological advancements came and he was able to achieve his creative concepts in 2009. The movie was *AVATAR* which won the award for best visual effects (CGI) in the OSCAR movie awards that followed in 2010. This underscores the fact that computer generated imagery can make the impossible possible in filmmaking.

2.7 Visual Effects in Ghanaian Films

From the days of movies like 'Who killed Nancy' and many others, visual effects have been employed in making the stories better. Those days the visual effects were limited to mostly making people (Ghosts) disappear and appear. CGI was non-existent during those periods. That particular effect was achieved by using a locked shot that is the camera was stationary. The shot was taken without the 'ghost' and another shot was taken with the 'ghost' in the scene. The two shots were edited with a simple cut transition to simulate the feel of a ghost appearing and disappearing.

These days with the advent of sophisticated equipment and software, production has really advanced in the areas of visual effects. Movies that are being made currently especially in the Ashanti region has a lot of VFX scenes. The movies are driven by these VFX scenes such that those without them tend to gain low patronage, this was made known through a personal communication with Samuel Nyamekye owner of Miracle Films based in Kumasi.

Visual effects have evolved also in the industry from simple fire balls to full characters generated on the computer and incorporated in the films. Also, environments are being created in CG and added to video as shown in Plate 2.2. On the left is the green screen being used and the left shows the CGI environment integrated into the background of the still from the video. The video won the best visual effects for the Foursyte Music Video Awards 2013 edition and it was directed by Nicholas Baeta a visual effect artist and music video director.

Plate 2. 2: A before and after visual effects scene from a Ghanaian music video using the green screen technology. The left portion of the image shows the green screen and the right shows the finished scene. (Credit: Jenirex Multimedia Company)

In an interview of Nicholas Baeta by Kristy Barkan in 2012, he stated that for visual effects to progress in Ghana, “Number one: create awareness. Number two: encourage visual effects as an art form in our universities. Number three: set up professional VFX studios to make the work easier for the artists.” From this one

could notice that even though progress has been made, we still have quite a long way to go.

2.8 The Production Process

Before a film or movie can be shown to the intended audience, it has to go through a process of production. The production process consists of three (3) main stages namely; pre-production, production and post-production

- **Pre-Production**

  This is the first stage of the entire production where concepts and ideas are drawn and fine-tuned. Storyboards, equipment, props, crew, locations, costumes and finances amongst others are all decided on at this stage. The Visual effect director and his or her team would be at the pre-production stage depending on the production. If the production does not have visual effect scenes, then their presence will not be needed. The storyboarding aspect of pre-production applies to all productions, but in a production, which has visual effects goes a step further with Previs of the VFX scenes. Sophisticated productions also have directors requesting for a Previs of the entire production especially where there will be tricky camera movement. In simple terms a Previs is an advanced storyboard with animated additions courtesy of computer software. As shown in Plate 2.3 and Plate 2.4.

Plate 2. 3: Pre-vis of Avengers Age of Ultron showing how the finished work might look like. (Credit: Marvel Entertainment)

Plate 2. 4: A shot from the final Scene of Avengers Age of Ultron based on the Pre-vis except this one has the actual live action characters and CGI integrated into the scene. (Credit: Marvel Entertainment)

- **Production**

  The production stage is where the live action shoot takes place. At this stage almost all the crew will be at work. The director, cinematographer (camera person), sound person, producer, production assistants and many others. Depending on how big the production is, there may be more crew members. On smaller productions, crew members take up other roles other than their

traditional roles to save the production money. For example, the assistant director may assume the role of a producer to do most of the running around.

In a visual effects shoot, you would have a VFX director on set apart from the director to assist in the VFX scenes. They would work with the director to make their work easier and also to help the director achieve his vision. The role the VFX team would play includes setting up tracking markers if needed, green screen set up, checking lights set up and capturing High Dynamic Resolution Images (HDRI) for use with CGI in terms of light rendering. In the case of specialized equipment that need special operators, they handle that equipment. Also, asset management for the production can be done by them since they sometimes do quick composites on set to test the live action footage taken.

- **Post-production**

  Post-production or post, as it is sometimes termed, is the last stage of the production process which it like adding the cosmetic touch for a product to be displayed in a stores display window.

  Various processes take place at this stage. The common ones are editing, colour grading, colour correction, sound design (scoring) and Title Design. This stage actually lasts way longer than the actual shoot. There is a lot of back and forth between the director, editor, sound designer and producers. They all have to settle on the same ideology or concept. Although the director has more power in terms of the final output, the opinions of the rest of the crew are very important for the film to come out as an excellent piece of work.

After the basic editing or first cut, as it is called, has been done that is where the VFX team comes in. spearheaded by the VFX supervisor, he or she collaborates with the director mostly and relays all the information to the VFX artist working on the CGI as to how to go about the work. He or she sometimes doubles up as an artist if the workload becomes a bit too much or the time frame is too tight.

This is where the production pipeline which includes Matchmoving is employed to get the final look the director wants. The production pipeline will be discussed in detail in the subsequent subheadings.

The artists employ the green screen technique, 3D modeling, rendering and compositing to execute the job at this stage. Rendering for final output takes a chunk of the time at this stage. Some of the big productions go and get specialized hardware to aid in accomplishing the task at hand. The setup is called a render farm where you have lots of computers interconnected to take care of the rendering workload. An example of a render farm can be seen in Plate 2.5 and Plate 2.6

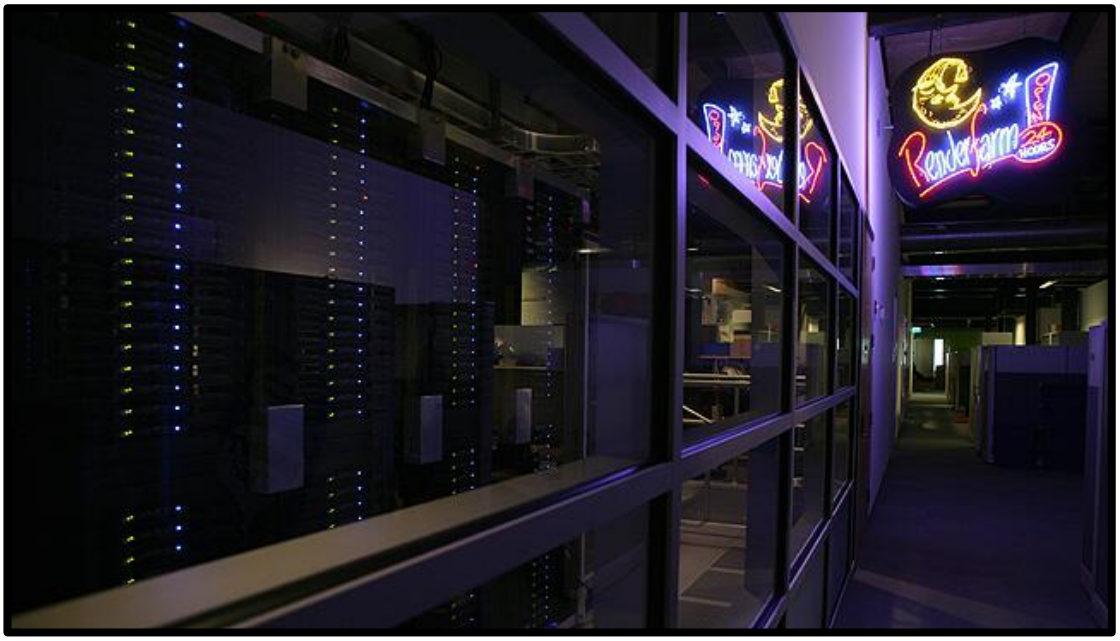

Plate 2. 5: A render farm from Pixar Studios (Credit Pixar Studios)

Plate 2. 6: A close up view of Pixar Studios render farm showing the servers used for rendering.

2.9 Matchmoving

Matchmoving has been explained by some school of thought as the basics of all visual effects scenes in foreign movies (Hollywood). They added that before any footage can be sent out for visual effects to be added, it has to be matchmoved. The idea behind it is to get as much realism as possible.

2.10 Definition of Matchmoving

Zeeb (2011) defined Matchmoving as a technique used to input computer generated imagery into live footage. Also, Dobbert (2005) defined Matchmoving as the process of matching CG elements into live action footage.

According to Hornung (2010), Matchmoving is taking data from a real-life set shoot and recreating the camera virtually including the adjustments made during shooting. Such that CG elements created would have the same perspective, depth and relationships to the live camera as live actors do. The VES handbook (2010) states that Matchmoving is the process of extracting tracking data from the foreground and applying it to the background during compositing. Another school of thought stated that Matchmoving is the process of inserting CGI elements into live action footage with correct position, scale, orientation and motion relative to the objects in the live action shot.

Although they all define it slightly different, the basic concept is the ability of the artist or the Matchmover to seamlessly integrate CG elements into live action footage.

2.11 Green/Blue Screen

Green or blue screen is a technique used by the visual effects industry to aid in adding CGI elements to live action footage or placing a subject or object in another environment other than the one it was shot in.

As shown in plate 2.7 and plate 2.8, the green screen technique was used to extend the scene by compositing CG building and adding more characters in there. The film from which the shot was taken is "*Snow White and the Huntsman*" directed by Rupert Sanders in 2012.

Plate 2. 7: A shot showing the Green screen background is as used on set during the live action shoot (Copyright Universal Pictures)

Plate 2. 8: A shot showing CGI elements added to the live footage shot after the Green screen background (as seen in plate 2.7) was digitally removed. (Copyright Universal Pictures)

Vfxbro.com (2012) defines the technique as compositing two or more images together and a color range is made transparent (usually the green or blue) to reveal another image beneath it.

Steve (2008) said Green or Blue screening is taking a shot of the subject against a solid background of either blue or green such that the computer with the aid of software can easily detect it from the background to composite in on another image or footage. The transparent part is also called a matte. The process is “pulling” a matte that is to make the blue or green background transparent as shown in Plate 2.9

The technique is also called Chroma keying by some artists.

Plate 2. 9: Sample image of characters on blue and green screen and a matte ready for compositing

2.12 Computer Generated Image(s)

The elements that are added to the picture can come from practically any source today. We might be adding an actor or a model from a piece of film or videotape; or, perhaps the mission is to add a spaceship or dinosaur that was created entirely in a computer, so it is referred to as a Computer-Generated Image (CGI). CGI is/are basically images created using computers. This terminology is now being used by professionals in the industry in reference to 3D (three dimensional) images created on a computer.

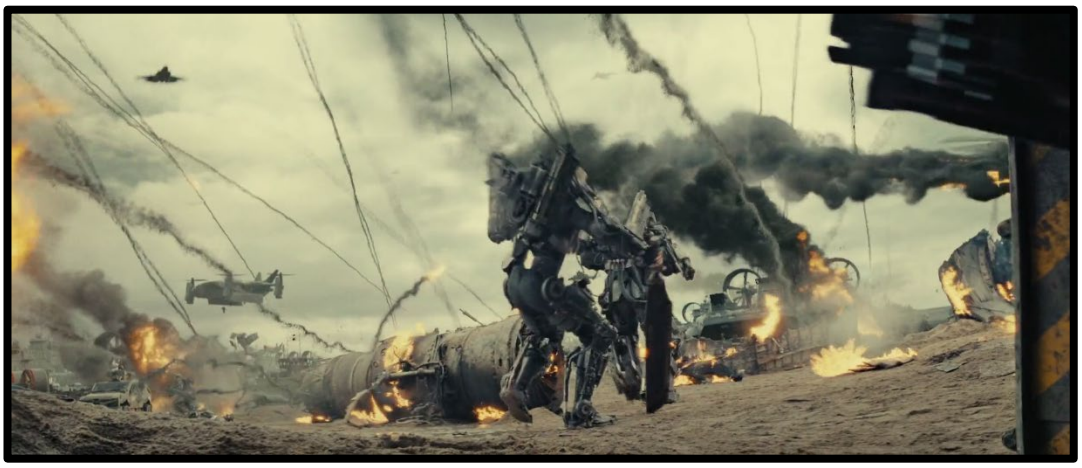

Plate 2.10 A shot from the film 'Edge of Tomorrow' showing composited images. (Copyright Warner Bros. Pictures)

In the early stages used for titles and end credits mainly. Filmmakers began to really utilize the full potential of computers in the form of visual effects. This phenomenon gained huge roots with George Lucas establishing Industrial Light and Magic, one of the power houses in visual effects creation to date.

2.13 3D Modeling (Creating CGI)

3D modeling is a visual representation of any three-dimensional object or surface whether animate or inanimate through a 3D modeling software. The representation can be seen in the software in a three-dimensional space. The product that is seen in the software is called a 3D model. The 3D model can be displayed as a two-dimensional image through rendering or 3D rendering. (VFXbro.com, 2012).

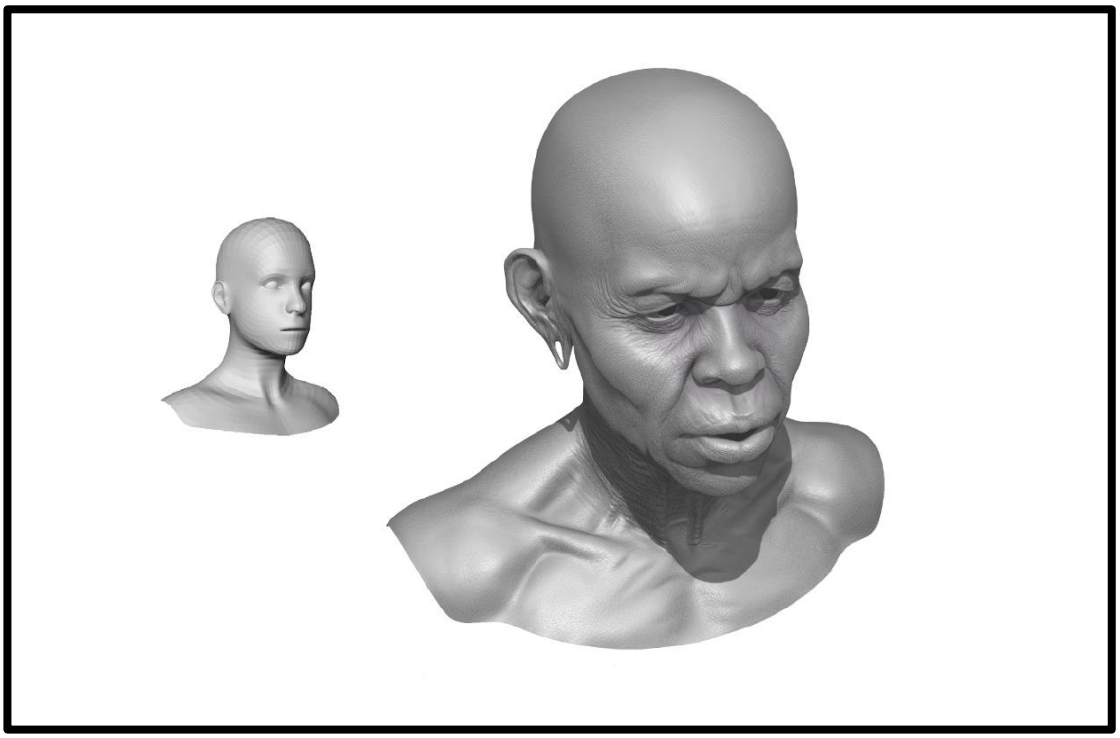

Plate 2. 11: Samples of 3D models (credit Digital Tutors)

2.14 Texturing

Texturing is when materials (materials are like the base color of a 3D mesh that allows the artist to see the mesh) and shaders are added to a 3D model to make it simulate real world objects. Texturing takes many forms it could be a simple two-dimensional artwork which is wrapped around the 3D model or a complex combination of shaders and two-dimensional artwork.

Gulati (2010) observed that this is the stage of production where shading materials are created and textures painted as per required in the scene. Again, textures in the form of maps are applied to surfaces and models according to the concept art and designs.

By default, all 3D models have a gray material or shader applied or assigned to them, although this differs from program to program. After the actual modeling process is completed then shaders are applied based on the concept art as already stated above. Texturing is rightly making the models seem to jump out of the scene in terms of reality. But rendering also plays an important role in the final output.

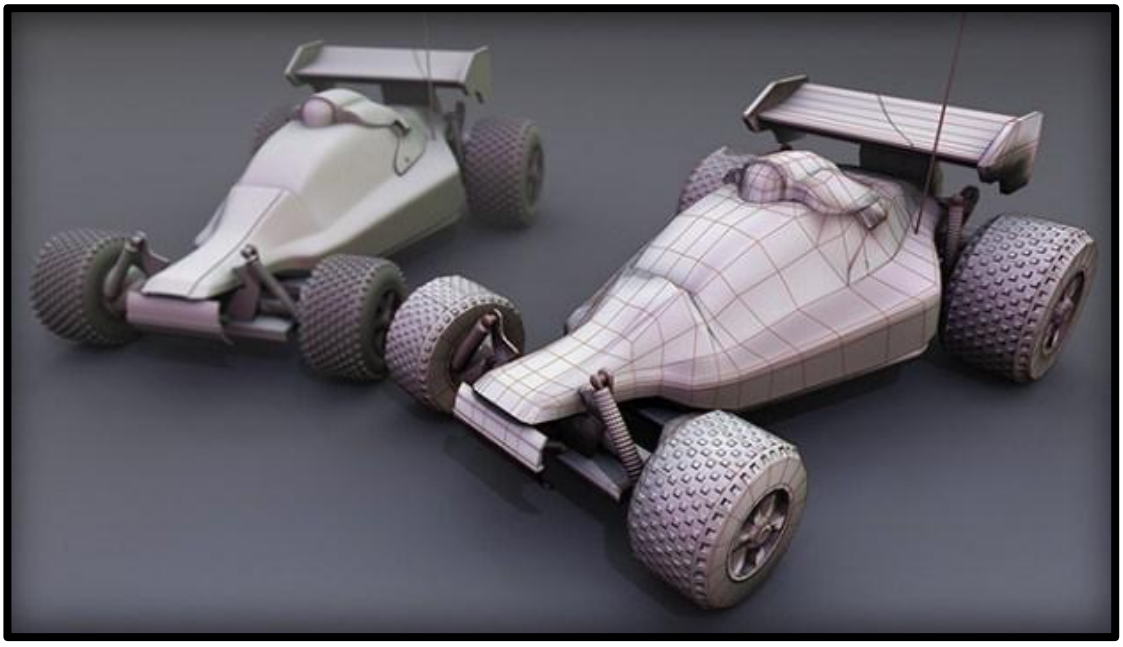

Plate 2. 12: Example of a 3D model without texture (Source: Digital Tutors)

Plate 2. 13: A textured 3D model (Source: Digital Tutors)

2.15 Animation

Animation in visual effects is one of the stages in post-production that makes all the CGI come alive. Carefully animated CGI is a beauty to watch on the screen and adds value to the production as well as offer the audiences memorable experiences.

It is the animator's job to make 3D models and characters come alive on the screen. It involves the step by step key framing of a character's walk sequence or the bits and pieces of an exploded car just to mention a few.

Plate 2. 14: A shot of a character from an animated short "The Chubb Chubbs" (Copyright Sony Imageworks)

Plate 2. 15: A scene from a visual effects explosion where the debris were animated

2.16 Integration

The integration of CGI and live action footage became a part of filmmaking as filmmakers seek to stretch their imagination beyond the norms of our world. The term for this integration is known as compositing in the post-production world. It has made it possible to create scenery that would either be too expensive to build or be humanly impossible to achieve.

CGI is rendered out from the 3D application or software into layers known as render passes. These passes are then composited in the compositing software. The layers are done such that the compositor can have control over each of the attributes of the 3D model such as reflection, color, shadows, occlusion and specular color.

This aids the compositor to easily adjust the attribute he or she wants without affecting the other attributes.

Plate 2. 16: A scene with CGI element (helicopter) integrated into a live action plate (copyright Lip Sync VFX)

2.17 The Visual Effects Pipeline

A pipeline in any production refers to the step by step process through which people undertake before the end product is realized. It differs from one production house to another. Although the pipeline differs there are areas common to all production houses.

According to Okun & Zwerman (2014), a visual effects pipeline is one in which shots are defined by the digitized live-action footage, and animation is integrated into said footage.

The Escape Studios, view the VFX pipeline as the process that makes Visual Effects in all its glory possible. It's the path that leads from the initial idea to the finished image. Matchmoving has become an integral part of the production pipeline. Escape Studios a leading school in the teaching of VFX made this known in their VFX pipeline image shown below.

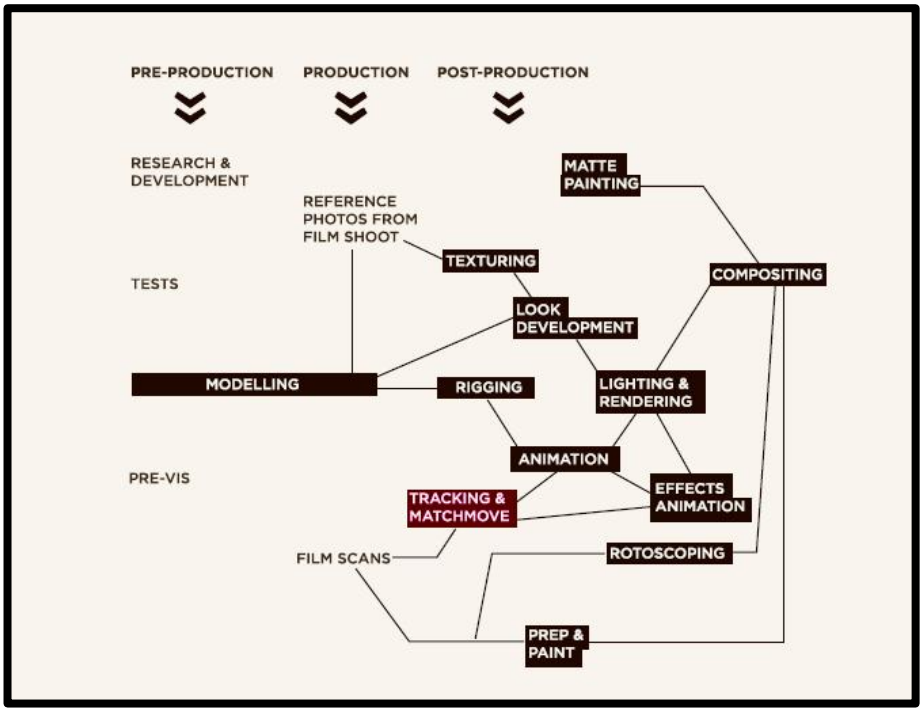

Fig 2.1 Production pipeline from Escape Studios, London(credit Escape studios)

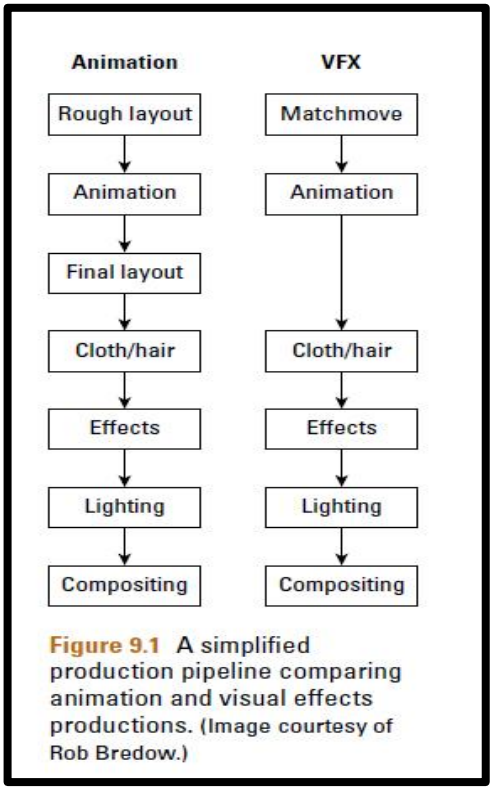

Figure 9.1 A simplified production pipeline comparing animation and visual effects productions. (Image courtesy of Rob Bredow.)

Fig 2.2 Simplified Production pipelines (credit VES Handbook of VFX edited by Jeff Okun and Susan Zwerman, 2010)

2.18 Trackers Markers

Tracking markers are artificial high contrast points usually placed in a scene by the VFX director or supervisor to facilitate Matchmoving. The markers can be handmade or downloaded from online resources and used for production. Some downloadable tracking markers are shown in Plate 2.8 below.

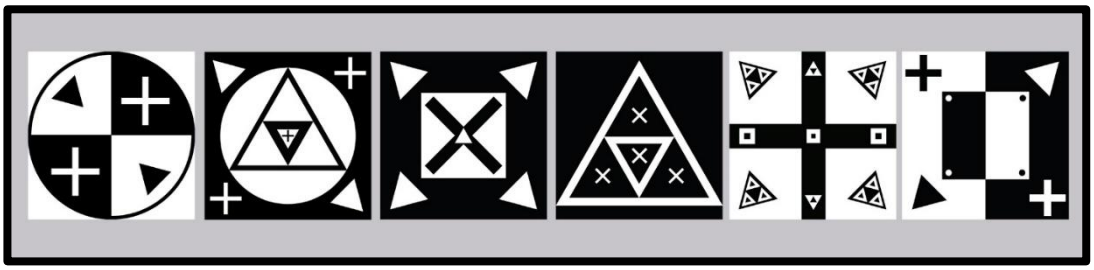

Plate 2. 19: Samples of printable tracking markers available for download online

Placing tracking markers in the scene is a requirement to aid tracking by either Matchmovers or Compositors in post-production. The markers are placed in the scene in a regular distance. This can help determine the scale of the scene especially where no other objects are in the scene (Dobbert, 2012).

2.19 Software

The evolution of technology has brought about new and improved ways of going about things. The film industry has not been left out of the technological innovations. New software and equipment are being developed to enhance storytelling.

There are a lot of software on the market specially tailored for Matchmoving. Some of them can perform other functions like stabilizing shaking footage and adding 3D objects to the scene to test the matchmove. Some 3D packages have tracking

solutions embedded in them but the professionals always recommend using standalone software.

Griggs (2016) stated that Matchmoving is constantly improving and there is the need for software to match creatively for the best output. These software aid the artist and filmmaker to achieve their goals. The top software for Matchmoving as of 2014 include the following:

1. SynthEyes
2. PFMatchit
3. Mocha Pro
4. Nuke
5. Adobe After Effects

Mike Griggs the author of the review stated “While it would be great if we could keep everything in one program like After Effects or Nuke. Dedicated tracking applications do offer focused workflows and optimizations in speed which can save hours if not days of time, especially if you are working on a lot of live action integration” (Griggs, 2016).

2.20 Hardware

All software operates on recommended hardware specifications for optimized outputs. The hardware required are usually expensive and difficult to come by without one breaking the bank for it.

Developers always think of this so the software are made with low end computers in mind where optimal performance could be achieved. The job can therefore be executed without spending much money. But with the minimum hardware, one

should take note that the time frame would be longer to complete each task than with the recommended hardware specified by the manufacturer.

The hardware specifications for Matchmoving (3D tracking) software in this case has been generalized for the many software packages available. The specifications are based on the windows platform (Operating System), which is predominantly used in Ghana for Film production. Firstly, the low-end specification.

- Intel or AMD "x86" processor with SSE2, such as a i7, i5, i3, Core/Core 2 Duo, Athlon 64, Opteron, or Pentium 4
- 2 GB RAM minimum
- 1024x768 or larger display, 32-bit color, with OpenGL support.
- 3-button mouse/trackball with middle scroll wheel/button. Use the "No middle-mouse button" preferences for tablets. While notebook trackpads operate with the software, they are not efficient or suitable for serious tracking work as they can be strenuous to use over long periods.

For the high-end specifications or the ideal hardware for easier workflows is as follows:

- Intel or AMD "x86" processor with SSE3, such as a i7, i5, Athlon 64,
- 16 GB RAM Minimum
- 1024x768 or larger display, 32-bit colour, with OpenGL support
- 3-button mouse with middle scroll wheel/button

2.21 Justification for the study

The ideology fuelling this research was to examine how visual effect artists in the major film producing areas integrate live action and computer-generated imagery.

The literature review outlined the production processes for visual effects and CGI creation. Visual effects production and presence in the Ghanaian film and video industry was also reviewed.

With the evolution of film throughout the ages, including Ghana, literature supports the use of visual effects in enhancing the stories (films) being created. There is the need for filmmakers to embrace the use of visual effects in filmmaking in order to increase the depth of their storytelling prowess as the literature stated.

The Matchmoving process which facilitates the easy integration of live action and CGI through the extraction of camera data from a live action shoot, and recreating it virtually (Hornung, 2010) also had some literature to emphasize on the importance of this technique.

Lastly, filmmakers are recommended to use optimized software and hardware to facilitate the Matchmoving process. The optimized hardware specifications were outlined in the review.

2.22 Chapter Conclusion

Literature pertaining to special or visual effects in Ghana was virtually non-existent. Just a handful of researchers have done any research in the areas of visual effects. The researchers concentrated on the narrative use of visual effects and not the processes used in creating and integrating the visual effects which is the main focus of this study. Therefore, there is the need for research into this area to bridge the knowledge gap. The next chapter talks about the research methodology implemented as well as the design in which the study is being conducted. Also, data collection, sampling and analysis were outlined to show the path, the researcher is using to achieve the set objectives.

CHAPTER THREE

METHODOLOGY

3.1 Overview

This chapter outlines and discusses the conceptual framework, philosophical assumptions as well as research design strategies that aid the study. The chapter also elaborates on the research methodologies, data collection instrumentation, and the data analysis procedures. The objectives of the study are identifying the challenges Ghanaian VFX artists face when integrating live action footages with CGI footage and find out how visual effect artists and movie makers integrate; and implement live action and computer-generated images together in a production. The various steps undertaken in the study are explained in detail.

3.2 Research Design

Research design is not only the plan for the study but should show adequate indications of the solution to the research question. Thus, the role of the research design "is to ensure that the evidence obtained enables us to answer the initial question as unambiguously as possible" (de Vaus, 2001). The research design used for this study was an exploratory case study and was investigated using qualitative methods. In case study research, the researcher discovers problems that exist in social sciences and how people handle these problems. According to Yin (2003) a case study design should be considered when the focus of the study is to answer "how" and "why" questions you cannot manipulate the behaviour of those involved in the study you want to cover contextual conditions because you believe they are appropriate to the phenomenon under study

3.3 Research Paradigm

All forms of research are underpinned by some philosophical supposition. A paradigm represents a viewpoint or assumption concerning how something work. Guba (1990) define a paradigm as "a basic set of beliefs that guide action". It is therefore required of the researcher to assume a worldview that offer a specific stance in conducting the research. This further assist to authenticate the elements of the study. It also directs the method or methods that are appropriate to gain understanding to a phenomenon and contribute to knowledge. Lincoln and Guba (1985) explains a research paradigm based on the ideas below:

The ontological question - What is the nature of reality? (This is concerned with the nature and form of reality). The epistemological question - What is the nature of the relationship between the knower and the known? (That is, concerning the philosophy of how we can know that reality). The methodological question - How we can come to know it? (Denoting the practice of how we come to know that reality). Based on the assumed philosophical assumptions, that is ontological, epistemological, axiological, rhetorical and methodological stances, the researcher is directed in the execution of the study (Creswell, 2007). The philosophical assumptions as they apply to this study are further discussed.

3.3.1 Ontological and Epistemological Perspectives of the study

The research process, as noted by Terre Blanche and Durrheim (1999), has three major scopes: namely, ontology, epistemology and methodology and this is seen a comprehensive organization of interconnected procedures and rational that directs the investigation of a research accordingly.

Ontological and epistemological stances in research are expressive of the viewpoint of an individual. This undoubtedly has much influence on what is believed to be the nature of reality. According to Wand and Weber (1993), Ontology is “a branch of philosophy concerned with articulating the nature and structure of the world”. It recognizes the nature of truth and what can be proven about it. Epistemology identifies the nature of the relationship between the researcher (the knower) and the research (the known). It refers to “the nature of human knowledge and understanding that can possibly be acquired through different types of inquiry and alternative methods of investigation" (Hirschheim, Klein, and Lyytinen, 1995). This study therefore assumes an interpretivist stance which is significant to understand what the knowledge is, and how it would be generated. It further seeks to understand the world as it is from subjective experiences of individuals.

3.3.2 Interpretivism

In research, the Interpretivist paradigm is associated with qualitative approaches and it emphasizes context during the analysis (Reeves and Hedberg, 2003). This worldview is considered when a study seeks to understand the world from the perspective of characters subjectively. As such, it makes use of methods that builds a subjective relationship with the research subjects, such as through observations as well as interviews. It must be noted that, the concern of interpretivist researchers is not the generation of a new theory, but to evaluate and improve upon interpretive theories.

Table 3.1: Characteristics of interpretivism as it applies in this study

Characteristics	Description
Aim of the Research	• To identify the challenges of integrating live action and computer-generated Imagery (CGI) and to understand the process of integration and its implementation in a production pipeline
Ontology	• Relativist Approach: Multiple truths exist. • The belief that truth or reality can be explored; the researcher is a part of knowledge construction together with participants. • There are varieties of social realities (in the context of film production) as a result of different individual experiences and understandings
Epistemology	• An understanding of the phenomenon is gained within the social context of real life or natural settings through interpretation • The researcher and research participants are connected in an interactive knowledge creation process
Methodology	• The use of a qualitative approach through interaction with participants • Data collection methods are through interviews and observations • The research is a product of the values of the researcher

Positivism or a positivist research approach is concerned with quantitative research. This involves methods to test a hypothesis in order to find truth in a phenomenon. The basis of positivism which is used to predict future occurrences is that truth is deemed to be objective. According to Henning, Van Rensburg and Smit, (2004) positivists seeks to uncover truth and present though empirical lenses. In a study where the research is seen to have an unchanging and stable reality, then a researcher would likely approach it as an objectivist, with a detached epistemological stance grounded on a conviction that an individual's perceptions and statements are entirely objective; that is, either true or false, or right or wrong. Such a belief is hinged on a view that knowledge is rigid, real and attainable through methodologies that relies on regulation and influence of reality (Thomas, 2010). Gephart (1999) notes that positivist researchers' experimental and quantitative methods have been augmented

in some cases with qualitative methods to gather comprehensive data outside of readily measured variables.

In this study, the researcher sought for the multiple or subjective experiences of the participants, the purpose of and techniques, processes and procedures in post-production for film and television and the researcher's understanding of these. The purpose is leveraging the strengths of interpretive qualitative methods to deliver explanations for such subjective reasonings and identify the relationships existing among complex facets of interactions among individuals. Without question, the nature of film attracts varied expertise such as directors, producers, cameramen, script-writers, costume designers, effects artists, set designers, editors, musicians and actors, just to mention a few; whose roles present real life or fiction in an experiential and emotional medium to an audience (Wood, 2001). Thus, we are offered from the onset, various participants who have differing viewpoint on the production down to subjective views, critiques and interpretations of audiences. The intention of the researcher is to centre attention on the nature of live action and computer-generated imagery as a subjective medium and the peculiar possibilities that it affords. The study will be conducted using a case study approach evaluating the integration of live action and CGI.

3.3 Library Research

Libraries are great sources of information when it comes to research. The researcher made much use of these available resources for the study. Libraries visited during the study included:

- The Prempeh II, Library, KNUST
- The Faculty of Art Library
- NAFTI Library

Another form of libraries included online repositories which are a collection of scholarly articles and writings. These include CG society article section (www.cgsociety.org), VFX Society white paper section and many others. The researcher obtained varied information pertaining to the research from these online repositories and libraries listed above. In all the researcher read 24 books, 14 articles and whitepapers, 13 online journals and, 42 blogs and websites. However, only the books, journals and articles that had undeviating information relating to the research were utilized. This aided in shaping the entire research to enable the researcher convey ideas and concepts easily.

3.4 Population for the Study

The visual effects section of the Ghanaian film industry is a relatively new field but the number of people working in that sector are many they include all crew members involved in production. Also, actors and actresses, viewers and anyone either directly or indirectly involved in VFX are part of the population. They all contribute a lot towards making VFX successful.

3.5 Accessible Population

Out of the intended population, the accessible population was professionals working in the areas of film and television productions in Accra and Kumasi. These professionals work in various aspects of VFX production. Some of the professionals were VFX directors, editors and artists. Their jobs varied from each other but they are all involved in the various stages of VFX production. The accessible population also had various educational levels and in VFX production, some learnt on the job and some on their own through online materials and videos. This made them ideal candidates for the study.

3.6 Sampling

Sampling is basically the selection of a unit of the entire population for a detail study. Sampling is often influenced by the population chosen by the researcher. Effective sampling techniques employed by the researcher tend to yield comprehensive outcomes. Owing to the fact that VFX artist do not have an association to determine the exact number in the film production the estimated number given by the artists was between 20 to 25 for those working actively in the industry. The number was obtained during the gathering of data for the research. For this study, the researcher chooses purposive sampling technique. The population selected was geared towards people with the pre-requisite skills needed for VFX production and Matchmoving processes.

The researcher made use of purposive, snowballing and criterion sampling techniques. 10 artists were sampled out of the population for the interviews. They were from the major film production areas in Ghana. Using the criterion sampling selection, selection was based on the artist having worked on films that had visual effects elements.

3.6.1 Purposive sampling

Purposive sampling is the sampling method employed by the researcher, when the researcher utilizes a sample that can give the needed data for the study Merriam (1998). Purposive sampling therefore yields maximum results from the selected sample.

Purposive sampling was used because the artists were all in the category of being directly involved with the creation and integration of CGI and live action. Also snowballing was used because the artists did not have an association where one could

gain access to them easily. They helped the researcher by giving the contacts of other people they knew in the field of VFX production.

3.6.2 Criterion sampling

Patton 2001, states that criterion sampling involves selecting in this case respondents that meet some predetermined criteria relevant to the area of study. The artists to be interviewed had to be people who have worked on films which employed the use of visual effects.

The professionals were selected because they were in the major film and television production regions of the nation namely the Greater Accra and Ashanti Regions. The difference being that films made in Ashanti Region had their targeted audience being the Akan speaking populace because of the language spoken in the films and those in Greater Accra being more geared towards the elite because the English language was predominantly spoken in these films and also affluence is depicted in them (Yamoah, 2014).

3.7 Types of Data

There are two main type of data gathered for this study, primary and secondary data. With the research being qualitative in nature, data obtained were mostly not numerical. The data came from the audio recordings, images and video recordings. Other forms included field notes and materials obtained from related literature.

Malhotra and Birks (2007) indicated that the researcher should have secondary data gathered and analyzed before primary data is gathered as this would aid the researcher in gathering relevant primary data. Secondary data is data obtained from related literature and books. Based on the literature review, the researcher was able to

structure a very good interview guide streamlined towards objectives of the study and also to gather primary data.

Primary data obtained by the researcher for the study came from audio recordings, field notes, video recordings and photographs. These were obtained from interviews and observations. The data was analyzed by the researcher and conclusions were drawn from them concerning the use of Matchmoving in integrating live action and CGI by VFX artists in the Ghanaian movie industry.

3.8 Data Collection Instruments

Data collection instruments are the various methods through which the researcher gathers data. There are a lot of them but the researcher employed two instruments namely interviews and observation.

Interviews were granted the visual effect (VFX) artists. Interview was used because the area of research was purely practical and the personal experiences of the artists were need to draw conclusions. The surest way is by allowing the respondents to talk about how they go about their work process hence the use of interview as a data collection instrument. Due to the vast areas in VFX production an interview guide was developed by the researcher to take the artists through a sequential line of questioning (see Appendix ‘A’ for Interview Guide). Also, the artists were sceptical about the interviews so most of them requested for the interview guide so as to enable them prepare for the interview. There were follow up questions and auxiliary questions based on the answers given during the interviews. These helped the researcher to gain thorough knowledge and data about the perceptions, ideologies and processes being used by the artists in the area of Matchmoving.

The researcher chose the participant observer role (Spradley, 1980) in observing the workflow of the artist in their natural environment (On-set during production and On the Bench during Post Production). The role of the participant observer adopted by the researcher for observation proved vital as the artist relaxed and divulged information easily when they saw the researcher as one of them. The researcher participated by means of helping them out in their setups for the shoots and also offering suggestions to undertake certain tasks but made sure these suggestions do not affect the core focus of the research thereby tarnishing the authenticity of the study. It is merely used as a catalyst in gaining the required information needed for research purposes.

3.9 Administration of Instruments

Interviews and observations were the instruments used for the study. The artists were interviewed to gain information about the challenges they face in the implementation of Matchmoving in their workflows. The researcher visited them in their working environment to conduct the interviews. Their level of education and understanding of the various processes in Matchmoving were also ascertained.

3.10 Data Collection Procedures

The selected Visual effects (VFX) artists were interviewed in their own office spaces as per their request. The interviews of the respondents centred mainly on their knowledge of Matchmoving as a trend in visual effects production and the challenges they face in the implementation of the technique. The interviews took place over a period of six (6) months between July and December 2013. The researcher made inquiries as to how Matchmoving affected their productions. When the opportunity

came for the researcher to accompany some of the artists on location, the researcher assessed the processes employed by the artists in the pre-production, production and post-production stages of the Matchmoving process. Their production pipeline was also compared with each other and notes were taken. Information concerning the educational background of the artists was also obtained during the interviews.

3.10.1 Audio Data Collection system

During the interview sessions with the artists, an audio recording device was used to record all that was being discussed. An informal conversation was used to set the tone of the interview. This allowed the artist to forget about the presence of the audio device and allowed the artists to freely respond to questions asked. Consent was sought for recording to be done before the interview day but was re-echoed on the day of the interview. The audio was recorded to allow for easy transcribing of the artist views for analysis.

3.10.2 Field Notes (Interview Observations)

The researcher made several observations during the interview sessions and whilst on set with the artists. These observations were noted down in a notebook. Comparison was made between the observations and the transcribed audio recordings to authenticate the views of the respondents.

3.11 Data Analysis

Data analysis is an important part of qualitative research and constitutes an essential stepping-stone towards data gathering and in relating the research findings to concepts (van den Hoonaard & van den Hoonard, 2008). In this study, thematic analysis was applied to generate themes from the data collected through interviews and observations.

3.11.1 Thematic Analysis

Thematic Analysis seeks to unearth patterns and relationships focusing on the participant's point of view (Schutt, 2009). It involves coding of raw data, categorization of codes and generating of themes to provide clear and descriptive patterns embedded within the collected data. According to Miles and Huberman (1994), "qualitative data, with their emphasis on people's lived experiences, are fundamentally well suited for locating the meanings people place on the events, processes, and structures of their lives and for connecting these meanings to the social world around them". The application of thematic analysis in this study sought to analyse data in a move to understand the phenomenon in its context.

3.11.2 Analysis of Interview Data

Braun and Clarke (2006) define thematic qualitative analysis as a method for "identifying, analysing, and reporting patterns (themes) within data. It minimally organises and describes your data set in (rich) detail"**.** Analysing data of the interviews required that the researcher transcribe the recorded audio into text format. This consisted of 10 individual interviews of various participants. The researcher transcribed the audio himself in order to familiarize with the data. The textual data was read thoroughly to gain a qualitative meaning into the perspective of the participants. Based on this, the researcher identifies 236 initial codes. Further analyses helped to categorize these codes by reduction into 48 categories and generated 3 themes and sub-themes for discussion. A theme "captures something important about the data in relation to the research question and represents some level of patterned response or meaning within the data set" (Braun and Clarke, 2006).

3.12 Chapter Conclusion

This chapter captured the paradigm in which the study is posited. It further explained the methodologies and procedures adopted in data gathering and analysis. It carried out the process of collecting data through a qualitative inquiry using interviews, and observations. The use of thematic analysis in identifying patterns would help to answer the questions posed in the study. The following chapter comments on the findings. Interpretations and discussions on the findings are provided.

CHAPTER FOUR

PRESENTATION OF FINDINGS AND DISCUSSION OF RESULTS

4.1 Overview

This chapter captures the presentation of data collected based on the analysis made. It also discusses the results of interpretation of the findings observed in relation to literature. In particular, the purpose of the thematic analysis was to identify patterns or themes that provides connections and capture meanings within the data.

This sought to answer the research questions for the study:

1. What challenges do Ghanaian VFX artists face when integrating live action footages with CGI footage?
2. How do Ghanaians and professional VFX artists integrate live action footages with CGI footages?
3. How do Ghanaian film directors implement Matchmoving in their production workflows?

4.2 Descriptive Analysis of Demographics

The table 4.1 presents the descriptive analysis of participants. The data covers the age range, gender, location and the roles each of the participant plays in the production of visual effects. Pseudonyms are used in place of the real names of interviewed participants.

Table 4.1 Descriptive analysis of the participants it includes the age range, gender, location and their roles.

No	Pseudonym	Age Range	Gender	Location	Role
1	Participant 1	25-30	Male	Accra	VFX Artist
2	Participant 2	30-35	Male	Accra	VFX Director, VFX Artist
3	Participant 3	25-30	Male	Kumasi	VFX Supervisor
4	Participant 4	35-40	Male	Accra	VFX Artist
5	Participant 5	25-30	Male	Kumasi	VFX Artist
6	Participant 6	20-25	Male	Kumasi	VFX Artist
7	Participant 7	25-30	Male	Accra	VFX Director, VFX Supervisor, VFX Artist
8	Participant 8	20-25	Male	Kumasi	VFX Artist
9	Participant 9	30-35	Male	Accra	VFX Artist
10	Participant 10	20-25	Male	Accra	VFX Supervisor, VFX Artist

4.3 Findings of the Study

The findings from the analysed data is presented in this section. This was obtained from methods of qualitative data analysis of interviews and observations, using thematic analysis. It draws attention to the views of participants collected through individual interviews with VFX Artists in Ghana. The aim of the study was to identify the challenges of integrating CGI with live action footages and to understand the implementation of Matchmoving techniques in production workflow in the Ghanaian movie industry. As such, the responses from participants generated through thematic analysis, some insights to this phenomenon. The analysis of interviews generated about 236 codes. These initial codes were based on the responses from the interviews of 10 VFX Artists, Directors and Supervisors. They ranged from issues of challenges, production processes, workflow roles and experiences of the participants. These codes were further categorized and refined to offer in 48 keywords. From this number, the researcher further refined them to have

3 major themes (Figure 4.1) with subthemes presented below: These themes are discussed in light of the research questions for the study.

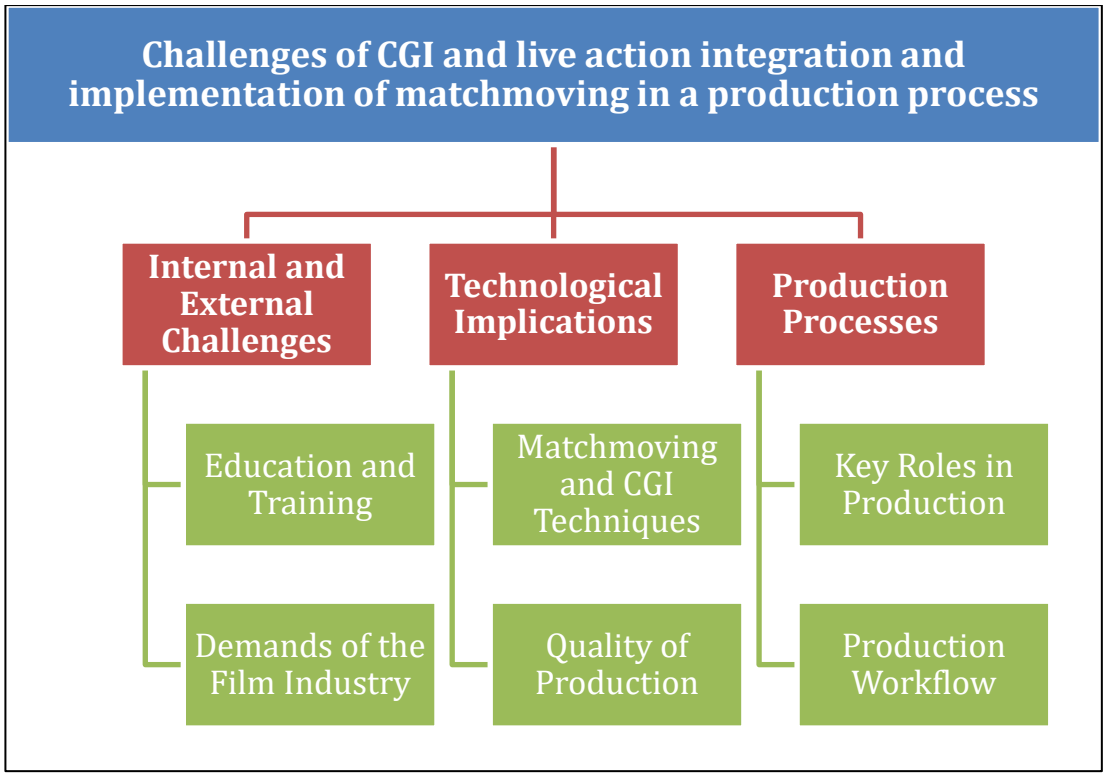

Figure 4.1 Description of Themes and subthemes generated through thematic analysis of collected data

4.4 Discussions of Results

This section presents a discussion of the results as they relate to the research questions and themes with the intent to provide an interpretation to the views of participants as well as to meet the objectives set out for the study. The study sought to identify the challenges of integrating CGI with live action footages and to understand the implementation of Matchmoving techniques in production workflow in the Ghanaian movie industry.

4.4.1 Research Question 1: What challenges do Ghanaian VFX artists face when integrating live action footages with CGI footage?

To identify the challenges Ghanaian VFX artists face when integrating live action with CGI footages, the responses from participants hinged around **Internal and External Challenges** as a major theme. It was deduced that, VFX Artists and Director both alluded to the fact that they had several challenges when it comes to integrating live action and CGI footages in productions. In this theme, two sub themes would be discussed, namely **Education and Training**; and **Demands of the Film Industry.** These are expanded below.

- **Education and Training**

  Education and training in CGI and VFX Integration is key if the process in any film production can be successful. The field of CGI and VFX integration requires complex set of skills and a high level of creativity and brilliance to achieve the needed results. In Ghana, VFX and CGI integration is an area of study which is not being addressed in our formal educational institutions. Training has been limited to apprenticeship and self-tuition. Data gathered indicate that most of the practitioners were self-taught but had some form of training in computer graphics and visual art related courses. Even for one respondent with a master's degree in VFX (obtained outside Ghana), he was also a self-taught practitioner prior to his formal training. Some of the respondents relied largely on online resources such as tutorials and eBooks as a guide to their practice. There have been some changes though with film schools like NAFTI now offering some level of training in the area of VFX creation and integration.

All participants highly stressed on the need for VFX Artists should receive formal training in the area of CGI and VFX. This should include practicing and prospective persons. According to a respondent, “some academic backing is very necessary for all artists. You experience somethings that you will not get when self-taught, for example working with people and teamwork” (5th Respondent, Field Notes). Although experiential learning is good according to a respondent, the participants were of the view that formal training was the best. This would imply that there is a deficit in training institutions, in terms of access to adequate teaching and learning facilities and the curriculum being adopted. Production companies would also have to make strides to train their crews. Hence, there is the need for strong collaborations between Academia and Industry.

- **Demands of the Film Industry**

  To a large extent, it was noted that the lack of adequate funding has impeded the growth as well as smooth operations of the industry. With regards to limited investment (funding) for productions by investors, whether local or global, participants agreed that this has been hampering the budding field of Visual Effects in film production processes in Ghana. It was noted that, not many people are willing to invest in movie production or acknowledge the role and prospects of VFX in film in order to invest into equipment, expertise and training of personnel.

  Participants also noted how the film industry is depending on VFX and CGI elements in various production. This has placed a high demand on VFX

artists and content in Ghana. VFX artists are expected to double in other time bound productions, going through strenuous tasks in order to present complete projects to their directors. This may imply that most VFX artists may not have the opportunity to be involved with Pre-production and production of the projects they are involved in. Hence there is the likelihood of VFX related productions suffering from some setbacks.

Time constraints for film productions has to some extent forced VFX artists to rush through integration processes, leading to low quality in the finished works. Participants noted how they are required to submit productions as soon as they receive raw footages. Complacency on the part of some VFX artists in producing substandard and ill prepared concepts for productions continue to affect the industry. Such artists are noted to be "money conscious" and are always after quick money and not quality of their productions.

A lack of expertise and specialization in key processes also were observed to beset the film industry. The challenge of renumeration for such limited expertise in movie making, cinematography and storytelling were also enumerated. In addition, participants noted that, most VFX artists are self-taught. This challenge is likely to affect the quality and output of local film productions. Since it requires a lot of time to be exposed to the techniques of Visual Effects, artists may not be able to master the field so as to create VFX to enhance productions. Pragmatic efforts would not always yield the best results for the industry.

4.4.2 Research Question 2: How do Ghanaians and professional VFX artists integrate live action footages with CGI footages?

Participants responded to questions raised on the integration of CGI and live action footages. This was needed to understand how these artists engage in the integration processes and how it affects film productions. The theme of **Technological Implications** was expanded to explain the discussions below. The subtheme associated are **Matchmoving and CGI Techniques** and **Quality of Production.**

- **Matchmoving and CGI Techniques**

  Understanding and implementing Matchmoving techniques appears to be critical for VFX Artists in any film production. It was observed that, VFX artists work with various CGI elements such as 2-D stills and animated sequences, 3-D characters and environment models and animation, Fluid simulations, set extensions and other simple compositing. Some artists also made use of stock elements acquired from internet sources. These were need in Music videos, movies, adverts, and news productions in both locked and moving camera shots. Participants alluded to the fact that 3D tracking (Matchmoving) has had a huge impact in the film industry, both foreign and local. Respondents were full of praise for Matchmoving technique in visual effects production accepting its capabilities to help create near realistic integrations in CGI and live action footage. However, the issue of VFX artist not involved with production of live action footages was noted by all participants. The difficulty involved in such an approach to production was noted and observed. Software that are used for Matchmoving techniques include Adobe After Effects, SynthEyes, Pixel farm's PF track, Mocha,

Autodesk Maya and Match Mover, Adobe Photoshop and Boujou. In addition, 3D applications that facilitate the creation of 3D models, animation and simulations are Autodesk Maya and 3D Studio Max, Maxon Cinema 4D, RealFlow and V-Ray for rendering. 2D stills were implemented using the Rotoscoping techniques or hand drawn.

- **Quality of Production**

  Issues on the quality of CGI and Live Action Footage Integration were observed to be significant factor in determining the outcome of a good production. Participants reiterated that local films in Ghana are gradually incorporating CGI and VFX to make their visuals much more interesting, communicating strongly the intended visual message and perhaps even memorable experiences to audiences. One issue that was strongly raised during interactions with participants was their inability to produce high quality CGI and live action footages integration. This was noted to affect the quality of the movie in general; that is the tone, the appeal and the overall experience of audiences. This in turn creates a weakness in the production. Respondents were asked to rate the current level of quality of VFX related productions in the industry from a scale of 0 to 10. With the 0 being the lowest and 10 being the highest. The average score from the ratings was 3.3 with the highest score being 5 and 0.5 being the least score. This average rating of 3.3 out of 10 may be due to the quality as compared to international standards in relation to VFX integrated into films. This suggests that, the quality of these integrations in local movie productions may not be meeting audience expectations.

Participants believe that when given the needed attention, they would be beneficial to the film industry and prospective VFX practitioners. Some also participants suggested that a strong knowledge and skill of software applications, the use of high-end production equipment and constant practice to would help them get acquainted with the production pipeline and produce high quality integrations.

4.4.3 Research Question 3: How do Ghanaian film directors implement Matchmoving in their production workflows?

The 3rd major theme of **Production Processes** would be discussed. To understand how directors, implement Matchmoving in productions, Participants responded to questions about production pipelines and procedures for creating and integrating CGI as well as challenges in postproduction as well as their knowledge of Matchmoving techniques. Subthemes to be discussed are **Key Roles in Production** and **Production Workflow.**

- **Key Roles in Production**

  The role of Visual Effects (VFX) Practitioners in production is pivotal and essential to the success of the entire video production process. Visual Effects Specialists are expected to make crucial production decisions about using the most effective and efficient execution technique to render and integrate Computer Generated Imagery (CGI). These decisions are crucial because of the need to produce believable imagery that may be extremely difficult to capture during the live action shoot. Respondents were therefore required to outline their specific roles in productions involving the use of Visual Effects.

Notable amongst the stated roles from respondents were VFX Director (supervisor) and Artists (2D, 3D, fluid simulators, animators, and general compositors). Fundamental to their duties are Matchmoving, 3D modelling, animation and compositing. The director overseas the shooting of relevant live action scenes to be taken to enable easy VFX integration. The supervisor's role during the post-production are to ensure that modelling, rendering, animation and integration of Computer-Generated Imagery (CGI) are executed with precision. The actual creation of the CGI is done by the VFX artists based on the specifications by the VFX director or supervisor. These significant positions in the production process places these respondents (VFX Directors, Supervisors and Artists) in shaping the nature and quality of the VFX rendered and integrated. It was however observed that these practitioners mostly play multiple roles in the execution of productions.

From pre-production through production to post-production, all respondents said they were involved in all the processes to ensure the completion of the entire project. This may be as a result of a conscious effort to avoid possible difficulties they may encounter in the post-production. Other relevant factors such as their enthusiasm, passion, creativity which could potentially be an influence on the role of respondents are not captured in the scope of this research.

- **Production Workflow**

  Production processes for CGI and VFX integration can be seen as a linear or iterative process. CGI creation and integration follows a production process referred to as Production Pipeline. It is the step by step procedure in which CGI is created and integrated with live action footage. These pipelines vary amongst production houses relative to the level of expertise because some production houses outsource certain aspects of the CGI and VFX integration. A typical sequence of the production pipeline for a production house may be: matchmove, animation, cloth and hair (for only characters that require rendering of cloth and hair), effects, lighting, compositing (integration) as per the respondents.

  Most of the respondents based on their production experiences mentioned varied production pipelines relative to the productions undertaken or their professional training background. For some respondents, they plan, shoot, track with Boujou tracking software, 3D modeling, compositing and final rendering. Others also adopt the production pipeline of storyboarding, planning the shoot, shooting, editing rough cuts, tracking of VFX scenes, integration of CGI, compositing and final exports of production. Other respondents said that they did not follow any definite production pipeline because of the unpredictable nature of productions and the challenges that come along at each stage of the pipeline process. However, when footages are obtained, they are edited, tracked, 3D elements are integrated and re-edited to achieve the final footage.

Software applications used also was relative to the type of project being undertaken. But prominent amongst them Boujou and SynthEyes which are primarily for Matchmoving. Furthermore, After Effects and Autodesk Maya were used by some practitioners because they had Matchmoving plugins embedded for CGI creation and integration.

On the preferred shot ideal for live action tracking, respondents cited locked and moving camera shots as their preference. This could be attributed to the easy syncing nature of locked and moving camera shots to enable CGI integration relative to the particular effect to be rendered in that scene.

On whether respondents, had ever worked on productions where they were not part of the live action shoot, they all acknowledged that they have at one time been presented with footage that had been shot already without their involvement but cited numerous challenges associated with such practice. They mentioned lack of control over the possible outcome of the rendering, poor quality and inappropriateness of footage for CGI integration which poses a challenge during post-production. One respondent however indicated that knowledge of the numerous possible difficulties arising from footages without his involvement makes him go on set during all productions to supervise the shooting process himself.

In all, the direct impact and future prospects of Matchmoving on the local industry cannot be understand. In such budding industry, some respondents were of the view that their role as VFX artists has made them more competitive amongst their fellow

artists since they are able to bring a little bit extra to the table apart from what the roles of other production crew. Matchmoving according to one respondent has made him an industry leader since he has worked on quite a sizeable number of movies in the Ashanti region using this technique.

4.5 Chapter Conclusion

This chapter presented and discussed the findings and results in the study. The method of analysis was discussed to explain the aim of the study. The researcher examined participants views on the challenges of integrating live action and CGI footages and techniques of Matchmoving in movie production. Results obtained were presented and discussed in view of the research questions posed in the study. To provide a clearer understanding to the questions posed, the themes and sub-themes that emerged were discussed. The concluding chapter provides the summary, conclusions and recommendations for the study.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary of the Study

The study was done to find out or investigate the use of Matchmoving technique in integrating live action and computer-generated images and also to identify the challenges of integrating CGI and Live action footages and its implementation in production processes. Also, factors that affected the integration of live action and CGI were sought out. The impact of these factors on the final output of visual effects scenes were understood through engaging with VFX artists and movie directors. The researcher also went on location with the participants to observe first-hand how they produce shots for visual effects.

To achieve the said objectives, the researcher selected a population of people working in the visual effects section of the film industry. The population was narrowed down to the visual effect artists, directors and supervisors who work directly with the creation and integration of computer-generated images and live action footage. The sampling method used was purposive and snowball techniques since the artists referred the researcher to other artist to aid the study. In all, ten (10) artists, directors and supervisors were chosen with five from Ashanti region and five from Greater Accra. The participants were interviewed on issues pertaining to challenges of compositing of CGI and live action. Their production procedures were also observed to find out how it affects the Matchmoving techniques and the overall production at large. An analysis of these views and observations were done in order

to further provide meaning to the dense data obtained. The outcome of discoveries was presented for discussed order to establish key concepts among the variables.

The study concludes by summarizing whole study. Recommendations presented were based on the findings that emerged in the study. This would seek to provide direction and possible solutions in terms of challenges of post-production techniques in the local movie industry.

5.3 Conclusions

Movies have become a source of entertainment and a medium of education to the Ghanaian populace and the world at large. The world has come to accept that most of our education is absorbed through the visuals that we see. The impression these visual effects have on the audience is amazing. They enable directors and script writers convey their ideas that are almost impossible to achieve to the viewers. High cost of production is cut down drastically by the use of these visual effects. It is therefore important that the creation and integration of these visual effects be done such that they resemble the actual real-life thing or reference to enable this be a reality, producers and directors need to make sure the visual effects director, and supervisor or artist is involved in the entire production right from pre-production through to post-production to achieve excellent results. Also, education of these artists needs to be upgraded in the education systems especially the curriculum of film and design schools.

Lastly, ample time should be allocated to the post-production section of the entire production to enable the artists come out with good results. All these will go a long way to boost the prestige of the movie industry on the international scene immensely and allow the artist to get some work from the international producers as well. It was

evident that the challenges of integrating CGI and live action footages in film production pose several challenges to all stakeholders involves. A lack of expertise, coupled with lack high-end equipment needed during production processes are and would continue to be setbacks if adequate funding or investments are not made into the industry. Current training institutions are not fully equipped to train and prepare learners to match industry standards in the local industries. Most artists in the industry rely heavily on self-taught approach; and pragmatic efforts to create CGI and Live Action footage integrations which is likely to result in a low-quality film production. There is a need to look critically into this industry to ensure it receive the needed support by all stakeholders considering the immense possibilities it can afford to the nation at large. Some recommendations are made with the hope that the film industry would be improved.

5.3 Recommendations

The following recommendations presented in light of the views of participants and observations made during the study:

- Planning of the visual effect scenes should be adequate right from the onset of production, it should not be a last-minute improvisation as this would improve the quality of output. Therefore, VFX directors, supervisors and artists should be involved right from the pre-production stage through production to the post-production stage.
- The Universities, Polytechnics and Film Schools should be including visual effects training to their curriculum. The programs should be well structured and tailored to the demands of the industry. In addition, the nature of the

artists' job does not allow enough free time to go back to full time classroom learning so institutions that teach visual effects can organize short courses, seminars and workshops that will suit the artists. These can be tailored to specific areas of the production pipeline like Matchmoving, 3D modeling, Compositing and others.

- The producers and directors should churn out storylines that are more practical to the current level of expertise in the industry. Some stories are just too impractical for the screen.
- Equipment should be acquired by producers and production houses if they are to output good VFX films. The high cost of equipment makes the artist cut corners because rendering takes forever and the producers want to start making their money back quickly. There is the need for strong investments to support production houses.
- Time frame for VFX production is usually limited. Artists sometimes get deadlines of three (3) days to produce VFX scenes that should take about three weeks of work to execute as per the level of expertise of the artists.

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APPENDIX

Interview Guide for Visual Effects Artists in the Industry

My name is Samuel Owusu Agyeman-Duah; I am a student of the department of Communication Design, Kwame Nkrumah University of Science and Technology. I am currently researching into some current trends in the visual effects industry in relation to the Ghanaian movie industry.

I ask for your help in this research as a professional in this area of study. All information supplied will be treated as extremely confidential and will only be used for research purposes only.

Please kindly note that audio recordings may be taken during the interview for data collection purposes only if the individual gives his or her consent.

Thank you for your time and co-operation.

Interview Questions

1. What is your role in Visual Effects (VFX) production?
2. Do you use Computer Generated Imagery (CGI) in your VFX production?
3. What type of CGI do you create in production?
4. Have you ever worked on a production involving CGI where you were not included in the live action shoot?
5. What kind of live action shots do you work with that require 3D tracking?
6. What software do you use for 3D tracking?
7. What type of production pipeline do you use in your workplace?

a. That is, what is the procedure for creation and integrating CGI in your VFX productions?

8. Are there any difficulties you encounter during post production in the areas of CGI creation and integration?
9. Do you have any idea about Matchmoving?
    a. What is the relevance of Matchmoving in film production in the Ghanaian setting?
    b. Do you have a special name for Matchmoving in-house?

10. What role does Matchmoving play in your VFX production?
11. How does 3D tracking affect your productions?
12. Have you had any formal training in the areas of CGI creation and integration?
13. Would you recommend professionals in your area to have some sort of training?
14. What is your involvement in VFX production as pertaining to pre-production, production and post-production?
15. Are there any specific tips and tricks you would like to share with people who are new to 3D tracking and visual effects?
16. Using a scale of 1 to 10 how do you rate the current CGI being implemented in the film industry.
17. What do you think are the challenges in the creation and integration of CGI in the Ghanaian film industry?
18. How do you see the future of CGI integration in the film industry?