

2021

**DAVIT
BITSADZE**

IMPRESSÃO LENTICULAR
Autostereoscopic Prints for Advertising

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Projeto apresentada ao IADE - Faculdade de Design, Tecnologia e Comunicação da Universidade Europeia, para cumprimento dos requisitos necessários à obtenção do grau de Mestre em Design e Publicidade realizada sob a orientação científica do Prof. Doutor Filipe André Cordeiro de Figueiredo, Professor Auxiliar IADE - Faculdade de Design Tecnologia e Comunicação da Universidade Europeia.

To grandpa.

Agradecimentos

Thanks to Prof. Doutor Filipe Figueiredo for providing me with the precise material on a subject and for his support in bringing this project to its final form.

To my brother.

To the amazing staff of IADE Print-Lab.

Palavras-chave

Estereoscopia, Impressão lenticular, Ilusão ótica, Fotografia, 3D, Publicidade.

Resumo

O objetivo deste projeto é demonstrar o resultado da interação da modelagem 3D com a tecnologia de impressão lenticular, e encontrar um caminho para sua aplicação prática no universo da publicidade. O projeto explora os exemplos históricos de arte imersiva e sua utilização diversa na prática, aborda os fatores que influenciam a percepção humana de profundidade e também analisa vários métodos usados para produzir impressões estereoscópicas, a própria tecnologia lenticular e técnicas de publicidade. Através do método de design surge uma solução criativa e o trabalho final é realizado na forma física de um poster de impressão lenticular, que é uma proposta da sua utilização como estratégia de comunicação.

Keywords

Stereoscopy, Lenticular printing, Optical illusion, Photography, 3D, Advertising.

Abstract

The objective of this project is to demonstrate the result of mixing 3D modeling with lenticular printing technology, and find a way for its practical application in the world of advertising. The project explores historical examples of immersive art and its diverse use in practice. It addresses the factors that influence human depth perception and also explores various methods used to produce stereoscopic prints, lenticular technology itself, and advertising techniques. Through the design method, a creative solution emerges and the final work is carried out in the physical form of a lenticular poster, which is a proposition of its use as a communication strategy.

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1. INTRODUCTION

The idea for this project came from my involvement in 3D lenticular business, as I currently supply lenticular postcards and fridge magnets to several souvenir shops oriented on tourists in downtown Lisbon. During these years I gained quite substantial knowledge in this field through the reading of limited material available and through unlimited trial and error. Along with the fact that my passion for this technique is more than enough to encourage my enthusiasm, it is also commercial successfulness that pushes me, as I witness in first hand that some people don't hesitate to pay the triple price for stereoscopic aesthetiques of a postcard, that thematically is practically the same as its cheap paper counterpart.

As I stepped into an academy and got familiar with various advertising techniques, one of them being "branded content", the insight sparkled in my mind. There is a lot in favor to be encouraged for a quest to interconnect these two concepts, branded content and 3D lenticular printing technology for the sake of advertising. As branded content is a strategy that nowadays, as it has been evolved, mostly relies on art, and uses its technical qualities at its best. On the other side we have a stereoscopic glasses-free imaging technique, a certain optical illusion, the effect so desired to be achieved in their works by the great painters of the past.

My idea was to create a sample of 3D lenticular posters, to demonstrate its aesthetic qualities, but firstly, I dived a bit into the past, to enrich my knowledge and get a general view and understanding of my subject to determine the future approach.

It has been a long time since the time when public criers used to carry out commercial communications. The Industrial Revolution gave an advancement of a practically new era in human history, manufacturing using machine aid led to the creation and growth of new industries and the birth of a consumer culture. Humans got overwhelmed by the products and services available. The information distribution channels got overloaded, as everybody tries to tell their story. Modern consumers are well-informed prosumers, who are exposed to thousands of ads on a daily basis and they have become very selective on what to let inside their minds.

Marketers acknowledged that information does not have to be uniform and creativity and art can be employed in combination, to achieve desired goals. First of all to capture consumer attention, because there are millions trying to do the same. Communication has become an art itself, and an emphasis made on visual entertainment.

The public loves entertainment, starting from Greek theatres and Roman gladiator fights to the era when executions were carried out on the main town squares in front of thousands of spectators, to the 18th century panorama business and the film industry. Today, the entertaining approach keeps growing in the advertising business and there are companies leading marketing strategies based on entertainment.

The Invention of a printing press accelerated the process of information sharing, but sharing visual imagery still was a challenge, as Gutenberg's invention was oriented on letter printing. That does not mean that people were unable to print and share images, but the printing methods available at that time were time consuming and still not the perfect way to place the mirror image of the real world on a paper as it was done a few centuries later by photography. These first image printing techniques lacked detail and color, and were as far from today's photo-printing as middle ages art differs in comparison to the Renaissance, when fundamental principles of image creation were invented and employed at its best by the great masters of Renaissance.

There is no doubt that the Renaissance period contributed heavily to the science of image creation. We saw the foundation of the principles of perspective, that helped to shape correct proportions, and foreshortening became more realistic, as distant forms were calculated by mathematical precision. The effect of chiaroscuro was well understood and used to amplify drama or simply give a certain three-dimensional depth to an image, but anyway, representing depth in paintings was a struggle for artists and when they successfully learned the way of placing objects receding in depth according to the laws of perspective, something still was not right. As Leonardo da Vinci argues and comments that, some people are not able to understand the complexity of the human binocular vision (Vinci, L. da, 1632/1835).

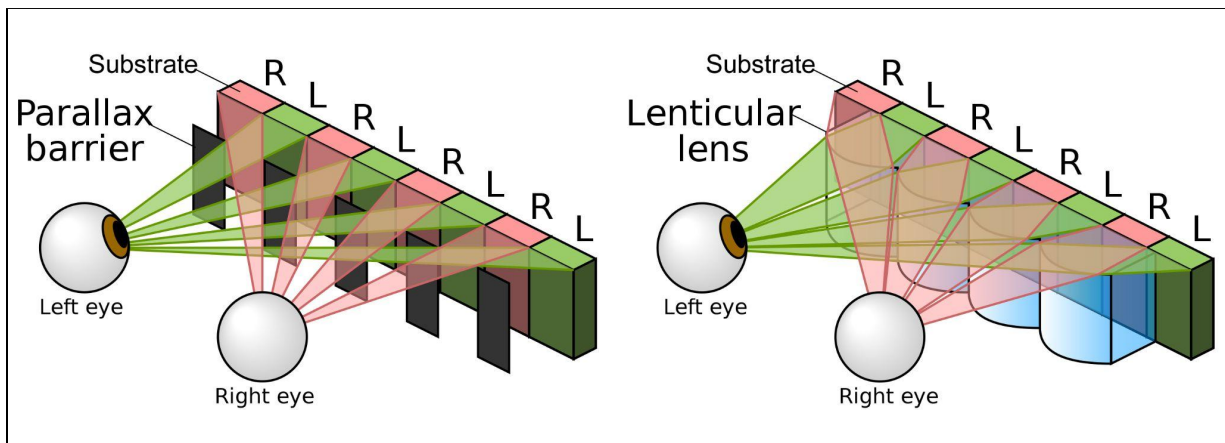
We see the world with two eyes and from different standpoints for each one, it is impossible to imitate this process of stereopsis on a canvas, but with the advancement in

technologies and scientific achievements of the 20th century, we are pretty able to represent printed images including three-dimensional information.

First trials with the stereoscope-free stereoscopic prints started in the form of a parallax barrier (see Figure 1), more than a century ago. A parallax barrier is a slit plate covering an interlaced stereo pair, where each eye sees only the relative strips from the pair, meaning that a person looking at this type of image is able to sense its depth, like in a stereoscope. Though, the process of picture taking and printing itself was very complicated as it was done in an analog manner. For decades technology saw no further advancements, until the end of World War II, which had a significant impact on industrial development, one of them being an invention of the plastic injection molding method. Also, the invention of new types of plastics led to the industrialization of lenticular lens printing technology that quickly spread throughout the globe.

Figure 1

Comparison of Parallax Barrier and Lenticular Lens Sheet Techniques



Note. Adapted from [Image link](#).

The Lenticular printing process that lets us print stereoscopic images, got reborn in the digital age, as digital image manipulation and computer-aided design (CAD) software gave us immense possibilities of a scene creation. We have been given the ability to recreate virtually any event from history, any object, or whatever comes to an artist's twisted mind. The photorealism achieved with the help of these software is remarkable (see Figure 2), and also the vast amount of freedom that they allow us to have in comparison to the analog process that

was the only option available to the pioneers of the three-dimensional imaging techniques, differ like a day and night.

Figure 2

3D Render of a Supermarine Spitfire Fighter Aircraft



Immersive art counts centuries of its existence, relatively primitive forms found in the before Christ era, turned into cutting edge technological wonders of nowadays. Some types of these technologies went to almost complete extinction, some gave way to a more sophisticated successor. One way or another, like in evolutionary theory we see “survival of the fittest,” ones that found their use in present times or transformed into something that is apt to gain public attention or commercial benefit, are still going strong.

As a theoretical basis for this project I went to explore the roots of immersive art, its implementation into mass culture, and its development stages. Strategically speaking, I chose to

deepen my knowledge about art and illusion, which I lately found quite useful. Optical tricks like forced perspective now I employ in my practice and it lets me extend some technical limits. I also found it valuable to understand psychological and physiological factors behind the human perception of depth. I saw this project as an opportunity to oblige myself to fill my long term memory with very interesting material on art, going through the inspiring texts of authors such as Ernst Gombrich (1977, 1982), Rudolf Arnheim (2011) or Arthur Shimamura (2013). These books helped me to improve my understanding of art, be it psychological, technical, or cultural aspects.

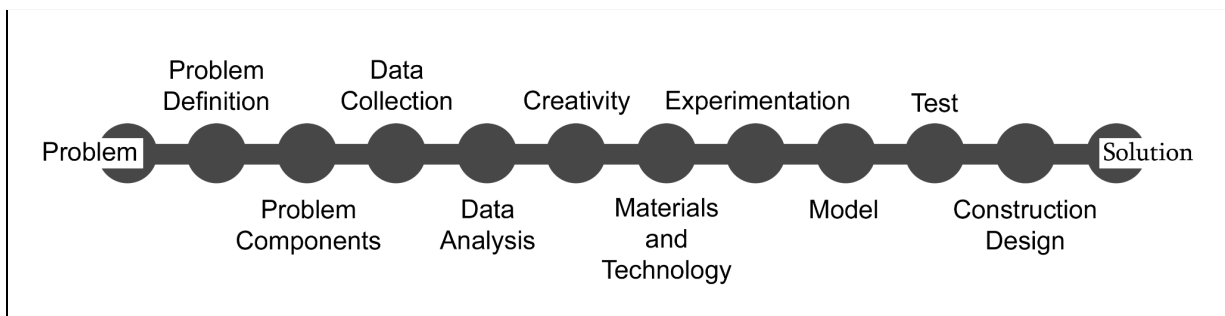
Regarding lenticular I should say that, there is a limited academic literature available on 3D lenticular imaging. One is Takanori Okoshi's *Three Dimensional Imaging Techniques* first published in 1976. The technical information in this book is mostly outdated as the techniques of analog picture making belong to the past. But I still could peck something valuable here and there. The second book is *Lenticular Imaging* by Yitzhak Weissman, which is a recent one, but I do not consider to be relevant for my project, as the mathematical calculations and formulas that author proposes for image construction can be done by the free software that circulates on the internet among the members of the 3D community. Also I should say that some scientific equations can not be considered as absolute, because there are some rules that you can brake, for example if you scientifically calculate maximum parallax of a distant element in your scene, that doesn't mean that you can not deviate, it all depends on your composition, you decide how much blur the scene element can take to stay visually comprehensible and satisfy your artistic objectives. If you want to mimic bokeh then the blur caused by large parallax can even be intentional, or if it is a smoke or a cloud you might not care much about its sharpness. Some suppliers also provide information about how much depth particular plastic can take, and this information is mostly provided by the community through their trials. On the other side, it is on online platforms that the most striking news and discussions are being taken by users around the world. That is why I preferred to look for more practical, non academic but relevant knowledge through community forums, than analyzing the formulas and author's peculiar scientific semantics.

1.1. Methodology

In regards to methodology, I found Bruno Munari's method much more suitable to complete my task. This method that I adopted for my research and visual project consists of 11 steps, starting from the definition of the problem leading to a possible solution, as shown in the figure below (Figure 3).

Figure 3

Design Method by Bruno Munari



The aim of this project was to link 3D modeling and lenticular printing technology, in order to be able to recreate historical events and present them in the form of 3D posters and then find a way for this work to be inserted into the universe of advertising. To realize this task I had to master some yet unknown to me aspects of 3D modeling, understand the science behind the lenticular printing technology, human perception of depth, dive into the history of optical illusions, stereoscopy, its variations, and specific advertising techniques. There was a need to be familiar with what has been done before, what has been the purpose and use of immersive art, lenticular technology and its known applications.

Analyzing all this helped me to make creative decisions about my project's shape and look. I chose suitable lenticular plastic for my samples intended size and format, made a decision about the printing method, and advanced with the production process. I did some virtual tests before, made a small-scale print to check if there was any defect present in the modeled scene and then printed the final sample.

2. DIVERSITY OF OPTICAL ILLUSIONS

2.1. Brief history of immersive art

The cave paintings found in various places across the world prove that even in their primitive stage of development the humans had an urge of creative expression. For whatever reason some people took a piece of charcoal in their hands and shaped the primitive but perceivable forms of their environment on a cave wall. Did they do it to satisfy their creative urge, or did it have some practical purpose? We can not tell for sure, but it is quite probable that primitive humans painted solely for aesthetics, as along the history we see extraordinary evolution of this creative gene.

The fresco of Villa dei Misteri is one of the surviving examples of immersive image strategies that dates back 60 Years B.C. The chamber was used for rituals by the cult of Dionysus. The painting almost entirely covers the spectators field of view and gives a sense of unification with these life-size human and mythical figures (see Figure 4).

Figure 4

Fresco From the *Sala di Grande Dipinto*, *Villa dei Misteri* (60 B.C.)



Note. [Image link](#)

This had to be a quite common practice in ancient Rome, as we meet another example in the Villa Livia at Prima Porta, dating almost the same time period. Another great example is Papal Palace at Avignon, France (see Figure 5). The place served as a study and living room for Pope Clement VI. The work is attributed to the papal painter Matteo Giovanetti and depicts a scene of hunting and fishing, which by that time was an activity reserved only for the higher hierarchies of society. Giovanetti's effort to create the illusion of depth is quite remarkable here, principally by placing human figures and trees in such a way that they appear distanced in space (Grau, 2003). But it is obvious that painting techniques are still kind in a primitive stage, the great team of Renaissance artists are yet to be born.

Figure 5

Chambre du Cerf (Room of the Deer), Papal Palace at Avignon (1343)

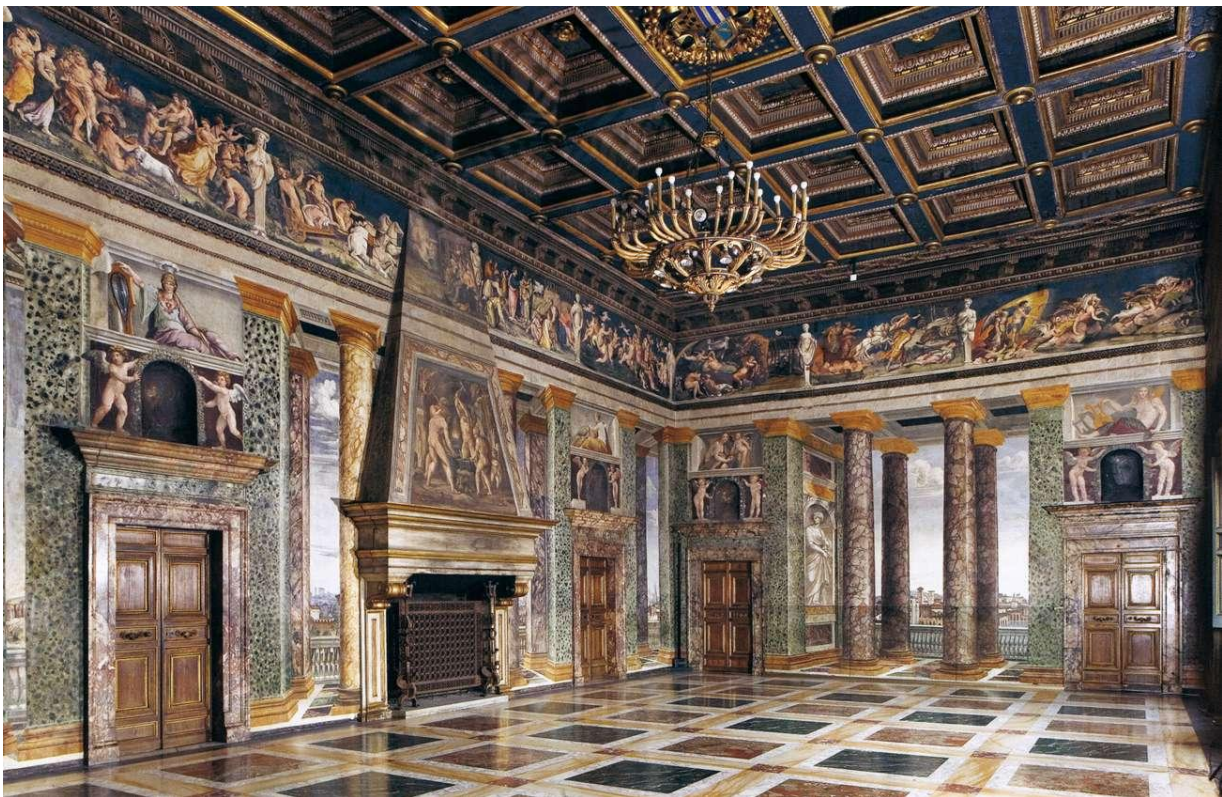


Note. [Image link](#)

As we look at this work (see Figure 6) at Villa Farnesina in Rome, which was commissioned by one of the wealthiest man of that time called Agostino Chigi and done by an architect and painter Baldassare Peruzzi in 1516-1518, we instantly sense the influence of new painting techniques developed in the era of Renaissance. Those pillars that lead to the balcony, actually are the wall paintings, but the rules of linear and aerial perspectives applied so meticulously, that according to Giorgio Vasari, when Titian first saw it, he refused to believe that it was a painting (Grau, 2003).

Figure 6

La Sala Delle Prospettive (Perspectives' Hall), Villa Farnesina (1516-1518)



Note. [Image link](#)

In 1787 Robert Barker patented the process of representing an image on a circular canvas with a correct perspective to a viewer located in its center, this technique later to be called panorama and the era of panorama enterprise began. The new type of illusion (see Figure

7) rapidly gained popularity and in a few years turned into a highly lucrative and successful business and a tool to be used for political ideology in a lot of cases. In the beginning they did panoramic city views, and by that time, as image circulation was very limited, people found it very amusing. Many panoramas traveled from town to town, with their service men and rotunda sets that could be built on a place. Prices for entry were quite expensive and it was mostly the middle class entertainment, but in the later period on some days businesses would lower the prices, so the working class could go too. As people showed keen interest in panoramas and liked this type of entertainment that could take them to distant places that they have never been and experience the sublime feeling created by the illusion, which sometimes was amplified by artificial sound effects, mist, wind and battle music, politicians showed their interest too.

Figure 7

The Jerusalem Panorama Crucifixion of Christ, at Altötting, Germany (1903)



Note. Created in 1903 it is still open to the public. [Image link](#)

The most notable panorama, the Battle of Sedan, 1883, that depicted this crucial episode of Franco-Prussian war, was commissioned by the German emperor Wilhelm I. It is a perfect example of the use of visual media for political purposes and propaganda, It was created

with the advisory and management of German painter Anton von Werner. The panorama itself did cost one million goldmarks, covered around 2000 m², and weighed several tons (Grau, 2003). It was painted by a dozen painters under von Werner's supervision, who meticulously planned the process, from the arrangement of reference photographs, surveying landscape, correct depiction of events, etc. According to Grau (2003), "The Battle of Sedan represents the sum total of contemporary knowledge in the field of the physiology of sense perception and of technical skill in the art of illusion. It is state-of-the-art illusionism and based on the findings of the great Berlin scientist Hermann von Helmholtz" (p. 105).

By the beginning of the 20th century, panorama business went into decline, because its static nature couldn't compete with a new invention of a moving film, that in a few decades would gain its sound, then color and would turn into a multi-million dollar industry itself.

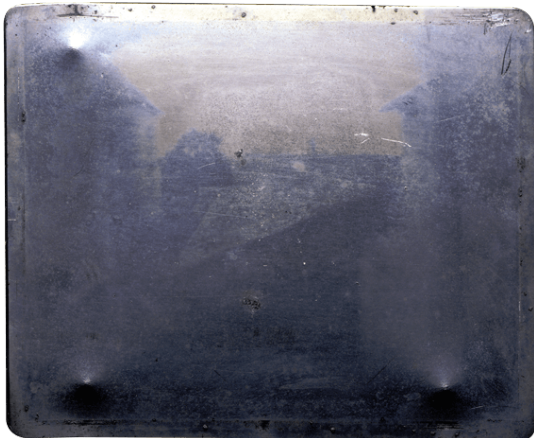
First commercial film projection took place at the Indian Saloon of Grand Cafe, in Paris, on 28th of December, 1895. Organized by its inventors, Lumière brothers. They named their invention Cinematograph and publicly demonstrated ten short films. One of which was a train arriving at a station that was filmed from such an angle that the oncoming train, gradually increasing in its size, scared the audience so much that they started to scream in panic, and by some accounts, they ran for cover fearing that the train would enter the room (Grau, 2003). The power of illusion created by this new medium did not go unnoticed for a stage magician named George Melies and he soon opened his own company that would combine art of illusion with pioneering filming techniques. He was the one who created the first sci-fi movies employing various special effects and even hand painted the film to give it a color. Cinematography developed quite fast, shaped by the innovative filming techniques from the early pioneers like: David Wark Griffith, Carl Theodore Dreyer, Sergei Eisenstein. We should mention that without the invention of photography, it would be impossible to have cinematography at our disposal, as both share the same base.

The story of photography itself starts in the French province, without complicated chemistry, but with enormous enthusiasm, and a bit of Bitumen of Judea which is a photosensitive naturally occurring material stubbornly used by Nicephore Niepce, who was able to register first photographic image on a medium yet in 1826 (see Figure 8). Obviously, it was

still far from the fine quality that his business partner Louis Daguerre achieved with a different mixture of chemicals, and photography was officially born in 1839 (see Figure 9). We have to mention that simultaneously an Englishman named Fox Talbot has been working on his research in this area and in 1841, announced his Calotypes. This completely different approach is practically the basic principle of today's film photography. Talbots created negatives, while Daguerre did expose directly on silver coated copper plates and the quality would surpass Calotypes. Both methods had their advantages and disadvantages: if Daguerre's method produced a better image quality, it was a direct exposure and each photograph would be unique, while Calotypes could be copied from negative.

Figure 8

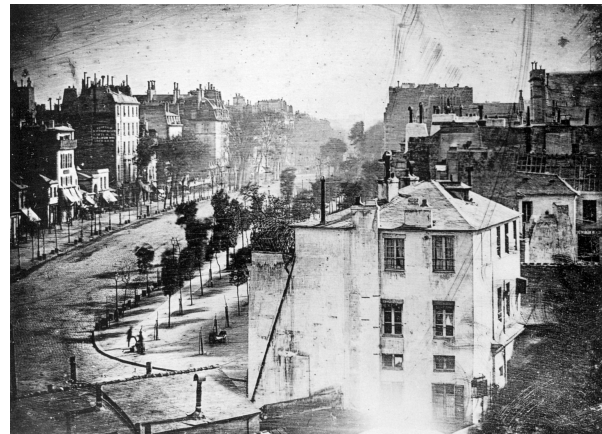
View From the Window at Le Gras
by Nicéphore Niepce (1826)



Note. [Image link](#)

Figure 9

Boulevard du Temple, Daguerreotype
by Louis Daguerre (1838)



Note. [Image link](#)

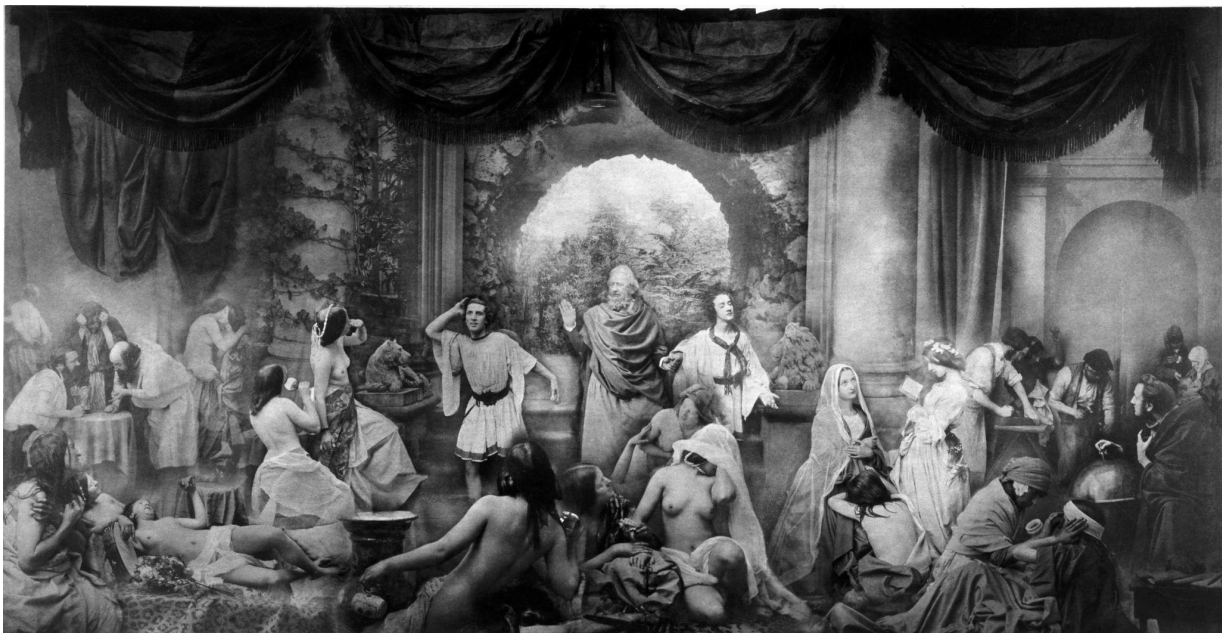
Photography saw its evolution rapidly, new methods of image development went along with the creation of new styles and market niches. The next year after the announcement of the invention of Photography at the Institut de France, there was already a portrait studio functioning in New York, and it kept spreading all over the world.

Besides conventional photography, as early as of 1850's, we already see photo montage, practiced by Oscar Gustav Rejlander, in his work - *Two Ways of Life* and Henry Peach Robinson's - *Fading Away*. Both works are the collection of combined negatives that shape the final picture.

Rejlander's work (see Figure 10) contains dozens of photographs joined together, depicting a scene of a father guiding his two sons and showing the virtues and sins of the life they might choose. This was not the only technique using more than one photograph for its purposes, there was also stereo photography, which soon would become a trend and would need a pair of images to be captured.

Figure 10

Two Ways of Life, Photomontage by Gustav Rejlander (1857)



Note. [Image link](#)

According to J. A. Norling (1953), the first stereoscopic drawing technique was developed by Giovanni Battista della Porta, around the year 1600. Few centuries later, Charles Wheatstone, who was a polymath and a pioneer in telecommunications, invented a stereoscope in 1838 (see Figure 11). A year later Photography was born and after several decades these two innovations found each other in the form of so popular stereoscopic pictures that were to be viewed through the developed versions of stereoscope by David Brewster (see Figure 12) which used prisms to direct the light to stereoscopic pairs and a bit later Oliver Wendell Holmes installed convex lenses that helped to amplify the depth effect by the property of lens

magnification. Such an improvement would allow to distance an image from an eye, where physiological cues for depth perception, like accommodation and convergence are diminished and image perception goes mostly through the psychological path.

Figure 11

*Wheatstone Stereoscope
at King's College London*



Note. [Image Link](#)

Figure 12

*Brewster Type Stereoscope, Made in
1860-70 by R and J Beck, London*



Note. [Image Link](#)

Stereoscopes became a middle class “must-have” gadget, thanks to the photographers that used to travel to distant places with their bulky equipment, sometimes exceeding several hundreds of kilos and bringing back exciting photographs. Stereoscopes would help a viewer to immerse into an image, and to a viewer back from the 19th century, no doubt, that it would bring a delight.

Anaglyph method was invented in France by Joseph D'almeida who had Portuguese origins, in the midst of the 19th century. It is a stereo technique, but is a different approach to stereoscopic pair projection using color filters. The photograph shot through the red filter stays visible through the cyan lens, while the cyan is visible through the red lens. So, each eye perceives its correspondent stereo pair. This activates our physiological mechanism of binocular vision and we sense a depth, but no rich colors, as filters take their bite.

Figure 13

Anaglyph Photograph of Dandelions

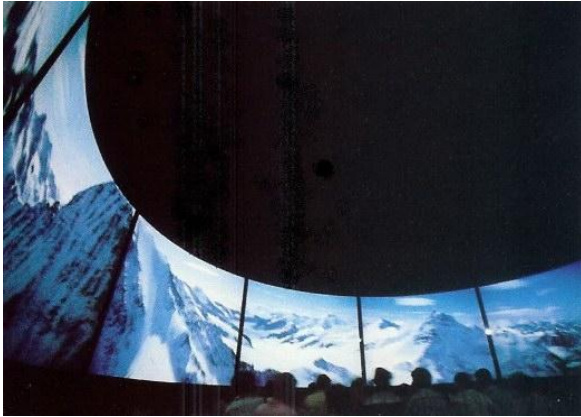


Note. Needs anaglyph glasses for 3D viewing. [Image Link](#)

At the 1900 Paris exposition Raoul Grimoin-Sanson demonstrated his Cineorama, that by the fault of a human miscalculation had to be shut down after few showings. Ten cinema projectors that would light up a panoramic canvas with the view of Paris from the air-balloon, produced so much heat that it became unbearable. Despite the fact that this technology didn't see its success, it can be considered as a great grandfather of the Imax Dome (see Figure 15) technology, and could be experienced in the Disneyland parks (see Figure 14) as they operated until recently, before an immersive technology became an easily accessible tool for masses and one can even experience virtual reality games at home, with head-mounted displays. The technology that was researched back in the 1960's, when Ivan Sutherland worked for the well known Bell Helicopter Company (see Figure 16).

Figure 14

Disney Circle-Vision 360° Movie Theatre



Note. [Image Link](#)

Figure 15

Imax Dome Movie Theatre



Note. [Image Link](#)

In the second part of the 20th century, several projects involving immersive techniques saw the daylight, such as: Imax Dome, Disney Circle-Vision, that was a modern working version of Grimoin-Sanson's Cineorama, there was also one in the political center of the Soviet Union, Russians would call it Kinopanorama.

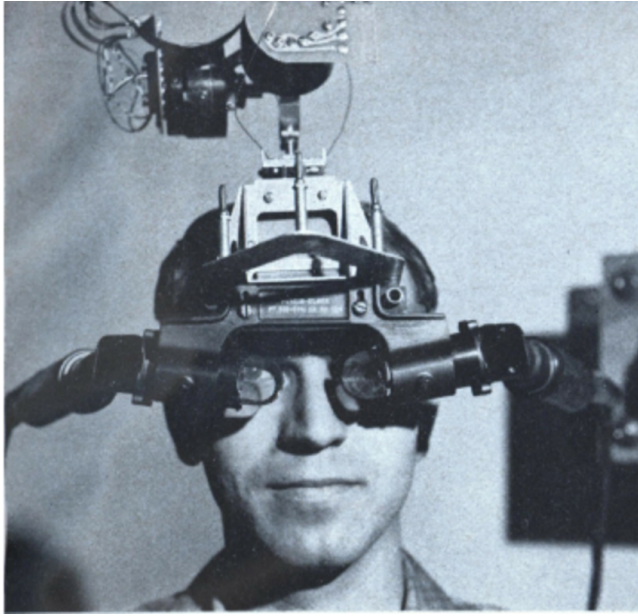
The Sensorama Simulator (see Figure 17) that was invented by the American cinematographer and inventor Morton Heilig, simulated a motorcycle ride through the streets of New-York and was equipped with a stereoscopic color display, sound, smell, wind and vibration emitter. One could find them in the amusement parks in California.

Figure 16

*Head-Mounted Display System
Invented by Ivan Sutherland*

Figure 17

*Sensorama Simulator
Invented by Morton Heilig*



Note. [Image Link](#)

The digital age gave a boost to the development of virtual realism. We have to mention Jaron Lanier, who coined the term “Virtual Reality”, American computer scientist that with his partner Thomas Zimmerman founded VPL research, that sold the first commercially available Virtual Reality Headsets.

Some artists also saw the opportunity to use digital technology and create immersive experiences. Pioneered by Char Davis with her famous *Osmose* of 1995, it was a highly debated work of art and the first major project synthesizing art and virtual realism. Grau describes its technical part as: “*Osmose* is an immersive interactive environment, involving head mounted display (HMD), 3-D computer graphics, and interactive sound, which can be explored synaesthetically” (Grau, 2003, p. 193).

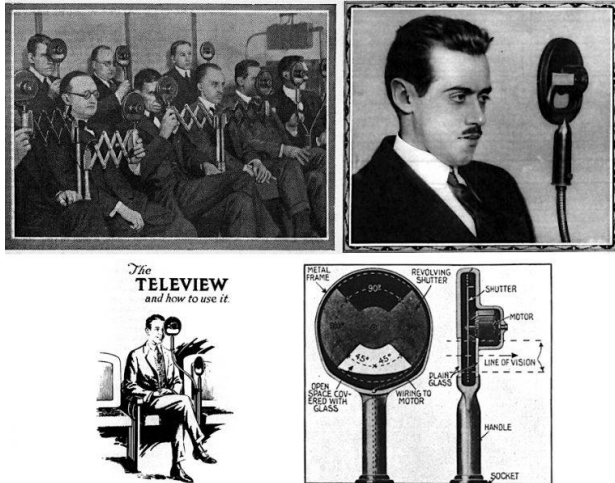
All these above mentioned examples except panorama and its variations such as Disney Circle-Vision or Imax Dome provided a viewer with stereoscopic imagery. Panoramas themselves were built in a way that they were evenly lit and the viewer that was kept in the dark circle in the middle of it, would see the canvas at a distance of beyond 10 meters. Enough for our binocular vision to be significantly diminished, as our eyes cross in a distance and the limit of convergence point falls somewhere around this length. Lack of stereoscopy on the

contrary worked to the benefit of panorama's success, as artists could place all the objects out of the range of our binocular reach, and the illusion that the viewer saw would match with what they could have seen in reality.

Inventor Laurens Hammond was behind the Televue project that introduced a 3D film in the United States in 1921. The effect was achieved by the synchronized optical device that was attached to every chair in the room and shutters would operate in a synchronic accordance with the film projector, switching in between left and right stereoscopic pairs (see Figure 18). 3D films at this stage had no success, as the equipment was quite expensive, production was difficult, a film had to be shot with two cameras, and Fred Waller's invention Cinerama overshadowed this concept, after its public presentation in the early 1950's (see Figure 19). Cinerama's success was a result of its immersive experience, as it would cover wider space than the typical movie screens that existed in that time period.

Figure 18

Televue 3D Movie Viewing System



Note. [Image Link](#)

Figure 19

Warner Hollywood Cinerama Movie Theatre



Note. [Image Link](#)

The Cinemascope was another widescreen format, developed by the 20th Century Fox Film Corporation in the same period. Unlike Cinerama projecting from several projectors, they used anamorphic method of movie projection, this means compressing the image with the

special anamorphic lenses and decompressing while projecting, which gives an ability to record on a standard 35mm film with a single lens at wider angles.

In his essay on stereo cinema, prominent Soviet film director, Sergey Eisenstein calls Stereofilm the day of tomorrow, meaning the future. And he imagines how a director can use a binocular effect for compositional purposes (Eisenstein, 1959).

In the following years there are several major studios in the United States shooting stereo, as anaglyph projecting method made the viewing process more comfortable with the cheap to produce, and easy to operate 3D glasses. The Stereoscopic movies achieved their peak in the last decades of the 20th century, when it was hailed by the American public, as large studios and names worked in the area. It was frequently featured in image media as a distinctive element of American culture. In Robert Zemeckis' blockbuster of 1985 - *Back to the future*, there is even a character that walks with anaglyph glasses all the time. Yet today, there are some directors still surprising us from time to time, like James Cameron did with his Avatar in 2009.

2.2. Art and optical illusion

According to Erwin Panofsky (1927/1991) we do not know for sure if Filippo Brunelleschi was the first to have produced a mathematical perspective, but he says that it is quite probable. Despite the fact that Ambrogio Lorenzetti came close to placing a correct linear perspective in his annunciation of 1344 (see Figure 20), we have to mention that it still lacks a vanishing point and all along the Trecento pictures we see no better improvement, until the second decade of 1400s, when several painters paid more attention to this subject. We see Jan Van Eyck, or Piero della Francesca following the rules of mathematical perspective, Andrea Mantegna makes spectacular foreshortenings (see Figure 21) in his works and so on.

Figure 20

Annunciation, Ambrogio Lorenzetti (1344)



Note. [Image Link](#)

Figure 21

The Lamentation Over the Dead Christ, Mantegna (1483)

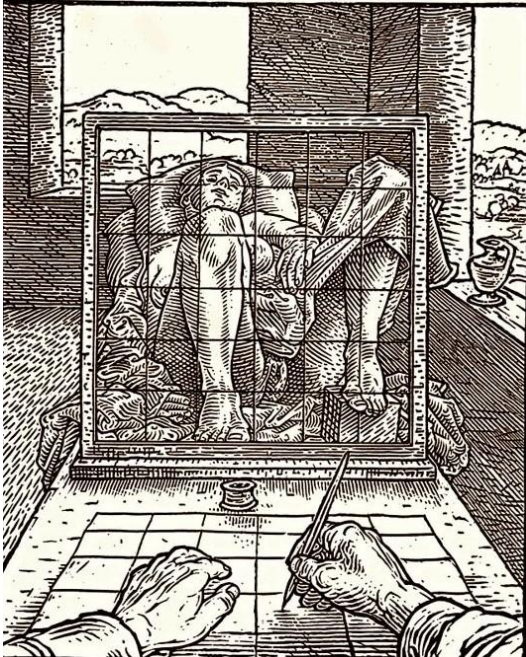


Note. [Image Link](#)

The period of Renaissance contributed heavily to the creation of the laws of perspective, which helped to render more realistic images. This is the time when perspective became the essential element of image creation and every artist would guide themselves after the scientific texts of Leon Battista Alberti, and a little bit later Albrecht Dürer, that even invented an optical device that would aid an artist to lay down a correct perspective (see Figure 22). Pretty obvious that artists like Hans Holbein who created spectacular anamorphic illusion, in his work “The Ambassadors” (see Figure 23), would aid himself with some optic tools, argues famous British artist David Hockney (Hockney, 2001).

Figure 22

From "Instruction on Measurement", (1525)



Note. Albrecht Dürer's perspective machine. The woodcut is from his book. [Image Link](#)

Figure 23

The Ambassadors, Hans Holbein (1533)



Note. When viewed from a certain angle, this strange figure on the ground turns out to be a skull. [Image Link](#)

As the construction process of perspective became well understood and tonnes of paint spent on biblical characters, some creative heads thought that one can intentionally distort perspective and will get an illusion, that at some point, will look like a real one. This is what Donato Bramante would have thought when he did this arch (see Figure 24) behind a pedestal in San Satiro church, Milan. To the viewer entering the church, space will seem larger, but it is artificially expanded by the forced perspective. A similar case of the forced perspective illusion employed in architecture we meet in the Palazzo Spada in Rome, created by Francesco Borromini in the 17th century (see Figure 25).

Figure 24

Forced Perspective at San Satiro Church, Architect, Donato Bramante (15th Century)



Note. [Image Link](#)

Figure 25

Forced Perspective at Palazzo Spada, Rome, Architect, Francesco Borromini (16th Century)



Note. The sculpture seen is 60 cm high. [Image Link](#)

The illusions of this kind were not limited to architecture and found their way in painting techniques too, such as Trompe l'oeil. Trompe l'oeil is a French term that means “trick the eye” and its nature comes from its name, it is literally a deception of a viewer with an augmented depth through the chiaroscuro effect. Artist accentuates a contrast of light and dark or figure and ground that increases the sensation of dimensionality and depth.

The first known tricks of this kind date back to ancient Greece, but this particular style became quite popular in the 17th century when Holland became the biggest art market in the world. There were numerous Dutch artists working in this genre (see Figure 26), but there also existed other optical illusions, such as the perspective box, that also became quite popular by

that time. The perspective box (see Figure 27) consists of a box that is painted inside with the correct perspective that is aligned to a peephole. As the viewer looks inside, meets an immersive experience, as his/her eye becomes totally surrounded by the image. It is obvious that by the 17th century, perspective and trickery around it were already quite well understood and this knowledge was well used in the creation of new types of illusions.

Figure 26

Trompe l'oeil Painting by Edward Collier (ca. 1699)



Note. [Image Link](#)

Figure 27

Interior of a Dutch House by Samuel van Hoogstraten (1655–60)



Note. The side is open to let the light in. A peephole is seen on the left. [Image Link](#)

It is quite interesting how artists who understood the perspective deeper or had their artistic urge to practice this particular style, like Maurits Cornelis Escher who would constantly distort the space, manipulating several psychological cues, such as: perspective, overlaying, light and shade, relative size. Most of the surrealist painters also frequently distort the space, similarly relying on these cues mentioned above (see Figure 28).

Like we talked before in the case of Anton von Werner, we can conclude that he had to be aware of the state of the art scientific knowledge of that time, published under the name - *Treatise on Physiological Optics* by his contemporary Hermann von Helmholtz.

The knowledge of the art of painting demands a good scientific background and perceptual psychologists are first to address for novelty. Observing art is a psychological process in the first place and there are ways to manipulate this process with optical tricks. Interesting to

check the perspectival illusions created by American scientist Adelbert Ames, whereby manipulating our perceptual cue of relative size and distortion of perspective, the observer sees a room where two humans standing on the opposite sides appear as a giant and a dwarf to each other (see Figure 29).

Figure 28

Melancholy and Mystery of a Street
by Giorgio de Chirico (1914)



Note. [Image Link](#)

Figure 29

Ames Room Optical Illusion



Note. A distorted room is creating this illusion. [Image Link](#)

We know from experiments that the eye can be fooled into accepting a photographic picture as a real space or the contrary, but it all depends on some circumstances. We know that under such circumstances the level of illusion was so high that participants even threw a ball in illusionary space (Smith and Smith, 1961).

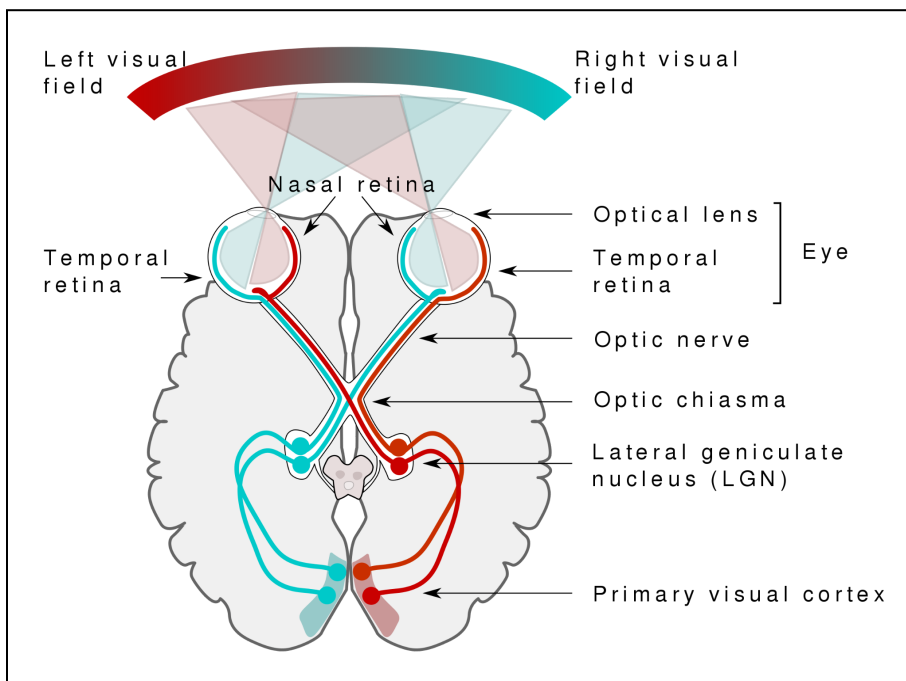
2.3. Depth perception

The Human visual system (see Figure 30) is a very complicated chain of connections, as its optical part is connected to our visual cortex that resides in the back of our brain and operates via electro-magnetic impulses received through light-sensitive receptors inside the

retina. There are two types of receptors in the retina, rods, and cones. Rods are responsible for our vision under the low lighting conditions and don't serve for the perception of color, while on the contrary cones perceive color. There are three types of cone type photoreceptors that perceive: green, red and blue light individually. The retina itself is divided into two parts, nasal and temporal. The optical information received from the nasal area corresponds to our peripheral vision and goes to the opposite hemisphere of our brain through the optic nerve. The temporal area of our retina is formed more for an active vision, which serves as a focus spot of our optical apparatus, because of the fovea located in this area, which is kind of a docking point of the optic nerve and the sensory centre of our clear vision, this is where we meet only the cone receptors. The visual information received in this area makes the clearest render in our brains, worth mentioning that all the visual information received in this area makes its way to the same hemisphere of our brains.

Figure 30

A Simplified Schema of the Human Visual Pathway



Note. [Image Link](#)

According to Okoshi (1976), when a part of the brain called the callosus body that connects the two hemispheres is cut out, the perception of depth is lost. That is how complicated our visual system is and this brief explanation is not yet to be finished.

We are good at reading small letters, as our eyes tend to focus by contracting muscles around the lens, we get a rapid awareness of any movement in our peripheral vision, we are also good at some level seeing at night, but our brain also knows how to interpret the size and the location of objects with a vision. We have this function developed through millions of years of evolution and there is no doubt that binocular vision would come in handy to hunter-gatherers whose survival depended mostly on their visual precision.

Our eyes receive slightly different visual information as they are distanced from each other. This is why we call it binocular vision. The phenomenon observed by Euclid yet in the B.C. era. Leonardo da Vinci knew well his limits, that because of the binocularity it was impossible to detach objects from the two-dimensional space of a painting.

Binocularity plays a fundamental role in our perception of depth, as our eyes converge in space, this convergence also works as a dimension measuring sensor. The Physiological system is developed in a way that it functions at its best at close distances, but there are also some psychological cues that play their role in depth perception. These are the factors that are based on prior knowledge and these cues were those secrets that artists understood well in the Renaissance and the result was an epic period that produced the world's most valuable artworks.

According to Okoshi (1976), there are ten cues that help us perceive depth, which are: binocular disparity, convergence, accommodation, movement parallax, relative size, linear perspective, aerial perspective, overlapping, light and shade, texture gradient. He also classifies them as physiological and psychological ones.

Physiological cues for depth perception:

Binocular disparity - Is the most important cue for depth perception. As we already have described, the separation between our eyes, which is around 6.5 cm in general, helps us to

perceive space from slightly different standpoints and the received visual information helps our body to orientate in space flawlessly. The separate images received in each eye go through the several parts of the brain, while unified and translated appear in our consciousness.

Convergence - Yet another muscle job. When we focus on something at distances smaller than 10 meters, the axis of our eyes converge in space and this tension applied to the eyeball for its rotation gives a cue for depth. During WWII, the RAF fighter pilots would change their gun convergence voluntarily against the rules, as fighting experience showed them that it was necessary to adjust them for more effectiveness. Our brain works in the same manner as we focus on some object in space, the image gets clear by muscle tension in the eyeball, even if we don't want it to.

Accommodation - That is an impulse created by the ciliary muscle tension in the eyes as we try to focus our vision on some point in space. This muscle affects the shape of the lens in our eye, as we choose to focus on closer or farther objects. It is a monocular cue, as it does not lose its effectiveness when looking at something with a single eye.

Movement Parallax - Is also a monocular cue and it is created by physical movement, of either object or an observer, to make it clear, imagine that you have some marble statue in front of you and you start to observe it from left side and walk around to the right, dimensional information you receive becomes much greater than in the start of your movement.

Psychological cues for depth perception:

Relative size - This is a priori knowledge in most cases. For example If we see a human being, or any object that has an established size that is known to us, we can relate this size to other objects and make a dimensional measurement.

Linear perspective - Gradual reduction of the size of receding space. That famous Renaissance perspective.

Aerial perspective - Atmospheric density or dust that is apparent at long distances when we look through the layers of air.

Overlapping - That is when objects are covering each other. Complete shapes tend to be the forward plane and the obscured ones the background.

Light and shade - So-called chiaroscuro. Loved by Caravaggio.

Texture gradient - Gradual changes in the texture pattern through depth. Objects that are close we can see in better detail. Also when the same pattern recedes in-depth it changes the form of its texture due to perspectival distortion.

According to Okoshi (1976), among the listed cues, the most important one is binocular disparity, and the author agrees, as it is so easy to verify. Obviously one with just one eye can perfectly live a normal life, even drive a car if it is legit, but never can experience the stereoscopic effect seen through a stereoscope, or any other device of its kind. Binocular vision is important for our perfect functionality, but if we somehow miss it, depth perception will be taken care of by other cues, at quite satisfactory levels.

2.4. Stereoscopic photography

David Brewster led a project which was a collaboration with French, notably, Jules Duboscq, who was a scientist and an optician to whom Brewster addressed to build his type of a stereoscope in 1850. At the Great Exhibition of 1851 in London, the displayed stereo photographs gained a huge public recognition, and in the same year stereoscopic images were published commercially for the first time (Flores, 2019). As stereoscope's popularity grew, there were also lots of photographers ready to explore this technique. First it spread throughout France (see Figure 31), but after the growing popularity, one could meet them almost everywhere. The most popular themes were: exotic places, foreign countries. Some would even sell under the counter sexual content (see Figure 32, 33).

Figure 31

Stereoscopic Photography Workshop,
A. Gaudin (ca. 1860)



Note. Roger-Viollet collection.

Figure 32

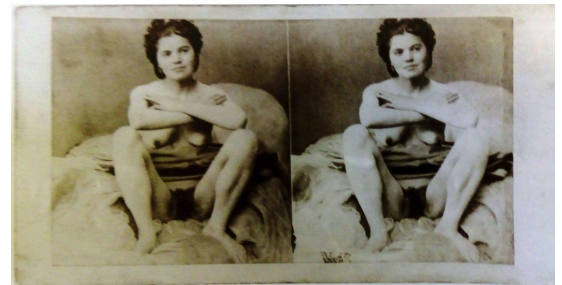
Stereoscopic Pair of Trajan's Kiosk on the Isle of Philae, Egypt,
Francis Frith (1858–1860)



Note. [Image Link](#)

Figure 33

Nude Woman, Anonymous Author (1860s)



Note. Bibliothèque Nationale de France.

In 1896 A. Berthier published his work in a scientific journal *Le Cosmos*, the work is titled *Images stéréoscopiques de grand format (The Grand Format Stereoscopic Images)* (see Figure 34), and proposed a line screen method (technically same as parallax barrier, see Figure 1), for stereoscopic viewing of photographs without a stereoscope. The line screen is a slit plate that would lay several millimeters above the photographic strips of a left and right stereo pair, in a way that the right eye would perceive the right stereo pair strip and the left eye the left. One looking directly at the picture plane, would see a pair of binocular images simultaneously.

In 1903 Frederic Eugene Ives of the United States independently proposed a similar method and named it *Parallax Stereograms*. French mathematician Eugene Estanave, also a remarkable pioneer of stereoscopic screen photography who worked in Gabriel Lippman's

laboratory, after hearing of Ives parallax method, he started his own research in 1904 (see Figure 35) and desperately tried to prove the line screen process' viability, but due to technical complexities of taking pictures with this method, he couldn't make big progress, yet he was the one of a few who would experiment for more than a two decades with several variations of this technique. At some point, he even worked with medical researchers as they were interested in applying stereoscopy to recently invented X-ray photography.

Figure 34

Interlaced Strips of a Stereo Pair, A. Berthier (1896)



Note. [Image Link](#)

Figure 35

Autostereoscopic Work, Eugène Estanave (1905)



Note. Gelatin silver on glass and line screen on glass, Gérard Lévy collection.

Gabriel Lippman himself had ideas about dimensional photography as of 1908 when he announced his work *Photographie Intégrale* (Integral Photography). Which was inspired by nature and would employ small spherical lenses occupying the plane in a fly's eye manner. Gabriel Lippmann described his integral photography as "a window onto reality" (Lippman,

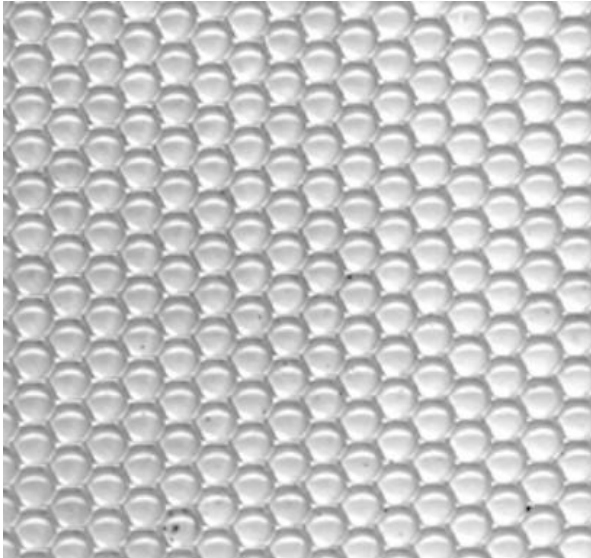
1908), as the viewer would move and with the help of some tiny lenses (see Figure 36), light rays would change their directions and expose more dimensional information to a viewer. As the technology was not that advanced by that time, it was impossible to manufacture such a lens and achieve satisfactory quality. Lippmann himself encouraged industrialist and inventor Louis Lumiere who was experimenting with different materials and molds, but as we know today, he never mass-produced them.

A.P. Sokolov of Moscow university experimented with pin-hole integral photography in 1911. Though he could not achieve satisfactory quality with 1200 pinholes on a 150mm x 200mm plane, his reports say that he took a photograph of a lamp filament and obtained a definite depth (Okoshi, 1976).

The United States patent (first registered in France in 1912) US1128979, describes the invention of Swiss Physiologist Walter Hess (Timby, 2015), that by its concept is practically an industry standard for the lenticular sheets produced today (see Figure 37). By that time Walter Hess was practicing ophthalmology and it is quite possible that he got his insight while working with optics and his knowledge in this area might also have contributed to this. We should also mention that he probably knew well the progress those above-mentioned inventors had achieved so far, as he uses the very same technical terms in his patent text. It is quite interesting that a man with a medical background surpassed an elite league of inventors that were specialized in photography, but an insight is like an apple, you never know when it is going to fall down on a smart man's head.

Figure 36

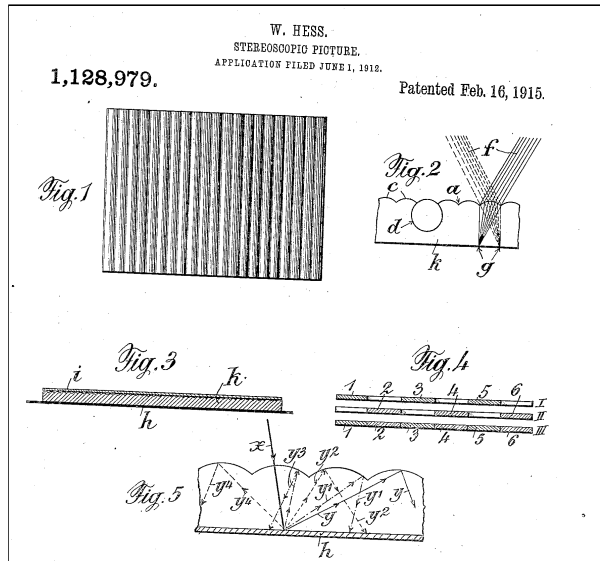
Fly's Eye Lens Array for Integral Imaging



Note. Commercially available from China.
Unlike the regular lenticular screens, vertical
parallax is also present. [Video Link](#)

Figure 37

A Fragment From Walter Hess' Patent Papers



Note. [Original Document](#)

There are several examples of Hess' lenticular photographs still preserved today and his work has been well praised by the leading pioneers of the technology, Bonnet and Estanave (Timby, 2015).

As of 1912, Louis Chéron patented a camera system for autostereoscopic photography. The term *Autostereoscopic* itself was coined by Estanave a few years earlier, meaning a presence of a stereo effect to the naked eye, when the beholder uses no device to observe the effect. Chéron's system would capture a series of images while a camera moved on a horizontal axis. Unlike stereoscopes, an observer would see several frames instead of two and the sense of depth got amplified by the presence of a movement parallax.

From the 1920s there was some progress in camera systems. Well known French scientist Gustave Bessiere developed a multi-camera system that would correct pseudo stereoscopic effect by installing the prisms. He tried to commercialize his invention and started a company named Diarelief, but as of 1934 it has been dissolved without having seen too much commercial activity.

Jacques de Lassus Saint-Geniès, another pioneer of 3D autostereoscopic technique, has praised Bessier's photographs and in 1933 presented his own Olostereograms to the Société Française de Photographie. He would collect multi-frames with a camera on a horizontal axis, in the correct order, avoiding pseudo stereoscopic effect. His autoportrait given to the Société Française de Photographie exhibits strong 3D effect and viewable parallax movement.

Despite the fact that there were top scientists and powerful industrialists involved in the quest of industrialization of autostereoscopic photography, not only in France but outside its borders, there is no significant advancement, as industrial machinery of that period couldn't boast surgical precision and the autostereoscopic image making relies on line screens that were easier to manufacture.

3. LENTICULAR IMAGES & ADVERTISING

3.1. Lenticular technology

In 1937 French photographer Maurice Bonnet created a company La Relièphographie to promote lenticular products and was quite successful in portrait photography. He started with the line screen process, but soon unsatisfied with their compromised brightness, went to search his own ways of manufacturing semi-spherical lenticular lenses that he eventually did. He invented a camera, that he named O.P. 3000 (see Figure 38), that could take thirty-three photographs while moving on a curved rail and the results were of a remarkable quality. He would work in portrait photography and also produce posters for advertisement (see Figure 39). La Relièphographie even industrialized the process of making lenticular plastic in the 1940s.

Figure 38

OP 3000 Camera for Lenticular Photography



Note. [Image Link](#)

Figure 39

Autostereoscopic Advertisement for Petit Bateau Undergarments (ca. 1937–1939)



Note. Musée Nicéphore Niépce, Chalon-sur-Saône. France.

Despite being successful for a while, making 3Ds of a great quality, Bonnet's products were costly compared to newly appearing competitors. Also he had some disagreements with his partners that led to legal disputes and he was dismissed from La Relièphographie in 1951,

right after he secretly planned mass production of cheap lenticular postcards. Bonnet couldn't realize this plan and also La Relièphographie officially went bankrupt in 1954 (Timby, 2015).

In the 1950s there are several companies in lenticular business producing own lenticular plastics and products, among which, the most successful ones were: Vari-Vue, that even made promotional merchandise for 1952 Eisenhower and 1960 Kennedy presidential campaigns (see Figure 40); Visiomatic in France; Toppan of Japan that still exists, but diversified their business in various other areas; and American Xograph, trademark owned by Visual Panographics Inc, that together with Eastman Kodak in the 1960's developed its own process of producing thin lenticular sheets very much suitable for magazine covers and postcards (see Figure 41).

Figure 40

Vari-Vue Lenticular Badges



Figure 41

British Airways Promotional 3D Xograph Lenticular Postcard



Note. Physical rotation makes images shift in Flip Lenticulars.

Note. Various companies did print under Xograph trademark, indicating it on the back of the print along with the company names.

There was also a company in Bhutan, which with some optical technology printed 3D postal stamps, that have a decent 3D quality and are frequently available for sale on Ebay nowadays (see Figure 42).

From the 1960's several companies all around the world were producing millions of lenticular postcards, the most popular product of its kind. But as time went by, gradually, lenticular

products went to extinction. If one checks photo postcards produced in that era, only images that were set up in a studio had a significant depth, outdoor images not that much. The more far and big an object is, the more distance you need between left and right stereo pairs to achieve a good result, and in outdoor situations it was not always possible to shoot like this, as physical obstacles and real life conditions would not give such a possibility. On the contrary, one had full control over the camera movement indoors, but thematically indoor images were very limited to some: dioramas, toy animals, dolls, mannequins, flowers, etc. The same tradition that Chinese printers even continue today.

By the late decades of the 20th century lenticular products went into significant decline, postcards became oversaturated and uninteresting with their gloomy visual themes and as people got used to an effect, their specific defects came out to be noticed. Aligning interlaced images under the lines of lenticular plastic is a very difficult job, even modern offset machines will leave you with a lot of defectuous prints. Some parts or the whole plane of a print may come out blurry, off focus, due to lens misalignment.

We are accustomed to look at images holding them on a parallel plane to our eyes and not tilted to one side or another, that cures the misalignment problem but distorts our habit. Xograph's thin plastic came at a price of compromising depth; on some images the 3D effect was barely noticeable (Timby, 2015). Vari-Vue's famous image-flip lenticular toys could not surprise 1980's kids that had seen Atari or Nintendo. Here and there, one time or another, some companies or individuals still print, but after that golden age of the 60s, no one went as far as: Vari-Vue, Xograph and Toppan.

Figure 42

Bhutan Postal Stamps

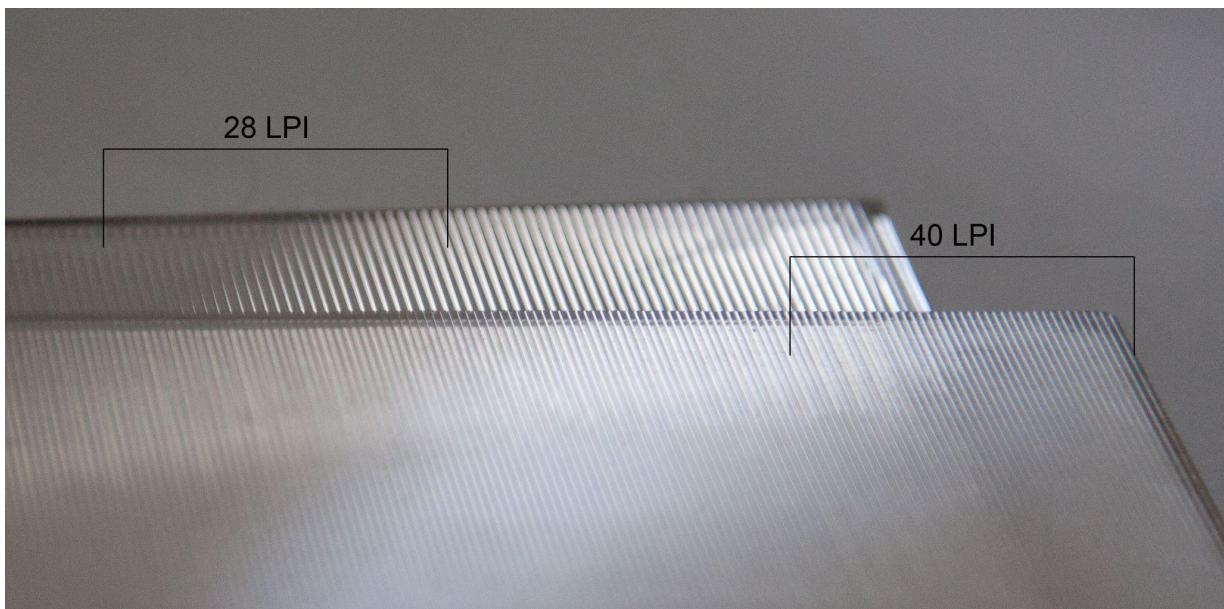


3.1.1. How does the lenticular process work?

Lenticular lens is a plastic sheet that consists of the columns of plano-convex longitudinal lenses (see Figure 43), one side is a planar surface while the other consists of these convex shaped lens columns that are directed to an observer. The light that hits the surface of a lens, refracts and we get exposed to its focus point on the end of this refraction path. Each eye receives visual information independently from each other, because of the lens shape. This technology permits us to perceive stereoscopic visual information that is present under the lens in an interlaced image, left and right views arranged accordingly in small strips. One can print an image on a sheet of paper and then apply it to a lens with a double sided adhesive sheet of optical quality, or print directly on the back of the lens using flatbed printing technology. Lenticulars can be printed even on an offset press machine, if the lens is not too thick and the machine can handle it.

Figure 43

Clean Unused Lenticular Plastic Lens Sheet



Note. Normally the lenticule count varies from as small as 20 up to 150 lpi. They come as: 20, 28, 40, 50, 60, 62, 70, 75, 100, 150 lenses per inch, but it depends on a manufacturer, there are even 10 and 200 lpi plastics available. Material is mostly fully recyclable types of plastic.

Usually, when they prepare the images for interlacing, they take the frame quantity into consideration, which is calculated by the printer resolution divided by the lens LPI (lens per inch). For example, Canon inkjet printers that print at 600 DPI (dots per inch) resolution, can output 12 frames for a 50 LPI lens, $600/50 = 12$. This way, division comes even for every frame and the print dots are allocated in the best order, each frame will get a dedicated size of one printer dot and there will be evenly allocated 12 different frame fragments under each lenticular column. The sequence of the collected frames that carries binocular information gets interlaced in a special software and placed under the lens in strips, in a manner that the left binocular sequence is visible to the left and the right to the right eye. As we move our heads, stereoscopic pairs shift to the next image in a sequence and aside from the binocular depth, we also get some parallax movement that amplifies the sensation of depth. More frames we interlace, stronger the motion parallax effect becomes.

There are different types of lenses. Thicker lens sheets give a better sense of depth, because of the lower lens angles that makes it possible to focus a light ray on more distant stereo pairs from a frame sequence and additional lens magnification/distancing that they provide. Lenses that have wider lens angles are better for animation, or movement effect, narrower angles are meant for 3D. The viewing distance is also limited to lens properties, higher LPI lenses are designed for close viewing and smaller distances, normally these lenses are thinner, while the small LPI lenses suit for far viewing and bigger distances. To perceive a stereoscopic effect lenses must be in a position of vertical columns, while flip lenticular effect doesn't have this limitation.

3.2. Making Lenticular

3.2.1. Methods of preparation

There are four general methods of 3D scene preparation for lenticular printing: 1. layer shifting; 2. depth map (gray map); 3. CAD method or 3D modeling; 4. Shooting a scene with a photographic camera on a rail, or with several synchronized cameras.

Let us first talk about the layer shifting method which is the less complicated one. Following this method, first we identify those components that we want to include in our scene and then cut them as independent layers in photo editing software. After, these layers are inserted into the software and adjusted through the depth axis according to our needs. Most people place the main object in the center, at a so-called zero parallax point, and aggregate it with an additional back (or background) and front layers that overlap with each other (see Figure 57). As we talked about before, overlapping is one of the cues that plays an important part in human depth perception. The software generates several frames as if there was a camera in a sliding motion. The layers that are placed in front of a zero parallax point will appear closer to a viewer, contrary to the layers that are placed behind the zero parallax point. It is a bit confusing, but anyone may experience it by standing in front of a wall (better if it has some grainy texture) place your thumb at a close distance from your nose and look at it with just one eye, and then switch to another. If you stretch your arm and do the same trick, you will notice that as your thumb was closer, it appeared to make a bigger horizontal leap while you were eye-switching. Let us assume that the front layer from the software is your thumb while it was close to your nose, the zero parallax point is your thumb while your arm is stretched, and the background layer is the wall. This is the effect that one creates with the help of a software and a lenticular lens sheet.

Another method that is quite popular nowadays is a depth map, also called a gray map method (see Figure 58). It serves mostly for a conversion of regular 2D images to 3D, but some interlacing programs also accept them together with cut layers for additional volumetric effect simulation. As in the formerly described method, first we identify scene components. Then we assign a conditional value of 0 to white color and 255 to black and start to paint the scene components. Whatever is in the front will be closer to white and gradually have to get darker as objects recede in space. Once we are done with the map creation it goes into the software together with original image and the software generates frames according to those values that we defined, whatever is close to white, shifts to one side, while becoming fixed as it reaches the value of 127(zero parallax), whatever comes behind it and graduates to black is shifted to the opposite direction. The dislocated pixels get filled with the help of an algorithm and do not

always give a satisfactory result. This is the main drawback of this method, as it leaves some artefacts in the shifted areas.

Figure 57

3D Postcard Created With the Layer Shifting Method.

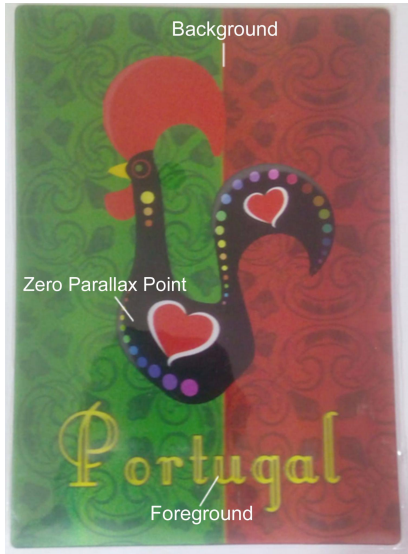


Figure 58

Manually Created Depth Map and the Original Photograph



Note. This method is more suitable for this kind of graphic layout.

Note. The software will use the depth mask (seen on the right) to generate additional frames for the scene.

The CAD method or 3D modeling is the cleanest and flexible of all, as it gives practically unlimited possibilities of scene and camera manipulation. It is time-consuming, as photorealism is a product of meticulous detail. All the frames needed are generated in CAD software and then exported for interlacing.

Shooting with a photographic camera is a classic method, some people use a slider and collect the frames while the camera is in movement, others use several cameras that are synchronized. Like in a previous method, the collection of frames get interlaced in a special software.

3.2.2. Optimizing for depth

The most important aspect of a good 3D scene is composition. Not every type of photography can serve for 3D, for example, there is no point to make plane landscapes, as there will be no objects sticking out. Practice has shown that wide shots are better to be avoided: if there is no element that occupies a significant part of the frame as the main element, the overall 3D effect will be weaker. It is better to construct a scene taking into account three separate planes: foreground, center and the background. Objects allocated on and around these planes should overlap with each other, if foreground doesn't overlap with the background directly, it should overlap with the center and then the center should overlap with the background, because on a lenticular print one pushes another. Without a contrasty background, one can sense the volume of objects, but there will be no sense of depth. The objects that get overlapped better to be textured and have a different color than those objects that cover them, in order to create a contrast that helps with spatial separation.

The dark scenes should be avoided, as outlines that create contrast will not be clearly visible and this destroys the effect. It is better to hide some notable details when overlapping the components. While viewing, parallax motion comes to an action and the discovery of something hidden amplifies the sensation of dimensionality. Creating space inside space also amplifies the depth sensation. For example in a scene with a building, if we create an inside of a room with its attributes that is visible through the window, it will give an additional depth and if we employ that "hide the detail" trick, it will be much better. Foreground and central objects that we base an effect upon, should have a little or no interconnection with lateral surroundings if possible, as this detachment will make them float in the virtual dimension much further. The Light and shade contrast is recommended, as it is one of the important cues that helps us perceive scene components as dimensional matters. It is better to place the receding into depth components closer along the imaginary axis that goes through the centre, in this way parallax movement comes more concentrated and feels stronger. It is better to keep the central object off the frame borders, and also avoid highly foreshortened central objects, since planar appearance diminishes dimensionality. Sure, to follow all these rules is not always possible,

especially if one shoots with a camera, or makes a 2D-3D conversion and has to work with whatever he has got, but we have to think beforehand if a particular scene is worth to work with. Like, no reasonable director would take a play Romeo & Juliet and turn it into a comedy.

3.3. Advertising

3.3.1. Advertising and imagery

After the first world war the advertising culture flourished and the images are playing a very important role in this trade, as a newly appeared trend - photography along cinematography made the pair with the advertising business, that mostly consisted of a paragraph of text and some blunt illustrations before. In pre-war period advertising agencies would focus on selling spaces for posters and did little intervention on creative process, but from the 1920s they assumed new responsibilities. Several agencies made a part of the American Association of Advertising Agencies that was created in 1917 in the United States and the similar pattern is seen throughout the industrialized countries across Europe (Frizot, 1998).

As of the 1950s American advertising business is dealing with billions. From the total amount of more than 6.5 Billion U.S. Dollars, solely newspapers, would make a revenue of more than two billions in 1951. The revenue share from subscriptions is gradually becoming insignificant in comparison to the contributions by the advertisement (Potter, 1954). Advertisement business disposes a huge amount of finances and the ability to hire the best candidates for the job and already from the beginning of the second decade of the 20th century, a growing number of professional photographers specialize in advertising photography. This is the time when we already see some advertising photography works that are constructed according to the principles of art. Such as: Paul Outerbridge's *Ide Collar* (see Figure 44) ad that was published in *Vanity Fair* and was admired by the famous French avant garde artist Marcel Duchamp; Maurice Tabard's advertisement for Michelin tyres; Edward Steichen's work for Camel Cigarettes; Florence Henri's advertising photograph for Jeanne Lanvin Perfumes (see Figure 45).

Figure 44

Ide Collar Advertising Photograph by Paul Outerbridge (1922)



Note. [Image Link](#)

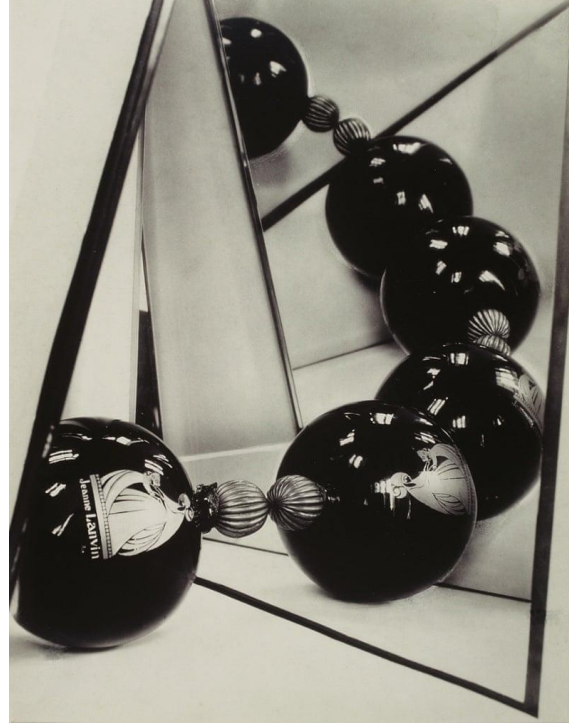
According to Michelle Frizot (1998, p. 560), Bauhaus culture had its influence, when some photographers would skip from orthodox principles and demonstrate some experimental type of work, such as Emmanuel Sougez's X-ray photograph of a hand which featured in Urodonal advertising poster.

The color photography itself and the introduction of it into manufacturers' brochures and the seasonal catalogues of big department stores revolutionized sales techniques (Frizot, 1998).

The countries that were governed by the totalitarian principles, would use photography along with cinematography for propaganda purposes (see Figure 46), because of the impact that a manipulated image would have on a viewer. As Oliver Grau argues (2004, p. 339) "all socially relevant new image media, from classical antiquity to the revolution of digital images, have advanced to serve the interests of maintaining power and control or maximizing profits;

Figure 45

Jeanne Lanvin Perfume Advertising Photograph by Florence Henri (1929)



Note. [Image Link](#)

hardly ever have they advanced solely for artistic purposes.” And this is so true, the majority of images that we see on a daily basis, either sell some particular product, or ideas. Be that a mupi in a subway, or a graffiti painting on a bridge pillar. These images themselves carry their own characters, it all depends on what creative path their makers took, or the ideas they support (see Figure 47).

Figure 46

Soviet Antireligious Propaganda Poster (1960s)



Note. Title says, *There Is No God*. The Soviets were first to launch a human into space. Technological success was exploited as antireligious propaganda.

Figure 47

Anti-Brexit Mural by Banksy (2017)



Note. [Image Link](#)

Dave Saunders' book, *The World's Best Advertising Photography*, as the title implies, is a collection of publicity photographs that features the works of world known photographers, like: Irving Penn, Elliot Erwitt, Don McCullin, Nadav Kander, etc. In this book we encounter lots of interesting examples of creative work that combines art and photo manipulation mastery. Like this ad for Smirnoff (see Figure 48), where a creative idea paradoxically implies that Smirnoff, a high concentration alcoholic beverage itself, makes it clear and helps one to see things that

otherwise he or she would not see. While surroundings are glowing with a drunken blur, only through the bottle of Smirnoff is seen a sharp image of a crocodile, that makes a part of the fallen tree outside the shape of the Smirnoff bottle. The image is constructed according to the golden ratio and as the right side is heavier than left, we see some red flowers creating a balance.

Fortunately, Saunders goes quite deep into describing the production processes and it is important to know how much effort it takes sometimes to realize creative ideas and shape them into a final form. Like this poster for Absolut Vodka (see Figure 49), which took five weeks to build a maquette, involved a professional architect to produce sketches and the photographer's trickery to make the tree shades on the beach visible, using dark clay, while normally they would have been washed out by the fill light.

Figure 49

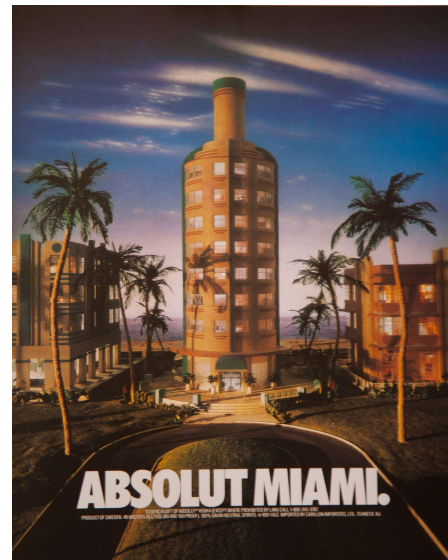
Absolut Vodka Advertising Poster

Figure 48

Smirnoff Vodka Advertising Poster



Note. [Full Size](#)



Note. [Full Size](#)

Another great example of enormous effort done by a creative team is this ad for Lloyds Bank (see Figure 50). Photographer Gered Mankowitz had to hire a special effects team, and build a 13 tonne water tank in a studio. The team had to varnish the submerged parts so the

paint didn't mix with the water. The water drops are made of polished plastic and suspended on a thin wire, and a green cast created by the thick glass had to be filtered out.

This book was published in 1994, when famed photo manipulation softwares for rasterized graphics, like Photoshop and Corel Photo-Paint were counting just a few years of their existence and neither digital camera systems were that advanced yet. The industry used to work on photographic film and the image manipulation process was carried out manually. It is not difficult to imagine how complicated the overall process had to be for a photographer working in a dimly-lit lab, being that a simple retouch for the brightness of James Dean portrait (see Figure 51), or Yevgeny Khaldei's - *Raising a Flag over the Reichstag*, where he had to scratch out the looted second watch from the soldier's wrist, to comply with the Soviet Censorship.

Figure 50

Lloyds Bank Advertising Poster



Note. [Full Size](#)

Figure 51

James Dean Portrait Before and After Edit



Note. Annotations for the dark room retouch is seen on the left. [Image Link](#)

3.3.2. Branded content

In later decades, we saw new marketing techniques emerging. The digital age came with its benefits and at some point it simplified communication, but for marketers the process became more complicated, as companies tend to communicate on cross-media platforms and have to make choices among vast marketing strategies. Branded content, sometimes called branded entertainment, is one of these tools that has become quite favoured in the late period.

As content distribution has become an easy job via digital media platforms and the internet has become practically a must like running water in every household. The idea of branded content itself is to deliver entertainment and engage an audience, while a brand stays in the background without making a bold intervention on a stage. With this approach brands usually make art to speak for themselves in the desired manner, and transmit their values.

The increase of this practice led to the creation of the Branded Content Marketing Association (BCMA), which is a nonprofit organization founded in 2003. It is a partnership of industry experts that promotes networking and sharing best practices, carries out events and researches in the field. According to the research conducted by BCMA, they clarify the meaning of this marketing concept as: “branded content is any output fully/partly funded or at least endorsed by the legal owner of the brand which promotes the owner’s brand values, and makes audiences choose to engage with the brand based on a pull logic due to its entertainment, information and/or education value” (Asmussen, B, et al., 2016, p.34). They classify this approach as seen from a managerial perspective and propose another definition that carries a holistic nature, such as user-generated content associated with a particular brand, though, not promoting brand values, but still connected with it. Conceptually speaking, the first definition is adopted globally, but sometimes people use terms, “branded content” and “content marketing” interchangeably, while BCMA separates them as an output and a discipline. They conceptualize content marketing as a process of planning and development, while branded content being a product of this process.

According to the Content Marketing Expert Project (CMEX, 2014), early cases of content marketing practices appeared by the end of the 19th century, when August Oetker started to include recipes printed on the back of the package of his baking powder in 1891.

In 1895 John Deere, an American company that manufactures agricultural machinery, launched *The Furrow* magazine, which didn’t intend to promote brand products on every page, but instead was oriented on solutions for problems that farmers met on a daily basis.

In 1900 Michelin tyre company published the *Michelin Guide*, which was intended to help drivers with tips about car maintenance and also provided them with useful information

regarding gas filling stations, mechanics, and tyre dealers. The *Michelin Guide* is still in print as *The Furrow* magazine of John Deere.

In the 1930s Procter & Gamble took a different path than its competitors in communication with its target audience. When they would place their products in radio shows that they sponsored themselves, the results reflected on its revenues, which were quite impressive, and as television advanced they took this idea in Television shows, so-called soap operas, where more possibilities were given as TV appeared to be a more powerful medium as it carried visual information too.

In 1966, after two years of its existence, Nike - by that time known as the Blue Ribbon Sports - co-founder Bill Bowerman wrote a 19-page booklet, titled *Jogging* (see Figure 52). Bowerman worked along with an experienced cardiologist to help Americans get in shape through running. Booklet neither advertised the brand, nor mentioned it at all, but was oriented to promote the sport, which in turn would create a need for jogging shoes.

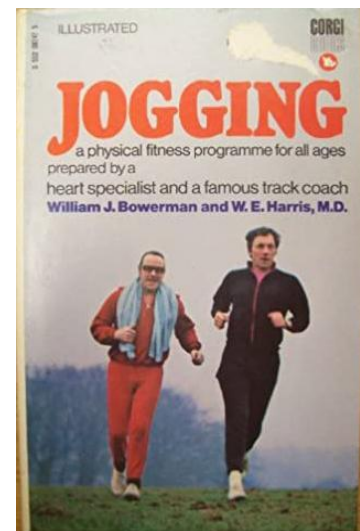
Hasbro is a toy company which in 1982 signed a partnership agreement with Marvel Comics and along with the comic books they would produce animated TV series and video games to promote their toy characters. As we talk about toy companies, we have to mention LEGO, which is a content giant, as Joe Pulizzi

(2013) calls it. The brand turned itself into a content powerhouse to beat the imitating competitors. In 1987 the company launched *Brick Kicks* magazine and they directed their focus on content creation. The brand is famous for its cross media strategy that includes: successful video games, microsites for each storyline, miniseries, Lego Life application - a community platform for sharing Lego creations, *The Lego Movie* franchise - that grossed almost half a billion U.S. dollars worldwide with its first movie release in 2014.

Red Bull is another company that leads a successful content marketing strategy, owning a magazine, TV, organizing sports events, such as: Red Bull Air Race World Championship, multiple extreme sports events, etc. The company received huge global media attention with

Figure 52

Nike Booklet - Jogging



Note. 1 Jan. 1977 Issue.

the Red Bull Stratos event, when Austrian skydiver Felix Baumgartner jumped from the stratosphere. The video content on their youtube channel is attracting millions of viewers, such as, *Last Call for Mr. Paul*, in which an athlete demonstrates his freerunning skills while overcoming obstacles through Munich International Airport. As of now, the video has been viewed more than 150 million times.

Figure 53

Danny MacAskill's Imagine



Note. [Video Link](#)

Danny MacAskill's Imagine (see Figure 53) has got more than 90 million views. This is quite an interesting example from the visual standpoint, with its plot, skillful use of complementary colors and camera movement, not talking about those crazy bicycle stunts.

In later decades, distribution of video content became an easy job, it is not necessary to own a dedicated media or pay huge amounts of money for publishing. A platform such as Youtube is a perfect opportunity for brands. It is the most visited website, if not taking Google into consideration, which is just a search engine and preferred homepage for the many. Apparently, lots of brands have understood the potential of this media platform and the basic recipes for achieving success.

Branded content is becoming popular and there are lots of brands that create entertaining material to engage with their audiences. Yet in 2001, BMW launched an online mini series - *The Hire*, episodes directed by famous directors such as: Alejandro Gonzalez Inarritu, Guy Ritchie, Tony Scott and John Woo. These episodes are full of the Hollywood style special effects and habitual filming techniques of each director (see Figure 54). Across that period it attracted more than 100 million visitors to its website and BCMA considers it as the greatest branded content campaign of all time.

Figure 54

James Brown and Gary Oldman Acting in Beat the Devil Episode, The Hire, BMW Films



Note. Directed by Tony Scott. Hollywood style “teal and orange” color contrast dominates in this episode, which features stars such as: Gary Oldman, James Brown, Marilyn Manson, Danny Trejo and Clive Owen who is the main character appearing in every episode. [Video Link](#)

Dove Real Beauty Sketches is the next great example of branded content, unlike *The Hire* it was launched in the Youtube era and its English version uploaded by Dove US reached more than 30 million views in less than two weeks. The video is very touching emotionally and constructed according to the filmmaking techniques. The director creates a melancholic mood with wide shots, colors are pale, emotional music in the background. The same technique that is used in films. Dove’s strategy for this campaign was to “pull” and it worked like a charm. The use of the art of cinema helped to transmit the touching moment very precisely via medium, as art always works, because it is a precise distribution of stimulus to its relative senses.

In 2016 American production agency Skunk won The Tribeca X Award, which awards the brand and filmmaker collaborations in several categories. Their film *Hearing Colors* is a part of *The Connected Series*, which are episodes of short films sponsored by Samsung, but does not mention brand products. This episode features a young man that is color blind, but with an electronic device connected to the back of his head becomes able to hear colors. The film is

shot in black and white, as achromatic experience helps us better understand the main character's perception of an environment.

The simplicity of publishing branded content on digital media channels has made it an option for many brands in the last decades, starting from global players to national department stores. It is not only that simplicity, also the statistical data that is quite promising. In a study conducted by Nielsen (2016), it appears that branded content generates higher brand recall and affinity. In a survey of the 20 North American media groups, The Pressboard Media Inc has found that 90 percent of respondents expect to grow their revenue for branded content (Bjornson, 2019). Apparently, they have reasons for their actions, as a customer mindset is changing and they get more and more informed. The internet gives this flexibility of product comparison, idea sharing, review analysis and instead of a consumer we have to deal with a prosumer, who are even willing to participate in product development or creation and not only this, generations are changing and the new ones come with their likes and dislikes. According to Shane Smith, the CEO of Vice Media (Smith, 2016, 0:42), “the millennial generation is this most savvy generation, marketing generation ever, because they’ve been marketed to since they were kids, cartoons were made to sell cereal, so they don’t want you to boop, and they get it, if they see Pepsi at the end of the music video or something, they get it, Pepsi made that, I understand that and I understand what you’re trying to do.”

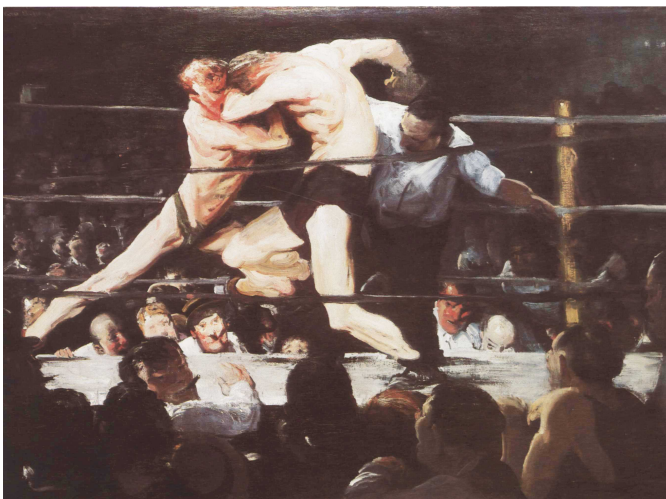
The term “Branded content” in its conventional sense is mostly associated with video material, but there are no limits, as long as there is something that carries the same nature and enough power to create an impact. The video in this case has become a “weapon of choice” for marketers because of its universality, the simplicity of distribution, and the power of emotional arousal. We can find parallels to be encouraged to link branded content with other visual techniques, such as the 3D lenticular printing. The video is a technique that employs so many elements of art and heavily appeals to emotions, the former, I mean the 3D lenticular printing technology can be considered an art itself, where we have a sequence of images that create a virtual three-dimensional frozen moment, the miniature world, that seems so tangible because of its stereoscopic nature, and from the photographic standpoint we know that image, despite being still, can pretty much tell a story.

Yet, we understand that still image is not a branded content in its convenient form, but if we look back through the history of the Catholic Church, we know that this organization was the biggest commissioner of the images that were painted during the Renaissance and the Baroque era, and the motive in today's marketing terms can be categorized as brand reinforcement. Those images still bring people in awe, and it is not difficult to imagine the sublime feeling a 17th-century peasant could experience if he was given an opportunity to see that perfect rendering of pope's mozzetta and facial expression from Velazquez's masterpiece.

Sure, it is not a perfect justification, if it is at all, when today we speak in favour of an impact that pictures had on a beholder a few centuries back. Neither those groundbreaking panoramas would have the same impact on today's spectator, but there will always be something that will excite us, as did those brushstrokes of impressionist painters which let us to feel the light, literally. The movement that we sense with George Bellows (see Figure 55), the ambience that we feel with Andrew Wyeth (see Figure 56), storytelling of Eugene Smith, or Terry Richardson's clever finding when he took vintage porn aesthetics and applied it to fashion photography to intensify its eroticism.

Figure 55

Stag at Sharkey's, George Bellows (1909)



Note. Cleveland Museum of Art. [Image Link](#)

Figure 56

Widows Walk, Andrew Wyeth (1990)



Note. Private collection. [Image Link](#)

In this context, we should see as an opportunity the unlimited possibilities that the computer generated imagery (CGI) gave to us. It is possible to recreate any event from history, present it from any point of view or focal length. There is virtually no limit, be that a flight of the 14-bis of Santos-Dumont, Ferrari winning the first Grand Prix, Armstrong stepping out of the Lunar module or let us say, beheading of Louis XVI. The most important of all, is the fact that this can be done with photorealistic quality that will be on par with autostereoscopic effect, resulting in augmented realism. The spatial depth effect that was so desired to be achieved by the great masters since the Renaissance period. Here we have a recipe for creating a unique visual and what we prepare is up to our imagination. Lenticular prints can be used for advertising and not in the manner that is commonly done. The majority of advertising posters that have seen daylight in recent years are flip-lenticulars, such as, Coca-Cola flip lenticular panels done in Brazil, or Spanish ANAR, an organisation that protects children at the risk of violence. They are simple to prepare for printing and difficult to appreciate that much, from the standpoint of a modern citizen who sees advertising TV panels and rolling or digital mupis on a daily basis. The 3D lenticular is another story, it is more complex, and that makes it rare. The glasses-free 3D is not widespread even as a technology, and it has the potential to excite people, when in combination with art and creativity.

I personally oppose making typical ad posters as the majority of 3D lenticular image makers do, as it is common in recent practice, the advertised product appears in the center, they give it a maximum depth that the lens can take and hope for the best. I think charming a viewer must be done in a combination and compromise of depth and composition. It is not solely effect, or solely image aesthetics that “sell” 3D lenticular, but both. It is like $1+1 = 2$, and I do not emphasize on mathematical correctness here, but on the power of two. I also imagine more of a branded content approach, when art speaks for a brand, as there is no technical limit in producing any historic or imaginary scene that can tell a story, be in association with brand values and at the same time appear autostereoscopic, glasses-free, and impress a beholder with its peculiar aesthetics. For example, let us imagine that we advertise an ethnological museum, how diverse our creative path becomes, when we practically have no limits of putting exponats

to their reconstructed life situations. We can create any mood possible, be that a fear and horror of say, enraged samurai, or curiosity for Homo erectus group hunting.

4. PROJECT

4.1. Idea

As a demo sample for this project I wanted to create something universal, which would serve to demonstrate 3D effect notably and also sufficiently justify the theories that have been spoken. From the possible different methods of preparation, the 3D modeling method has been chosen. The subject of this project is based on the historical accident of the train derailment at Montparnasse train station, that happened in Paris, in the year 1895 (see Figure 59), when the brakes malfunctioned and the locomotive number 721 with its tender, broke out the station wall and fell down the street, masonry fragments killing one person on the ground eventually. Fortunately there are enough photographs available from the scene, thanks to the

photographers that didn't miss their chance to capture this unusual occurrence with their cameras.

Figure 59

Press Coverage of the Accident



Note. Novembre 2, 1895 Issue, *Le Génie Civil*, weekly magazine. [Image Link](#)

From the technical standpoint, this scene gives a possibility to have a satisfactory balance between 3D effect and composition. To be more accurate, the moment of impact has been recreated, seconds after the locomotive hits the balcony parapet and together with the fragments of masonry flies out of the station. As there was no particular brand to work with, in a rough sense the artwork was thought to serve for the brand awareness campaign of an insurance company. To keep a certain order and make the process more comprehensible, I will

follow the sequence in which the scene was constructed and explain the related aspects on the way.

4.1.2. Process

I did my work in Blender 3D modeling software, which is an open source software and has its own rendering engine. Despite the fact that it is not as powerful in terms of reproducing photorealism as other industry standard engines, it is getting better and better with every release and even at this phase gives quite satisfactory results.

After a decision has been made about the project's subject and gathering all photographic references that I could reach, the image aspect ratio was in question, in order to design a composition accordingly and also think what would be the best kind of lenticular sheet to print on, as they come in specific sizes.

Considering all these I chose to work in a 2x3 format, portrait orientation. I did not have too much creative freedom in terms of environment design, since I had to follow the reference photographs that were shot after the incident.

In terms of composition, I chose a point of view that would let me avoid as much as possible the foreshortening of my central object which is the locomotive, and also would let me have enough protrusion of frontal elements in favour of three-dimensionality.

I began by roughly sketching the locomotive and the station in Blender (see Figure 60). After adjusting the camera position, I started modeling. Unfortunately, there was no blueprint available for this particular machine, I only found one reference image in a web search, of the same type of locomotive with a view from the side (see Figure 61), almost parallel to the camera plane. But being a photographic image shot some 120 years ago, it could have some geometric distortions caused by a variety of factors, from an imperfect lens to a result of the digitizing method used. Instead of starting with the locomotive body I began my work from its wheels, where the slightest deformity be it horizontal or vertical should be more noticeable. To my surprise, when I placed circles on them they fitted almost perfectly and I took my start from

there. I could create a more or less correct proportional interrelation of its body parts but I still didn't know how to define its correct length, height and width on a metric system.

Figure 60

Rough Sketch to Determine a Camera Angle

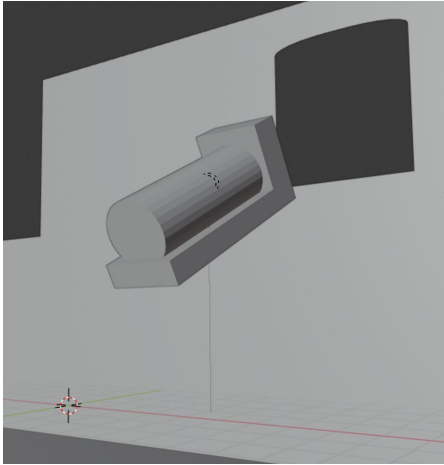
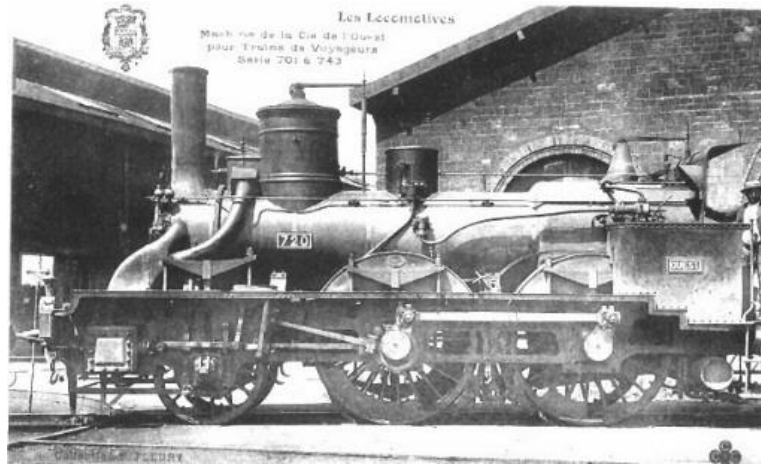


Figure 61

Side View of the Locomotive n°720

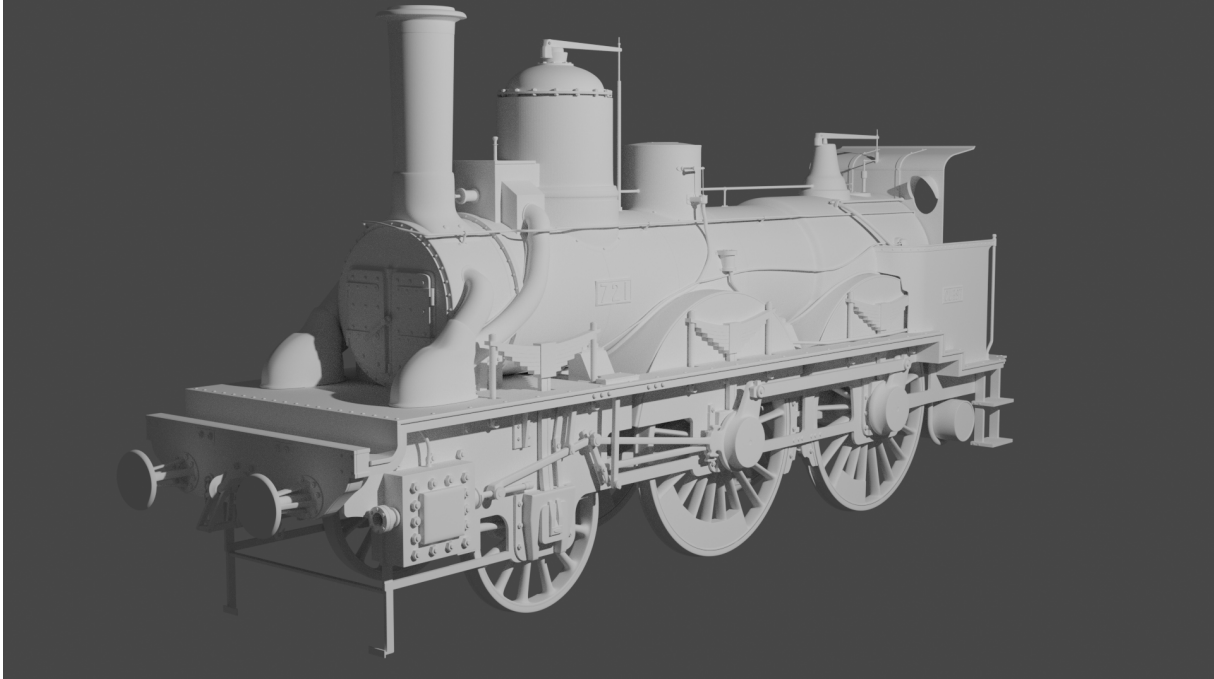


Note. [Image Link](#)

By knowing the height of the fall from the original newspaper report that I obtained through a web search, I placed a cylinder and square that would resemble the locomotive in the same position as it was shown on photographs available. Then comparing various photographs and the views from different perspectives, I made an assumption and defined the length of the locomotive in relation to the height of the wall. For width, I found quite an easy solution. I searched the web for the track gauge of the 19th century French railway system and as I found the answer I took my measurements from there. Finally, when I found the approximate length and width I started to shape the body. Height was not difficult to determine: as I knew the length now I could model over the side view image that I had. Final result came quite satisfactory, as there were no obviously detectable inconsistencies in the model (see Figure 62), so I placed the locomotive in the desired position and advanced with the station architecture.

Figure 62

3D Model of the Locomotive n°721



After getting done with the station building I gave the scene elements some quick temporary textures and checked the rendered stereoscopic pair in a stereoscope. This observation let me understand that it was necessary to somehow expand the space between the balcony parapet on the left side and the wall behind it (see Figure 63), as the texture and color are the same, the given angle did foreshorten it even in 3D and there would be no substantial spatial separation and something had to be done. I came up with an idea to place a ladder that would lean against the wall below the letters, and it would prevent foreshortening. I also wanted the ladder to have a “reason why” being there and I tilted the letter “U” a little bit, having in mind the maintenance work in process.

In the next step, I took care of the destruction caused by an impact, direction and quantity, and also the size of the fragments. I could not rely on the inbuilt impact simulation as it did not give me satisfactory results. I searched for the wrecking ball photographs used in the building demolition process and got some references of the wall fragments falling down. I followed the reference and manually placed the fragments in the scene, keeping in mind not to

cover too much of the key architecture details and also not to forget the direction of an impact, also the appearance to a viewer that would see them in 3D. As it was difficult to estimate on a 2D plane the perceptual forces that would come into action after viewing the scene in 3D, I rendered a stereoscopic pair once again and checked the effect this way (see Figure 64).

Figure 63

Test Textures

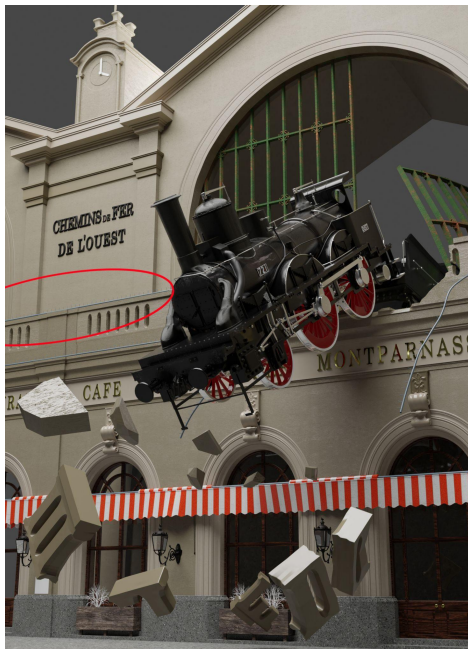


Figure 64

Test Stereo Pair



Note. Foreshortened zone marked in red. Temporary textures are seen applied.

Note. Effect can be observed with a stereoscope. The ladder is seen in the foreshortened zone.

Detailed texturization took place in the final phase when I practically finished the modeling process. I took a bit of creative freedom and decided to paint the wheels in red with a white rim, though in the original pictures it does not appear to be like this. The reason for this was to avoid color monotony as I had too much of it because of the gloomy color appearance of the architecture. I felt that it would not be dissonant, as these colors are very stereotypical for old steam train wheels. I gave a little bit of damage to the frontal air tubes, broke and twisted the rail guards, and gave a slight brownish tint to the front, as it had to appear dirty after an impact. I avoided too much scatter of the dirt and smoke, as too much of it would hide the

substantial part of the architecture and would obstruct the scene components overlapping each other, which is essential in achieving a decent illusion of depth. I chose a green color for the window frame in the upper part that would come in harmony with the complementary red color of nearby wheels. I also added a little bit of rust for realism. I used the same tactic of the complementary color harmonization for the awning canvas. Then I applied dirt smudges on almost every dihedral angle of the architecture, the lower part took more of it as it is in touch with the ground. To boost realism, I painted a smudge around the doorknob. Also on corners and sides of the front windows and the skylight structure glass.

For the lighting I used the soft box type illumination directing the light from above, keeping in mind cloudy daylight. There is also a directed light resembling overcast sunlight hitting the watchtower, to determine the location of the sun for that season and daytime I searched for some Paris photographs on www.flickr.com. I found several pictures of the Louvre area that were a close match, as these photographs were shot in the same month and time according to their EXIF data. So, I could determine through the falling shades the sun's approximate location at 4 P.M in the second part of October when the accident happened. Then by comparing two geographic locations on Google Maps I was able to find the approximate location of the sun in relation to Monparnasse train station.

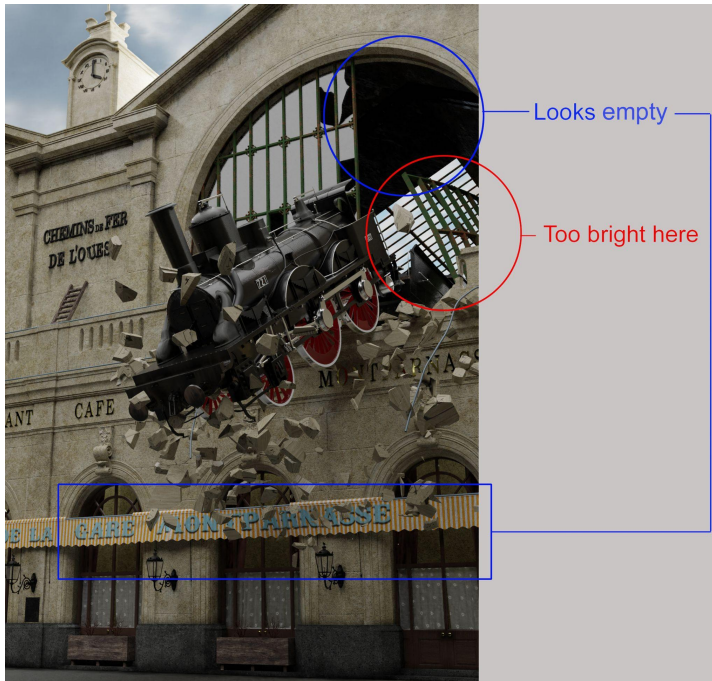
I had too much light coming from the skylight glass (see Figure 65), which brought undesired attention to the background and seemed to be in conflict with the intended hierarchy of scene elements. As I did not want to lower the power of the main light, which would affect my whole scene, I thought the solution would be to paint the sky darker in that area, and it worked.

In the next step I directed my attention to final optimizations. I modeled the roof holding structure and the clock, and made their outlines visible by slightly illuminating them, also placed the fallen window structure in a manner that it would overlap with them. I did not want this area to draw too much attention, but I wanted to have certain details that would guide an eye into the image depth (see Figure 65). I did the same trick in the lower part, by placing some textured elements, such as: tiles, paintings on the wall and a clock, in order to create a feeling of

space and characteristic atmosphere of a cafe. I gave a slight motion blur to those objects that are supposed to be in motion and rendered the final version of my work (see Figure 66).

Figure 65

Identifying Problems, Test Render



Note. Blue area looked empty, that is why I decided to bring in some additional elements.

Figure 66

Final Version



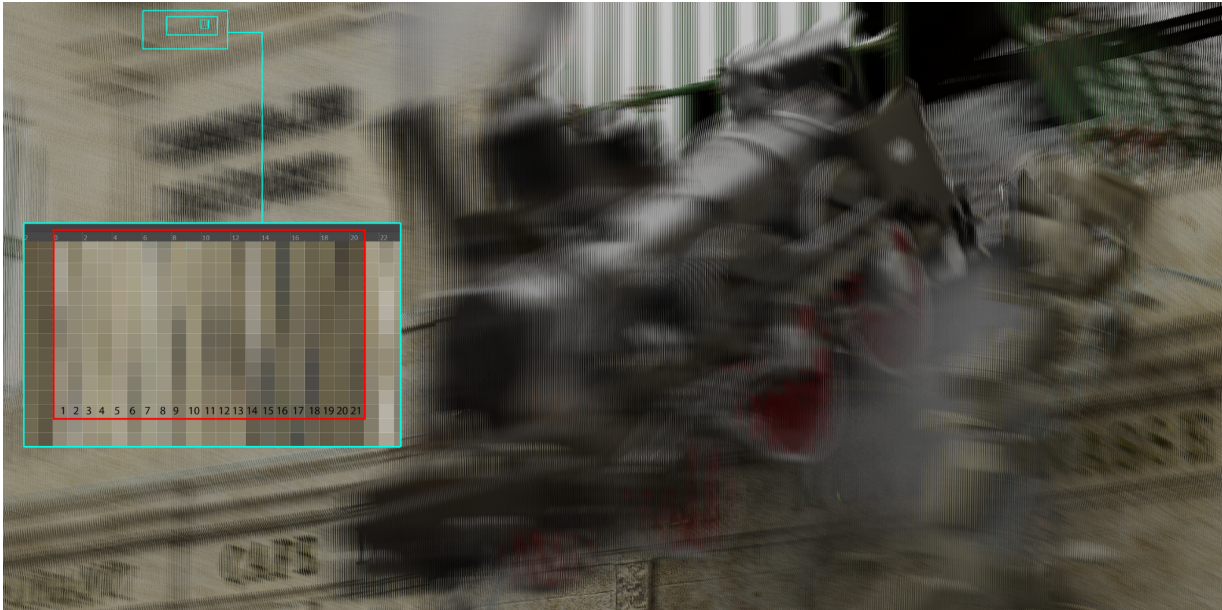
Note. [Animated Sequence](#) - [Full Size](#)

Once I got satisfied with the results, I went to proceed with the rendering of the frame sequence for interlacing (see Figure 66, Animated Sequence). I obtained a 28 LPI lenticular plastic, which is the best option for medium format prints. They don't come with an adhesive back layer and I had to laminate it with an optically clear film. So, later I could attach the print. As my option was the Canon printing machine that prints at 600 DPI, I needed 21 frames in total (see Figure 67). I used the manufacturer's recommendation for the parallax distance, meaning the distance between the same points of utmost left and right images in a sequence and after placing two cameras on the tips of a horizontal line in Blender, I could find the parallax distance by rendering these two views, then juxtaposing in photoshop and measuring it with the digital

ruler. Then I divided this line in segments in a way that in total it gave me 21 evenly distanced dots.

Figure 67

Fragment of the Interlaced Image

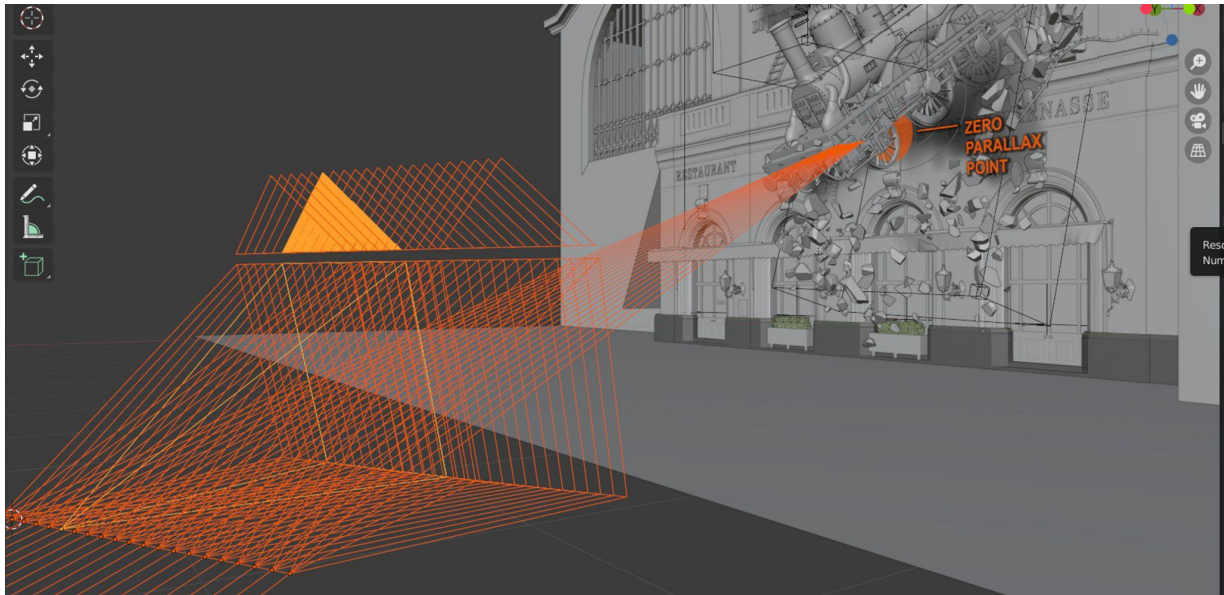


Note. Zoomed section marked in red shows interlaced frames to be under the single lens column consisting of 21 Pixels (600 DPI / 28.30 LPI (according to the pitch test) \approx 21.2 PPI) as I had to round it.

I attached a camera to each dot and directed them to the center of the image, to a spot where I decided the zero parallax point to be, this point would be a center of the rotation of imaginary axis, on a print leaving the front section fly to a viewer, while the back receding in space. Collecting the renders from each of these cameras would simulate a camera toeing in while in a sliding motion (see Figure 68).

Figure 68

Cameras Directed to Zero Parallax Point



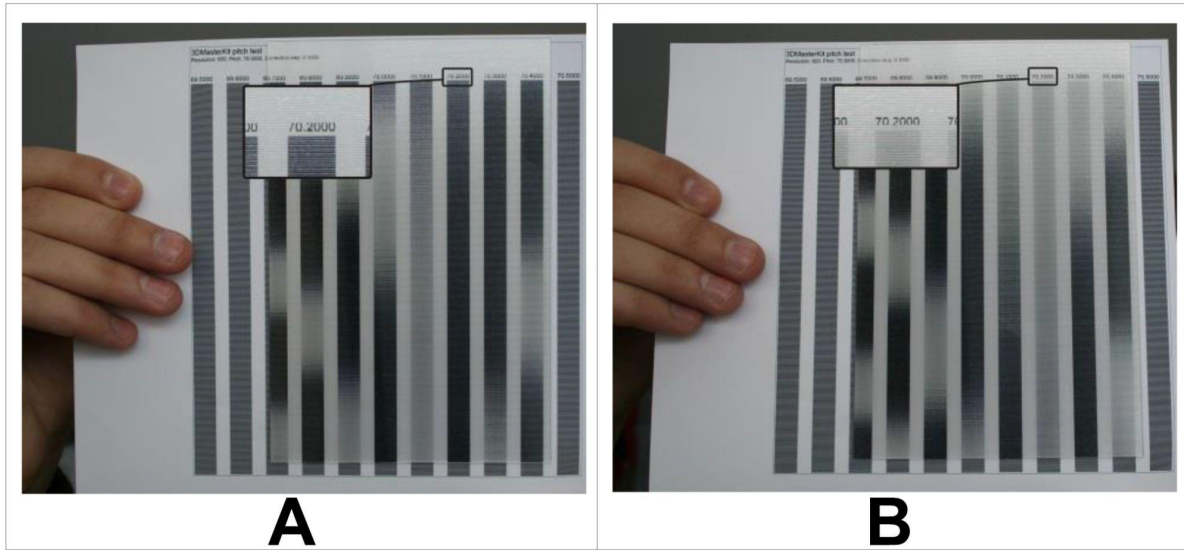
Note. 21 evenly distanced cameras seen on the left in orange. The cameras are directed to zero parallax point, which is located on the surface of the station's front wall.

4.1.3. Printing

After I had all the frames ready to be interlaced, I proceeded to the process called pitch test, that is necessary for adjusting the print under the lens columns (see Figure 69). The ambient temperature or type of a print substrate can all affect the in-between strip distances, so the test sequence of several vertical lines has to be printed with step changes of its value to find the ideal pitch. In my case I found that the value of 28.30 would give me the ideal result, as I would look at the pitch test print from the defined distance, in my case 150cm. The white space would change to black all over the horizontal plane instantly as I moved my head to the sides, meaning that strips were well allocated under the lens columns and my frames were ready to be put in the software for interlacing.

Figure 69

Pitch Test Sample



Note. Image is extracted from the Triaxes 3DMasterKit software manual. Lenticular sheet is seen imposed on a print, zoomed boxes show the ideal value.

For interlacing I used 3DMasterKit software by Triaxes. Before printing the interlaced image, I had to make sure that colors and brightness would come out the way I wanted, as the plastic lens affects these properties. I made a few scaled down prints with notes for variance in brightness and saturation and placed them under the lenticular sheet. Once I was able to find the best values for my print, then I opened my interlaced file in Photoshop and applied those selected values to it. Finally the print has been attached to the lenticular sheet and got ready to be viewed. The final sample is: W61 cm x L85 cm, recommended viewing distance: 150-250 cm. Viewing angle: 20-30 degrees. The binocular effect can only be observed in person.

5. CONCLUSION

We have seen through this text that the optical illusions come in a wide variety and diverse utilization. As my particular objective was to create a physical sample that would mix stereoscopic glasses-free technique and 3D modeling with the idea of adapting them to advertising purposes, I consider this part of my task to be accomplished. The printed result demonstrates decent three-dimensionality and it can be observed with naked eyes. About photorealism I would say that I had to compromise with the realistic look of the impact dust scattering for technical causes, this is something that I couldn't calculate and foresee. Anyway, overall photorealism is pretty convincing and the image has more photographic than cartoonish look.

My assertion is that this type of illusion can be used in advertising practice, since the unlimited possibilities of 3D modeling in terms of scene creation gives a great advantage from a creative standpoint. The glasses-free 3D effect is pretty practical, as any passer-by can observe it. Sure, there are some technical limits which I mentioned before, and this particular project has shown me that a scene construction has to be planned in the smallest details to avoid errors in the forthcoming phases.

I hope that my contribution in consideration of trying different visual techniques in advertising has been sufficiently demonstrated with this project and whoever sees the final work can get a firm grasp of the ideas introduced through the text. Posters of this type are visually rich and unique. The dimensional information encoded into a lenticular print helps to establish a better sense of connection between a beholder and the depicted visual environment, because of this sensation of tangibility created by the three-dimensional space. In comparison to conventional photographic images, here an observer senses augmented realism, because the brain automatically activates our capability of binocular vision, and because of its tangible nature lenticular image can be emotionally more appealing. An observer becomes able to feel the environment and this is one of the reasons why I chose to come up with this branded content approach, as emotion is also a main drive for branded content type of advertising, and

the advantage in terms of practically unlimited scene creation is another point that can come very useful. Without leaving a room, one can recreate any historic period or an event, and invoke certain emotions amplified by the lifelikeness of three-dimensional visuals, that in the end can be a solid prerequisite in terms of successful selling of the ideas, services, or products represented.

I think that future research can be done in order to find a way to reduce the costs of lenticular advertising. As lenticular plastic is much more expensive than paper, there must be a way to make those sheets multi-use by finding a way to wash the ink if it is flatbed printed, or find a weaker adhesive that will let us peel-off an applied print without leaving residues.

I am very content that I took this project, as I learned lots of new things and extended my knowledge, particularly in 3D design, advertising photography and art. I hope this will serve me pretty well in my future career in the creative industry.

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