

The Role Of Modern Technology In The Development Of Stop Motion Puppet

Mahmoud Attya Almahdi Hussein¹, Mohammad Mustafa Salem Al Smadi²

¹Assistant Professor, Graphic Department, Faculty of Fine Arts, Helwan University, Egypt

Email: mahmoudatya_2009@yahoo.com

²Lecturer, Graphic Design Department, Faculty of Architecture & Design, Al-Ahliyya Amman University, H. K. of Jordan, msmadi@ammanu.edu.jo

Abstract:

This paper investigates the importance of modern technology in the development of puppetry. It is an endeavor to show the role of modern technology in reshaping the traditional art of puppetry. Moreover, this study aims to find solutions to some of the difficulties that traditional artists face in building dolls and models, whether for decoration or accompanying doll purposes. The researcher highlights the role of using modern technology in the field of digital printing of 3D object. For this purpose, the researcher conducts a practical experiment, describes it with pictures and provides detailed explanation. The findings reveal that the modern digital technology plays an important role in the development of stop motion puppet, and it provides solutions for traditional artists to overcome the difficulties they face in building dolls and models. Moreover, this study highlights the role that modern digital technology can play in the development of digital printing of 3D object.

Keywords: modern digital technology, stop motion puppet, 3D printing, puppetry, traditional artists.

Introduction

Puppetry is one of the oldest forms of art. It appeared as an independent work of art on the ancient Greek and Roman theaters. It started in the streets of the ancient Greece and its purpose was to entertain the public. Then, it was developed and performances were held on the stage of the ancient Egypt. Since the year 1700 BC, or even earlier, puppetry has been an expressive form of art. This is evident in the forms of dolls, available today in the East Berlin State Museum, which dates back to 1700 BC. Moreover, dolls made of wood were found in Egypt and it is believed that such dolls were made between 2500 and 3000 BC.

This type of art was also practiced in the Middle Ages. In Europe, for instance, a type of doll moving by pulling the strings and dating back to 1170 AD was discovered. It is known as the "Garden of Pleasure" painting. The doll is in the form of two boys holding two dolls of two knights doing fencing.

According to Shadbolt (2013), stop-motion is an animation technique involving the physical process of rearranging miniatures frame-by frame, which considers scale, perspective, construction materials, sets and character performance.

The art of moving puppets is one of the most important means of visual communication in which artistic values and creativity are reflected on the one hand and technological progress on the other hand. Moreover, animation films have had a strong impact on modern societies in all political and social aspects and behaviors of society, especially in the early stages of life. Undoubtedly, digital technology has also positively affected the production of two- and three-dimensional animation films, as well as puppet films. It has entered the fields of graphic design, illustration, film and television animation, game design, multimedia design, industrial modeling design, architectural design, advertising design, photography, personal CG creation and other visual design fields (Tao and Zhuo, 2020). Moreover, it has facilitated all stages of film production, from design to characters, production and visual effects. According to the timeline of stop-motion animation history explained by Priebe (2011), it is likely implied that Laika studio was the first stop-motion animation company that successfully used 3D printing technology in their pipeline to produce *Coraline* (2009). In this digital era, the ability of 3D printing technology to translate a design or model that only virtually exists over real physical objects is able to change the way how people manufacture objects (Yekti, 2017). It is believed that “*Madame Tutli-Putli*” is the first stop motion animation completed by Chris Lavis and Maciek Szczerbowski in 2007. Commenting on the success of *Madame Tutli-Putli*”, Pallan (2015) states that one of the most impressive is the use of digital technology in the stop motion animation for the first time to synthesize live-eye video onto the eyes of the puppet, making the character's performance more vivid than the previous stop motion animation.

Some large-scale stop motion animations

have already begun to use the method of film production. In some post-production special effects, digital technology and special film color correction equipment have been used (Gabriel & Essa, 2001). One can create richer and more powerful scenes according to the imagination of the script or the director (Ken, 2011). This technical development has changed the direction of this form of art, especially in the construction of the doll and the total transformation that occurred in the way of implementing and building the doll and the use of modern methods of software and modern devices such as three-dimensional printers which is the main focus of this research.

Research Objectives:

This research is an endeavor to achieve the following objectives:

1. To highlight the role of modern digital technology in the development of stop motion puppet.
2. To find solutions to some of the difficulties that traditional artists face in building dolls and models.
3. To highlight the role of using modern technology in the field of digital printing of 3D object.

Research Questions:

Through the researcher's practical experiment, the present research seeks to answer the following questions:

1. What is the role of modern digital technology in the development of stop motion puppet?
2. What solutions can modern digital technology provide for traditional artists to overcome the difficulties they face in building dolls and models?
3. What is the role of using modern technology in the field of digital

printing of 3D object?

Hypotheses:

It is assumed that:

4. The modern digital technology plays an important role in the development of stop motion puppet.
5. The modern digital technology

Research Methodology:

The research depends on the descriptive analytical method to describe and analyze several models of films implemented with stop motion technology. It also depends on the applied approach, as the researcher reviews a self-experience in the field of building dolls implemented by 3D printing and three-dimensional programs in the process of animation.

Research Terms and Materials:

1. Marionet: Dolls move by ropes.
2. Muppet: A term referring to the Jim Hanson style dolls.
3. Stop motion; It is a technique in the intermittent photography of a doll that moves slightly, then takes a cadre for it, then the motor returns to move the doll, and the filming resumes, and this process is repeated until the end of the shot to obtain a productive movement through the stopped movement.
4. Cell animation: Animation produced by drawing switches and interlocks.
5. Armature: A metal skeleton consisting of manually moving joints for all parts of the body and connecting the different parts of the body to reach a gradual movement that is captured by the stopped movement.
6. Latex: It is a natural material extracted from the bark of trees. It is a liquid substance that is poured into molds to be formed and then left to dry, giving the shape of the mold.

provides solutions for traditional artists to overcome the difficulties they face in building dolls and models.

6. The modern digital technology plays an important role in the development of digital printing of 3D object.

It contains the property of rubber and can be colored to give a suitable shape according to the design. It is known by its commercial name as "Al-Kula Al-Bayda."

7. Latex Foam; A foamy sponge that contains latex, which is prepared in certain proportions and poured into closed molds of gypsum in the shape of a doll. After drying, we get a flexible doll used in the manufacture of doll films.

8. Cold Foam; A foamy spongy material that is similar to latex foam, except that it is prepared on cold and is also used as a molding material for dolls.

9. Foam gelatin; A natural gelatinous liquid substance prepared in a certain way to obtain a soft, rubbery substance that is mostly used in make-up and can be used to cover dolls after they dry.

Data Collection:

For collecting the data of the present research, the researcher relies on the Internet, educational videos, documentaries, books and personal practical experiment.

Stop motion puppet film making: An overview

Stop motion puppet film making is one of the industries that depend on two main axes; the creative axis, which depends on the artistic sense and the ability to be creative and transfer the idea from the artist to the tangible world, and the technical axis that depends on

scientific development that serves the arts and improve their performance.

In general, this industry has developed in the last two decades, as it has not witnessed since the pioneer (Willis Obrien) who is best known for his immortal characters such as the

giant gorilla in the movie series King Kong, (See Figure 1) and other characters of his immortal works. Today, this industry has witnessed a significant change. One of the reasons for this development is the technological development which positively influenced this art and ensured its continuity.



Figure 1: Director Willis Obrien - United States - A shot from the movie King Kong

Since the advent of the three-dimensional graphics in the early nineties of the last century, great developments in this field have been achieved. The credit goes back to one of the pioneers of this world, Steven Spielberg, who was an international director. He is best known

for his famous movie Dinosaur Park - Jurassic Park which appeared in 1992 (See Figure 2). This movie marked the first attempt made in the history of live cinema that superhero characters were implemented using virtual three-dimensional technology instead of implementing them with dolls.

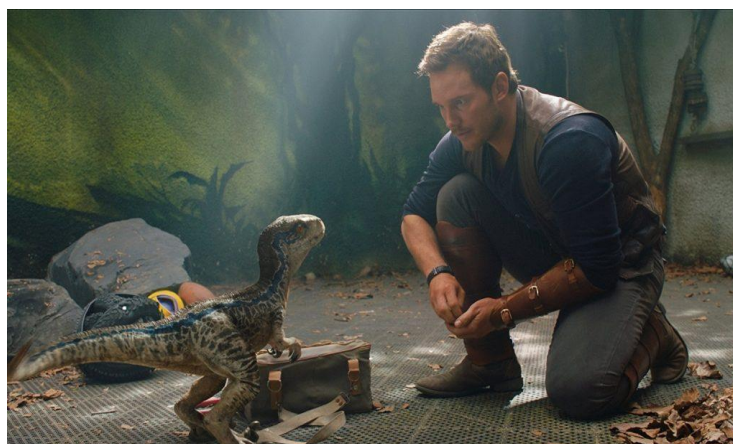


Figure 2: Steven Spielberg of the United States - A scene from the 1992 movie Jurassic Park

After that, dolls were replaced in live films by digital technology, and the technological progress almost completely devastated the world of dolls. But, there is always a glimmer of hope that prevents the fading of that ancient art that dates back to thousands of years and through which the world of dolls has been preserved. It has remained shining in the world of visual arts. Despite the emergence of digital technologies and virtual worlds, many puppeteers and production companies have responded to technology but to the extent that preserves originality. The following is a brief presentation of the most important works and films that were produced with the technique of puppets with discontinued photography puppet stop motion, which has been developed to build the doll and in line with modern technologies:

- **Shaun The sheep 2015 produced of Ard man**

Using 3D printing to build characters:

In this part of the research, the researcher has conducted a practical experiment on the use of 3D printing to build characters. The goal of this experiment is to employ 3D digital programs to draw characters and take them out of their

- **Movie A close shave produced of Ard man for the director Nick Park**
- **Chicken Escape movie produced by Ard man Directed by Nick Park**
- **A movie NIGHTMARE BEFORE CHRISTMAS directed by Tim Burton**
- **Film Corpse Bride Corpse Bride 2005 Tim Burton**
- **James and the Giant Peach 1996 Directed by Tim Burton.**
- **Movie Para Norman 2012**

Modern technologies have been taken advantage of in the above listed works. By listing them, the researcher has shed light on the influence of modern digital technology on films that were produced with the technique of puppets with discontinued photography puppet stop motion.

virtual world into the real world through the use of 3D printing.

The experiment is represented in building complete personalities that are capable of movement and costumes, as shown in Figure (3).



Figure 3: Character designed and implemented by the researcher

The virtual model is created by using the Zbrush three- dimensional software. The researcher uses this software to build personal AZ of J (See Figure (4), and shows the interface.



Figure 4: Program Tools; Zbrush Light box menu- Choosing the primitive objects

The next step is to begin the first phase of the entry in the lists of what is known as light box. It represents a storehouse of the primitive forms of what is known as primitive objects. All of

them are simple primitive geometric shapes that are formed as a soft, easy-to-form paste, and the ball shape was chosen to make the head because it is the closest geometric shape to it, as shown in Figure (5).

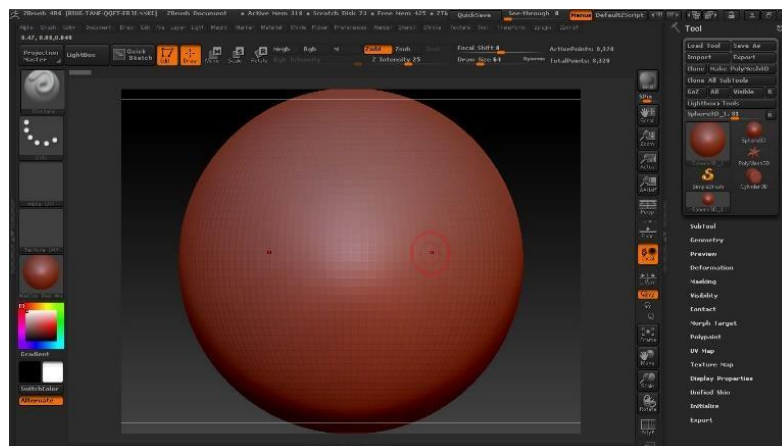


Figure 5: Choosing the ball to make the head shape

By using the symmetry feature, it becomes possible to make a symmetrical formation of two or more sides according to the desired

design and through the use of sculpting tools or what is known as the program with brushes from the list of tools, select the displacement

tool move (See Figure 6) through which the ball shape is formed to reach out to the shape

of the head of the personal figures as shown in Figure (7) and Figure (8).

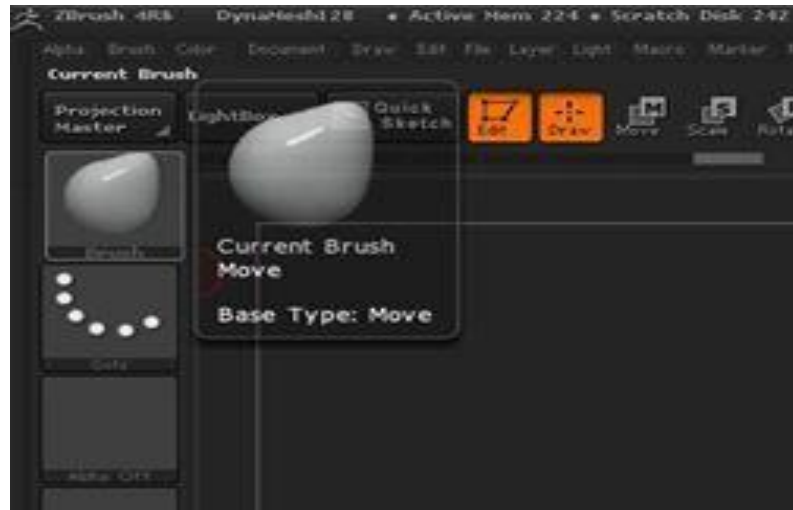


Figure 6: Select the move tool to shape the ball

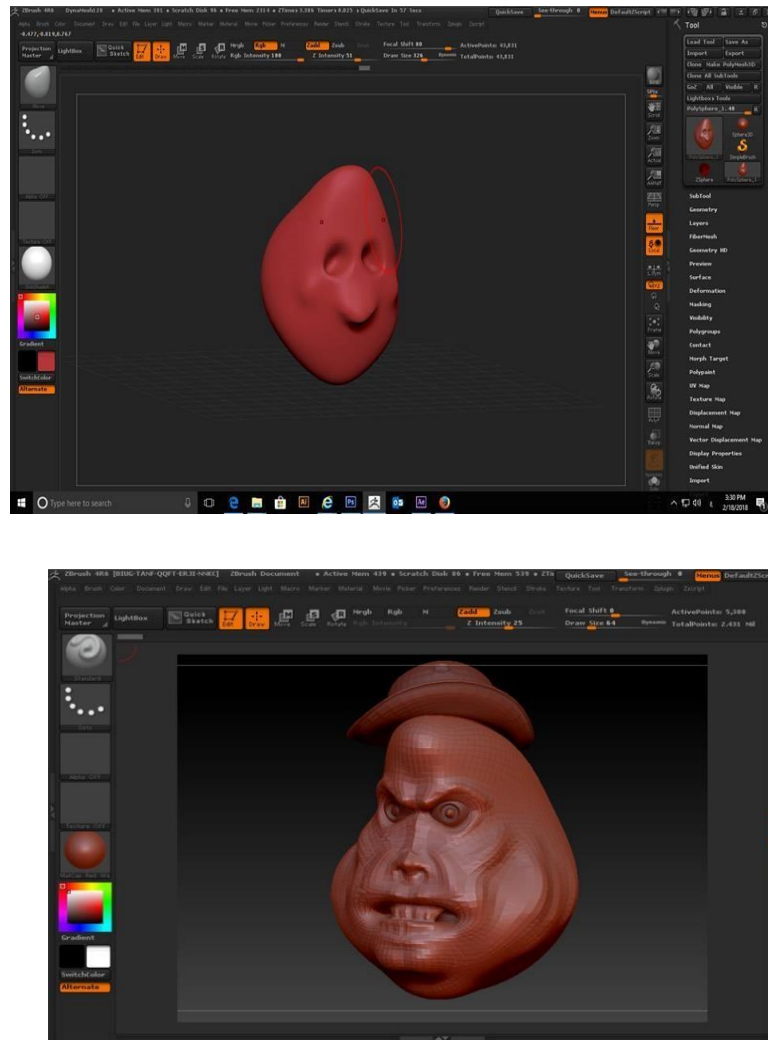


Figure 8: The head of the doll has been sculpted by default

For making the eyes, the researcher uses a brush known as insert sphere. Moreover, the hat is made using an insert cylinder. The body of the character is made by using another ball. Furthermore, the shape of the clothes and wrinkles are added to it (See Figure (9)). The body parts are made separately, and it is sufficient to make a part and then reverse it in

the program to give a right and a left. It is easy to make many positions of the palms and make the required gestures and signals or pick up things using the Poser Bowser program used for this work. Many modes are stored in the form of a serialized virtual library in preparation for printing, and all previous models are stored in a format of stl, which is a 3D printing format.

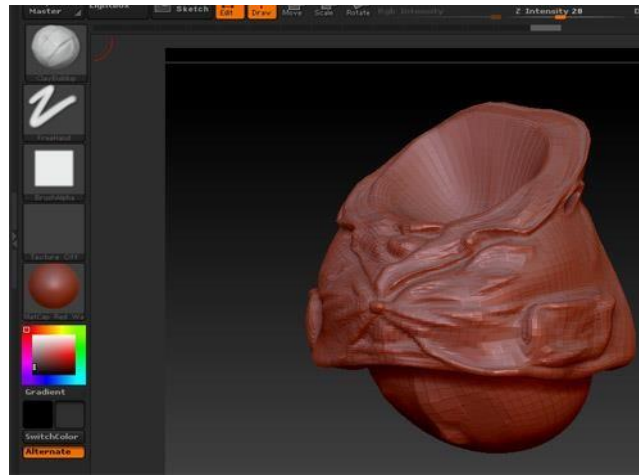


Figure 9: sculpt the doll's body by default

3D printing stage:

There are many ways to print holograms. The printing of the hologram requires knowledge of the types of printers, which are as follows:

* FFM – FDM Printers, as shown in Figure (10) which is a single-color plastic printing. The printing is made using plastic material.

FFM-FDM They are plastic coils that are compressed inside the machine and fused to exit from the head of the machine according to the axes and coordinates given by the computer. Moreover, the printing is in the form of layers less than a fraction of a millimeter, and a layer is printed on top of another until it finishes the required stereo.



Figure 10: 3D printers of the type FDM. FFM

* SLA Printers, as shown in Figure (11). Printing is done using a laser beam by focusing the laser beam on certain types of liquids with

photo-hardening property, so parts harden and remain parts according to the output commands from the computer.

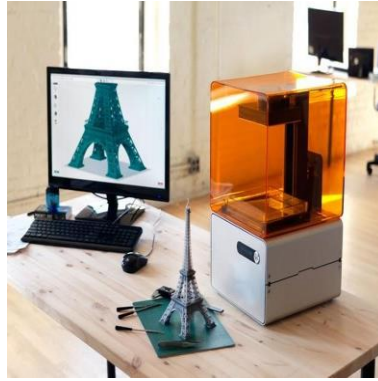


Figure 11: SLA 3D printers using a laser beam

* SLS Printers, as shown in Figure (12). This type of 3D printers works by shedding a laser beam to harden the powder.



Figure 12: SLS printers that works with hardening powder

* LOOM Printers, as shown in Figure (13). This type of printers is one of the highest, most efficient and most expensive machines ever and has multiple colors.

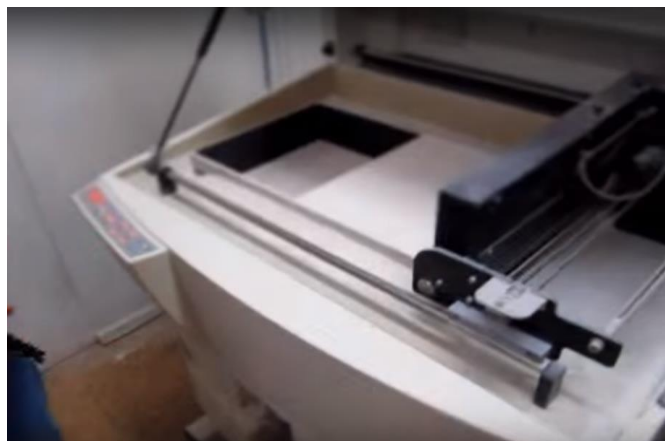


Figure 13: LOM multicolor printers

The researcher chose the first type of printers to print the character, each part separately, as shown in Figure (14).



Figure 14: Head print finished

Then the researcher assembles the parts which are then printed by joints, as will be clarified in the

The joints are done in an innovative and economical way. The researcher creates a type of arthropod that can move and stop in an

following joint working stage:

unprecedented way, as some parts of the bicycle were used; (cutting track) with metal balls of Bicycle chain (See Figure 15).



Figure 15: Innovative metal joints

Moreover, Ala birth is used for what is known as the structure of metal expensive, which is known as Armature (See Figure 16).



Figure 16: Traditional Metal Scissors (Armature)

Stage of Facial Expressions and Letters Lips- sync:

This stage is devoted for making facial expressions, whether they are azimuth expressions or letters of speech, which is known as Lip-sync. The researcher inserts the already designed face into Zbrush. Through the process of modifications known as Morph, a form for expressions with a logical sequence is applied. Each character and each expression is then individually stored in a form OF Obj. That is, it is an existing model of its condition, which is then printed as a realistic model. Thus, we have obtained a special library for

the face of the character. Here are the steps in detail:

- 1- After designing the character's face and building it, the animation tool (move) from the list of Brush is used. As mentioned before, it is a tool for moving and changing shapes.
- 2- By using the Layer list (See Figure (17)) the work of modulations is done. Then by using the Move tool (move) from the list Brush, a key is registered one after another to obtain a change by pressing the plus sign (+) (See Figure (18)).



Figure 17: Morphing from the Layer menu



Figure 18: of the addition key (+) a key is made

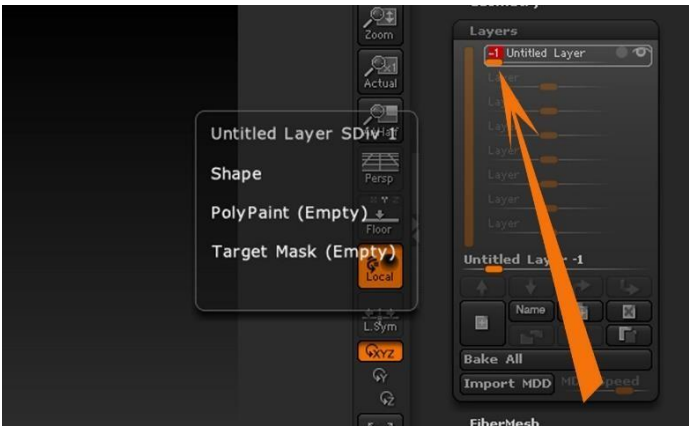


Figure 19: Using the Move tool, a movement key is created for an expression



Figure 21: Obtaining serial keys by moving the cursor



4- Record each key individually in the form of obj and use the list Zplugin. Then use the 3D print export (See Figure 22). Each key is exported as a virtual model with an extension (stl.), known for monochrome 3D printing, thus converting each default expression into a printable file in Format of stl.



Figure 22: Exporting each key as a 3D-printable hologram in STL format

Then, the printing is done according to the designation of the type of printing and the machine (See Figure 23). The stereotype is capable of being photographed and moved. Furthermore, an archive is made for the personality, its expressions, and the movements of the lips.

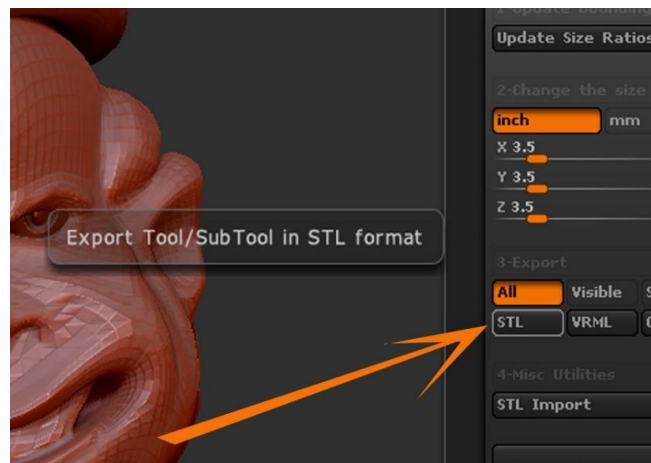


Figure 23: Printing virtual keys using 3D printing and making an archive of movements

5- After that, pieces of magnets are installed behind each piece of the printed parts, as well as in the head for easy installation and removal during filming (See Figure 24).



Figure 24: Magnets are installed in both the head and the face for easy installation and removal during filming

For hands, the character moves them, such as badges, gestures, or picking up objects. In this case the Poser program is used for making different positions of the hands and storing them in the form of virtual models of obj and then export them as stl to be ready for printing.

Accessories and decorations:

The characters are usually accompanied by

miniature figures for purposes (accessories), such as bags, hats, sticks, and other decorations and objects that are also designed on three-programs. Dimensions can be obtained ready-made from some private commercial sites on the Internet circulating in different formats in the form of virtual stereoscopic models. It is also printed, taking into account some of its relation to the character.

Character coloring:

The character is colored as required with

acrylic colors to be ready for photography after this stage (See Figure (25)).



Figure 25: the character in its final form after assembly and then coloring

Film shooting:

The process of filming after preparing the doll is the second part of the process of moving and filming the stopped dolls; known as the stop motion animation puppet. The following equipment and tools are required:

- Theater and decorations, known as Balatoh.
- Artificial lighting.
- At least one cinema, video or digital imaging unit.
- Dolls have been built before.
- Photography programs. There are various photography programs, some of which are simple, so that they are available on phones in a non-professional form.

The purpose is to display this successive series to get the shot as if it were taken with the live image feature and transform this bundle of photos into a snapshot. Shot Animation gives a useful sentence of the static images and moving the doll in front of the camera connected to the computer. The next step is to stop then capture then move then capture. Then the shot is taken. It is through shooting physical objects one by one, making use of the visual temporary principle of the human eye, and then making it be shown continuously (Min, 2019; Brierton, 2004)). This program gives an opportunity for the photographer to see the previous image with the current image in an interlaced way so that the photographer is able to match the previous image and adjust the position of the doll and perform a slight movement every time. This program also ensures the user the ability

to erase any unwanted image. After completing the filming process, the photographer gives commands to the program to collect the captured images to save them as a video file inside the computer's memory until they are combined scene with scene later in the montage programs to obtain the

complete movie. The doll is sometimes photographed on the green screen. This is to enable the director to put any virtual background later on the computer by using the After Effects program (See Figure 26).



Figure 26: shooting scene on the plateau and the green screen

Findings:

1. The art of moving puppets of all kinds is one of the oldest arts that have been practiced since the ancient times, and it has passed through many technical developments.
2. The art of puppetry moved from one generation to another and one culture to another until it reached us in its
4. By nature, man has shown his dissatisfaction with the traditional technique that has been used in puppet films and has made modifications to it using the gifts of science to go in line with the spirit of the age and protect this type of art from fading.
5. Willis O'Brien and Ray Harryhausen are the pioneers of the art of stopping

current form.

3. The art of puppetry has entered all fields and is one of the most important means of visual communication in which artistic values and technical progress are reflected, and it has influenced all aspects of life such as politics, society, education, teaching and learning.

motion and the inventors of the art of 3D animation in cinema, especially articulated puppets. By following their work and creative achievements, the history of this art in the modern era and its development can be traced.

6. Modern technology has not overshadowed the originality of that art. It has also retained its early

origins, and modern technology has added to traditional dolls keeping pace with our age and its developments.

7. Modern technology has entered the traditional art, thus increasing its accuracy, mastery, speed of performance, and saving raw materials.
8. To complete an articulated doll from the outside, it is implemented in two ways. The first is the molding method; the indirect method, which is preceded by the work of models, and the direct method which is the three-dimensional printing method.
9. The traditional puppet is a stand-alone art that does not enter into comparison with any other art, as is the case in virtual puppets in three-dimensional programs implemented by computer graphics, as both complement each other and the evidence for this is the movie Dinosaur Park, which used both techniques in the same movie, and sometimes even in one scene.

Recommendations:

1. Paying attention to the traditional arts, supporting them with modern technologies, working to expand the focus of learning these arts in art colleges and

Conclusion

This research has highlighted the role of modern digital technology in the development of stop motion puppet. It has shown the solutions that modern digital technology can provide for traditional artists to overcome the difficulties they face in building dolls and models. Moreover, the role of using modern technology in the field of digital printing of 3D object has been practically revealed through

institutes, working to preserve them from fading, and spreading the concept that every art has its value, whether it is traditional or contemporary.

2. Paying attention to the element of permanent and continuous innovation and not always standing by the technical postulates in circulation and working to develop the technical work on an ongoing basis.
3. The lack of raw materials sometimes cannot be a challenge in the implementation of a work of art. Rather, the artist must constantly innovate and constantly experiment to find alternatives without prejudice to the quality of the technology.
4. Experimentation is the only way to reach the goal. The puppet artist must be constantly experimenting to obtain successive creations.
5. Mold making is the casting of the plaster model of the doll on a mold made of gypsum or fiberglass, in which rubber or sponge materials are poured to obtain a movable doll.
6. Skeleton is the internal ruler of the doll, which consists of the different parts of the doll and contains the motors and joints.
7. Covering is a term that means getting the outward appearance of a doll's shape and has several ways to implement it.

the experiment conducted by the researcher. This practical experiment acts as strong evidence that the modern technology can be beneficial for the art of puppetry.

Reference:

1. Al Mahdy, M. (2018). The role of digital techniques in Stop Motion Puppet features. *Journal of construction, Arts and Humanities*, Issue 12 (2)), 404-423. Doi: 10.21608/0048969

2. Al-Hamdani, M., Al-Jadiri, A., Qandilji, A., Bani Hani, A. and Abu Zaina, F., (2006). *Research Methodology - The basics of scientific research*. 1st ed. Amman: Al Waraq For Publication & Distribution, pp.110-115.
3. Boorsma, B. (2020). *A New Digital Deal* (1st ed., pp. 59 - 64). Beirut: Arab Institute for Research & Publishing.
4. Brierton, T. (2004), *Stop-Motion Puppet sculpting. A manual of Foam Injection, Build-Up and Finishing Techniques*, Jefferson. North Carolina, and London: McFarland & Company Inc. Publishers, pp. 1-47.
5. Diabat, B., (2020). Analytical Study of the Jordanian Puppet Theatre. The Play "I Want to Have Fun, Joy, and Learn" as a Model. *The Jordanian Journal of Arts*, 13(3), p.339.
6. Gabriel J. Brostow, and Irfan Essa, (2001). "Image-based motion blur for stop motion animation", *SIGGRAPH01: The 28th Internaton Computer Graphics and Interactive Techniques*, Association for Computing Machinery, New York, 2001, p. 561-566, p. 561-566.
7. Jarwan, A., & Al-Qudah, M. (2013). *Studies in the humanities and social sciences*. Deanship Of Scientific Research / University of Jordan., 2, 411.
8. Ken A. Priebe (2011). "The advanced art of stop-motion animation", *Proceedings of Annual*, p. 242-244.
9. Min, Qi (2019). *The Development of Freeze Animation in the Era of Digital Media*, *Advances in Social Science, Education and Humanities Research*, volume 342, pp 134-137.
10. Pallant, Chris (2015). "Animated Landscapes: History, Form and Function", London, Bloomsbury Publishing, 2015, p. 159-177.
11. Priebe, K. A. (2011). *The advanced art of stop-motion animation*. Boston, MA: Cengage Learning.
12. Purves (2010) points out how animators manipulate physical things to be able to move in a real space, light, focus and depth become the main attractions of stop-motion animation.
13. Purves, B. (2010). *Stopmotion* (1st ed., p. 26). Singapore: AVA.
14. Rawlings, K. (2003). *Observations on the historical development of puppetry* (p.1).
15. Shadbolt, J. (2013). *Parallel synchronized randomness: stop-motion animation in live action feature films*. *Animation Studies Online Journal*, 8. Retrieved January 8, 2017 from <http://journal.animationstudies.org/>
16. Tao, Jiang and Gao Zhuo (2020). *Enlightenment of Digital Technology on Stop Motion Animation Teaching*, *The 15th International Conference on Computer Science & Education (ICCSE 2020)*, Carleton University, pp 733-736.
17. Yekti, B. (2017). *Study of Laika's facial expression mechanism system for stop-motion animation puppet through knock-down strategies on home-scaled 3D printer*. *New Trends and Issues Proceedings on Humanities and Social Sciences*. [Online]. 4(11), 185-193.