

An interaction between graphic design and anamorphosis



Beyond Perception

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Abstract

This project report shows a new way for designers and content creators to present their work and interact with the audience. It focuses on the creation of the anamorphic effect using 3D modelling software. The anamorphic effect is achieved by using two-dimensional media to simulate a three-dimensional result that can only be perceived from one point of view. This creative process is described step by step to help other creatives achieve this illusion, bearing in mind that this report only focuses on how to achieve the output to create the illusion. Additional key points and terminology will be mentioned to give a more comprehensive report. This digital illusion can be presented in a number of ways, but our focus has been on exploring its iteration with a projector. This medium of presentation is coupled with important characteristics such as: the ability to adapt the images to any surface, good mobility and low cost. This allowed the mock-ups created to be presented using not one but two surfaces, which helped this report to be more exponential and allowed for a more complex exploration of this technique from a designer's point of view to develop and show examples of what could be done in communication design. Beyond these mock-ups, other examples of real-world applications are reviewed to demonstrate what has been done and what can be achieved when collaboration happens between different fields that use this technique to create the wow factor that most content creators and us designers pursue every time.

Key words: anamorphism, perspective, graphic design, projection, illusion.

Resumo

Este relatório mostra uma nova forma para, os designers e criadores de conteúdos, apresentarem o seu trabalho e interagirem com o público. Centra-se na criação do efeito anamórfico criado através de software de modelação 3D. O efeito anamórfico é conseguido através da utilização de meios bidimensionais para simular um resultado tridimensional que só pode ser percepcionado de um ponto de vista. Este processo criativo é descrito passo a passo para ajudar outros criativos conseguir esta ilusão, tendo em conta que este relatório se centra apenas na forma de obter o resultado para criar o efeito anamórfico. Outros pontos-chave e terminologia serão mencionados para dar um relatório mais abrangente. Esta ilusão digital pode ser apresentada de várias formas, mas a nossa atenção centrou-se na exploração da sua iteração com um projetor. A este meio de apresentação estão associadas características importantes, tais como: a capacidade de adaptar as imagens a qualquer superfície, a boa mobilidade e o baixo custo. Isto permitiu que as maquetas criadas fossem apresentadas não numa, mas em duas superfícies, o que ajudou este relatório a ser mais exponencial e permitiu uma exploração mais complexa desta técnica do ponto de vista do designer para desenvolver e mostrar exemplos do que poderia ser feito no design de comunicação. Para além destas simulações, são analisados outros exemplos de aplicações reais para demonstrar o que foi feito e o que pode ser alcançado quando existe colaboração entre diferentes áreas que utilizam esta técnica para criar o fator “uau” que a maioria dos criadores de conteúdos e nós, designers, procuramos sempre.

Palavras chave: anamorfismo, perspetiva, design gráfico, projeção, ilusão.

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Introduction

This project involves the research, registration and presentation of a method I called “digital anamorphosis”. This project focuses on the application and exploration of the anamorphic illusion, created by our days technology. The whole process has been developed to be used digitally, with the intention to be presented by a projector, but it can also be applied on a LED screen, if that is the intention. This project is seen from a graphics designer perspective explaining the exploration of this illusion through the interaction with typography with the objective of creating immersive 3D content.

The technology used allows anyone who wants to create content to present their work using two-dimensional means to simulate a three-dimensional result. This allows a new way of creating content to be explored and interacted with, allowing more to be discovered and new forms of implementation to be developed. We believe that this report will facilitate the understanding of “digital anamorphosis”, as I call the methodology in question, and its application.

The majority of this project is based on open source or free software. I choose Blender for 3D modelling and Davinci Resolve for video editing, to make it as accessible as possible. Not only does this add value to the project, by making it more accessible to others with lower resources for example, small studios or businesses that want to advertise their work in a innovative way. Even though this are free to use their capabilities are very well suited to the needs of this project.

The main aim of our report is to introduce a methodology and a new perspective to the development of 3D content and the interaction it can have. I want to demonstrate what can be explored and created by experimenting with the geometry behind the concept.

Although the main focus of this project has been on the use of a projector, this method can be presented on a variety of platforms such as mobile phones or billboards. This medium was the most logical and suitable choice for exploring our method as a projection can adapt to its environment, meaning we could test not only on flat surfaces but also on angled ones, which would not be possible without a projector as access to curved screens is currently very expensive and difficult to obtain. A projector is cheaper, easier to transport and allows wider exploration. The fact that the media price is low helps to reduce the overall cost of implementing this technique. Although there are some differences when developing for other technologies, the process developed can provide a starting point for other supports.

In this project we wanted to record the methodology we used to develop our project, as we realised when researching on this topic that there was not much information available on a start to finish guide to implementation, but rather separate information that we examined, tested and adapted to create a process that can be explored and from which results can be obtained. The content created during the development of this project is provided to demonstrate ideas of what can be achieved when exploring the methodology with graphic design.

It is important to bear in mind that this project report is a written guide to what was our method of creation and it could vary in implementation depending on the objective and/or the tools available to work with. It is not the only way of conception but it is what we have achieved based on our knowledge and research.

Most of our technical research has been carried out on web forums and developers websites, to example blenderartists.org, blender.org or cgmatter.com, which are constantly experimenting and developing new ways of working, raising questions and possibilities that I have tried out. Some of, I have applied to our method of creation, some were considered based on the idea that they would improve the output by making it simpler or improve overall quality. Most of the technical research has been done using these sources, based on what we have searched, the lack of documentation on the creative process is due to

the rapid rise of this type of work, and as it is fairly recent it is normal that there is a lack of documentation. Historical and contextual understanding on anamorphosis has been done through literature research.

This project report is divided into five chapters. Chapter one, Contextualisation, is a brief historical introduction to anamorphosis and its development over time, followed by a basic explanation of how the anamorphic illusion can be created digitally using 3D modelling software, and we continue our explanation with some examples of how it can be presented.

In chapter two, Visual References, we present some examples of projects that we have chosen for the innovation and originality they bring to this type of work, using the interaction between the animation and the point of view to simulate depth and deceive the viewer’s eye.

Chapter three, Tools Technical and Graphical Considerations, we present tools that can help in the creative process, helping to set the measurements that are very important if we want the illusion to play as it should, and importing them to create so it is easier to set up the scenery in Blender. We will also explain some important terminology and procedures that are very important for understanding the creative process.

Chapter four, Creative Process, presents the different programs we used to produce and present the animations that create the anamorphic illusion, followed by our creation process inside Blender and how we set up the output to be projected, as some tests we made along the development of the creative process that help understand some of the steps we took.

In chapter five, Mock-ups, we show some examples of our designs, how they look when they are finally backed, and how they behave when presented on an edge or a flat surface. We have only created for these two types of shaped surfaces, we know that more can be done with other types of shapes, but due to limited time we could not explore these interactions further. This chapter is intended to show different approaches, from a designers perspective, to what can be created and to inspire further creations to develop on this type of work.

1.0

Contextualization

1.1 Brief historical introduction to anamorphosis

Over the years, an ancient technique used in painting has experienced a resurgence in the digital age. The evolution of this technique and its various applications over the years, in different disciplines, have ensured its contemporaneity. The technological evolution has permitted its integration as part of our every day life, through LED displays and projections. The technology has allowed for an easier way of displaying the work, to the masses through its availability and abundance. It has given creative artists, such as digital designers and video-effect artists, a new canvas on which they can develop their work and create truly unique viewer experiences.

The technique referred to is anamorphosis or anamorphic illusion. The term illusion, or more specifically optical illusion, needs to be emphasised, an illusion is a visually perceived image that appears to be different from objective reality.

The most common ones are certain 2D configurations that trick the eye, giving a false impression about lengths, inclinations of lines, or tonality of colours. In 3D space, optical illusions usually refer to our ability to perceive perspective views, the understanding of light and shadow as well as our wrongly perceived distance from certain objects. More specifically, Anamorphosis is a distorted projection of an image or object, which only becomes clear when the observer's point of view originates from the so-called vantage point or it is viewed as a reflection produced by special devices, such as a specific curved mirror surface. The word "anamorphosis" originates from the Greek compound word, whose prefix *ana-* means back or again, and the word *-morphe*, which means shape or form. There are two main types of anamorphosis: perspective or oblique, and mirror or catoptric from Greek *catoptron*, which means mirror. (Symeonidou I. 2016)

To the best of our knowledge anamorphosis had its earliest appearance in the fifteenth century. Among various famous paintings that used this technique are *Pala di Brera* by Piero della Francesca (1472), *Leonardo's Eye* by Leonardo Da Vinci (1485) and *The Ambassadors* by Hans Holbein the Younger (1533).

Along the years this technique was explored and improved mathematically, thanks to authors like Jean François Nicéron, artist and mathematician, who wrote the treatise *La Perspective Curieuse*, which presents diagrams, that helped to understand the technique and how it could be implemented.

The diagram presented (Figure 1) helps to understand how artists such as Fra Andrea Pozzo and Emmanuel Maignan made their frescoes. (Figure 2, Figure 3) In short, the drawing is divided into a grid system, each square in the paper corresponds to a square on the wall, the drawing, orthogonal to the wall, is painted in it through this system, and the space occupied by the painting is determined by the point of view intended to be seen. As the viewer approaches the advantage point, the painting goes from a distortion to a perceived image, surprising and astonishing the viewer.

In the sixteenth century, new forms of realising and observing anamorphic art appeared, called catoptric or dioptric anamorphosis, depending on whether the image is being reflected or refracted, and to see the anamorphic image, usually an external optical device is used, usually a cylindrical or conical shaped mirror, these instruments are called "anamorphoscopes". (Figure 4)

Di Paola et al. (2014) pointed out that between the sixteenth and eighteenth centuries, a series of paintings were developed and categorised as "quadraturism" and "trompe-l'oeil". These painting styles aimed at the composition of false architectural perspectives, realised in full scale, to create illusionary effects on ceilings and walls.

Presently this technique has been implemented in different fields, the evolution of the technology, as mentioned before, was one of the principle causes of its implementations in advertising, graphic design, product design, architecture and many other fields.

Its representation in the world of digital graphics is mainly presented through LED screens, due to its rapid commercialisation over the years. This has opened up a new field of research that creates exciting content capable of surprising audiences. The scenarios created through the implementation of anamorphosis can be presented not only on LED screens, called anamorphic DOOH (digital out of home), or projected into a building interacting with the architecture, projection mapping with anamorphic illusion.

Nowadays, anamorphic illusions are in great demand due to their growth in commercial works. Some examples of these digital illusions can be seen in works by Refik Anadol such as "Quadrature" (Figure 5), although the main objective of the artist is not the illusion created by perspective but the art generated by AI (Artificial Intelligence), I consider it a great example due to the various works where he has variously explored the illusion of depth and his recent exploration with projection mapping, which is related to perspective like anamorphosis.

"The Infinity Wall" by d'strict (Figure 6), this type of anamorphic work is created by a specialised studio that focuses on developing artistic and commercial projects with anamorphic illusion as a primary objective.

With the urge for this type of work, generated by the good results achieved with the public, new creative ideas and, as a result, new techniques will emerge, generating new formats of creation and presentation, contributing to the continuous evolution of the history of anamorphosis.

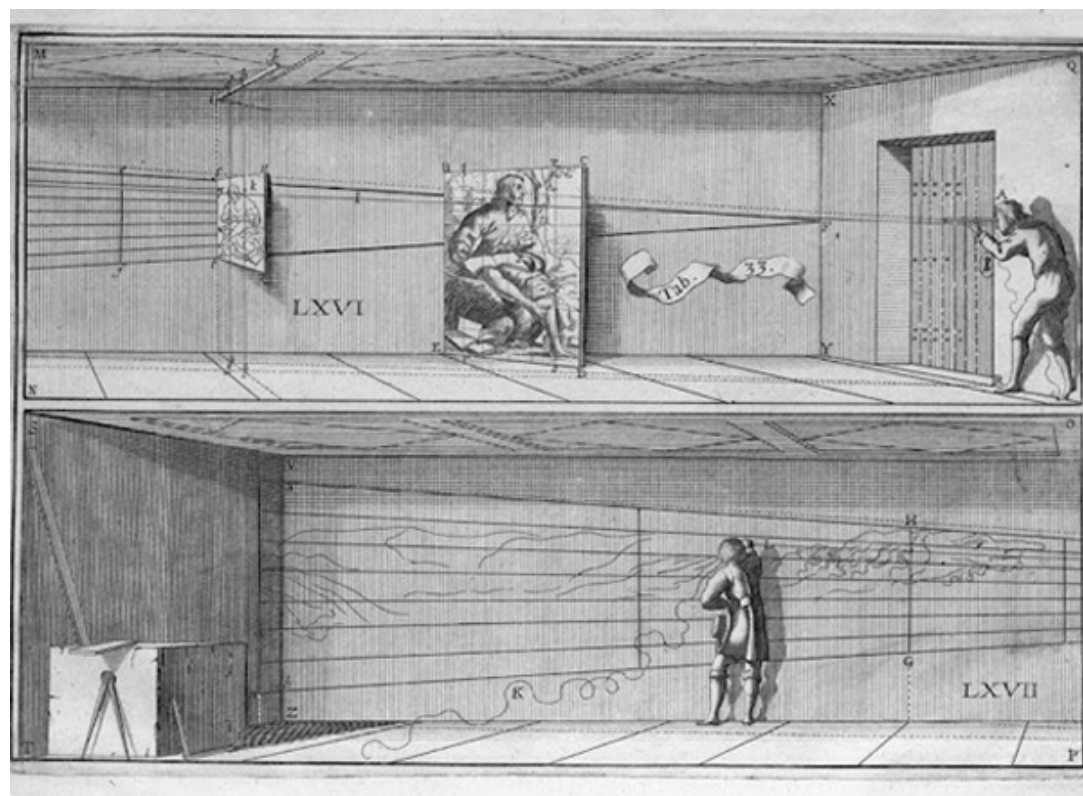


Figure 1: Anamorphic structure by J.F. Nicéron, Thaumaturgus Opticus (Tab. 33, Fig. LXVI and LXVII), Paris, 1646



Figure 3: L'affresco di Maignan, San Francesco di Paola, Roma 1642.

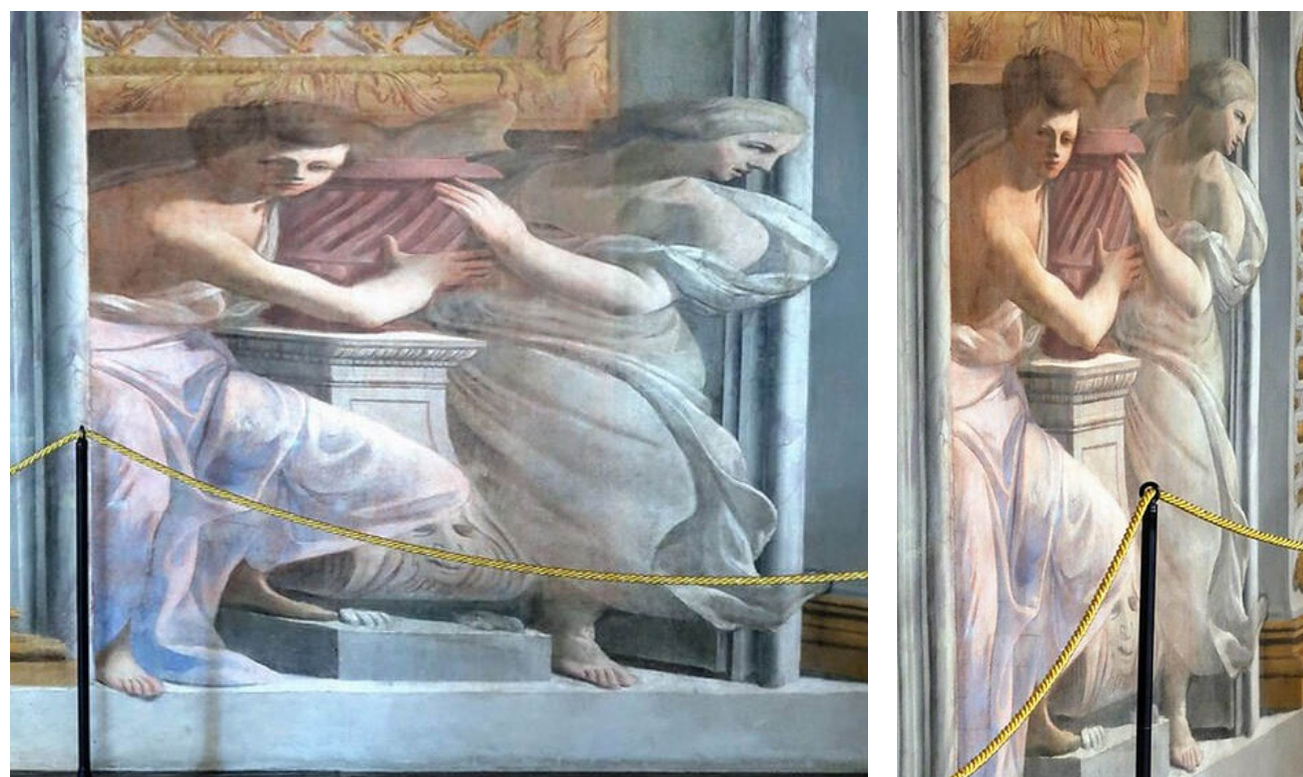


Figure 2: Frescoes of church Sant' Ignazio, F. A. Pozzo, 1681-1686



Figure 4: Curiose Riflessioni. Installation view at Palazzo Barberini, Jean François Nicéron, Roma 2018.

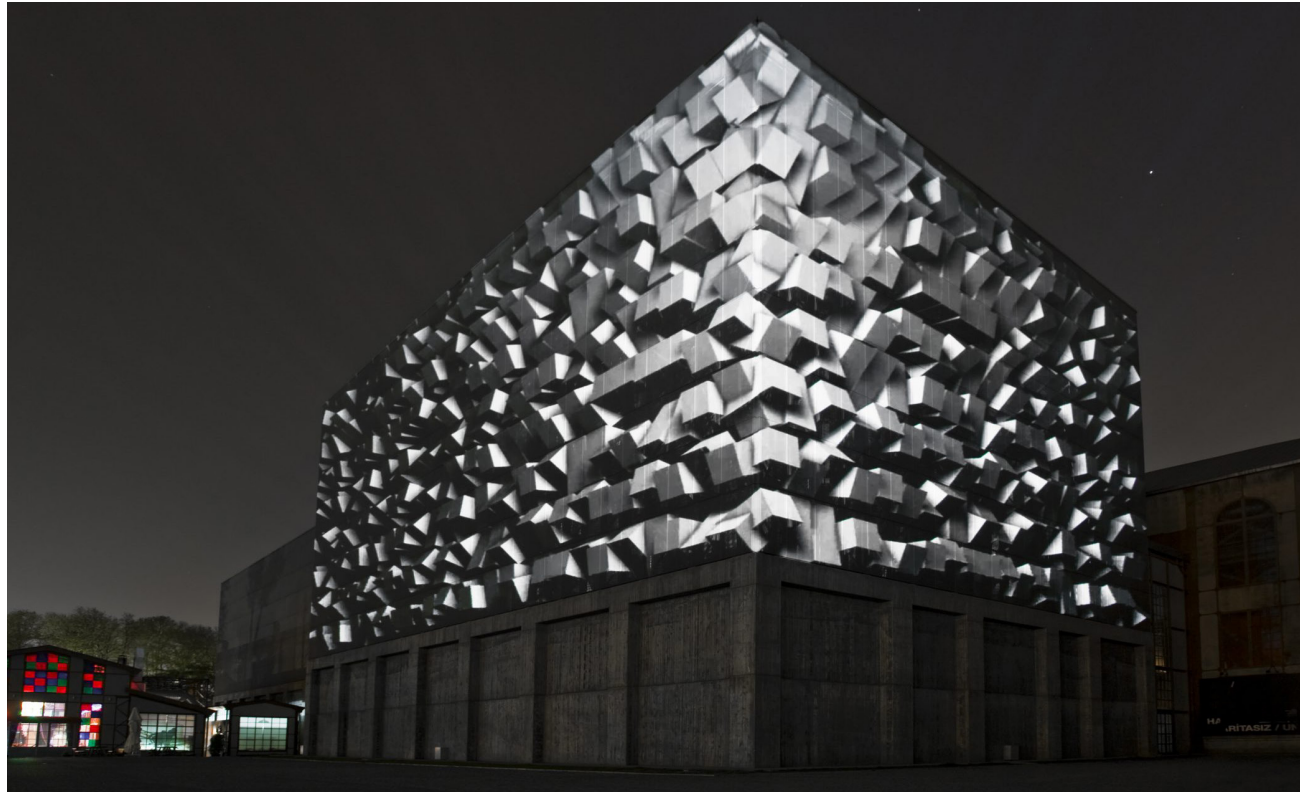


Figure 5: Artistic projection interaction created by Refik Anadol. “Quadrature”. Istanbul, TR. 30 Apr 2009.

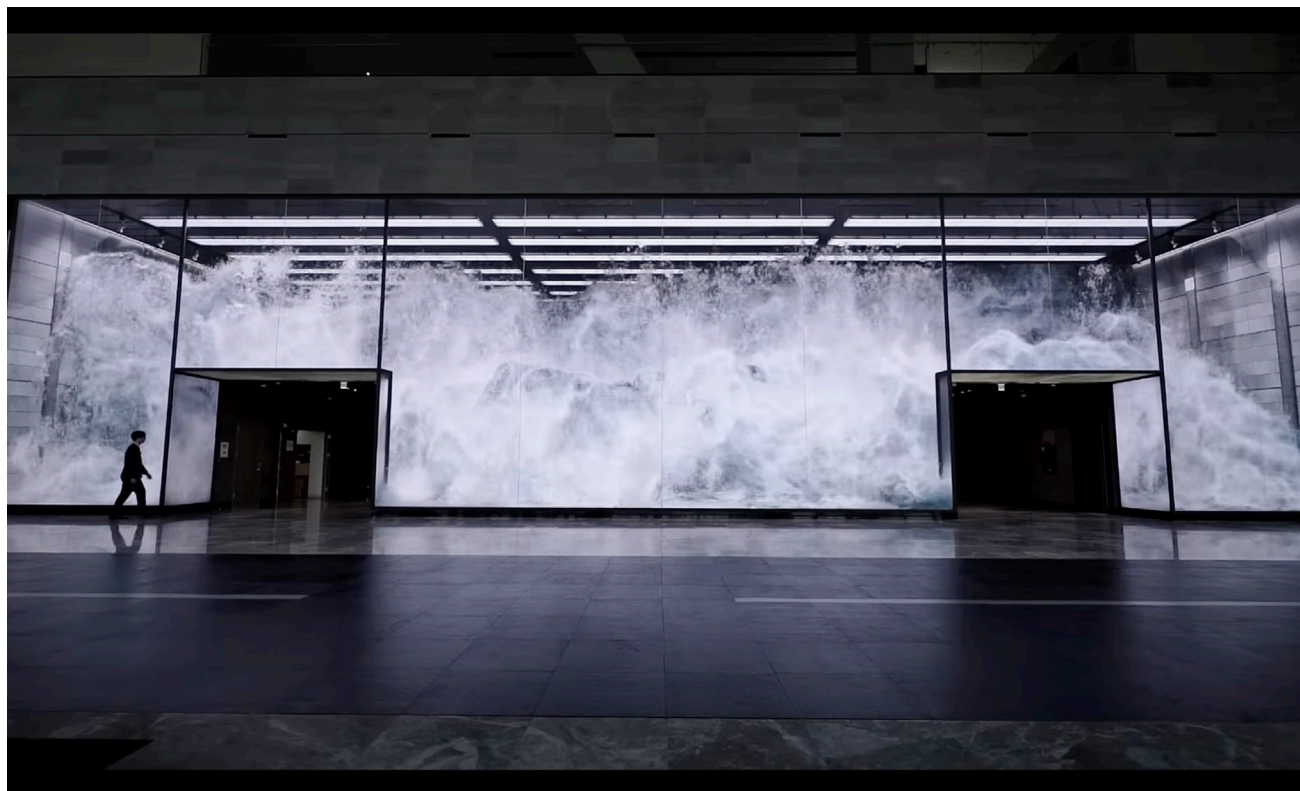


Figure 6: Anamorphic illusion on LED screens from d'strict. The Infinity Wall. Nexen University. April 2019.

1.2 Digital Anamorphosis: brief explanation and concepts

As mentioned above, the anamorphic illusion can be presented digitally using two types of technology: LED screens or a projector. Both use the same design principles, as the illusion technique differs only in a few parameters.

In the digital world of anamorphosis, mechanical tools such as pencils, rulers and paper are replaced by hardware such as a computer, mouse and keyboard, as well as software, which I refer to as the canvas, since the creative process takes place on it. The type of software used is CAD (Computer Aided Design), this type of programme can produce two-dimensional (2-D) drawings or three-dimensional (3-D) models and allows the creators to do any type of modelling and, in this case, to create the volumetric space where the illusion must take place and the actual creative process of the illusion. Anything that needs to be seen has to be within that volumetric space so that it's visible in the final piece. This can usually be presented in many different ways, static or animated, printed or digital, it is up to the creator and the intended purpose.

In this case, the focus is on digital presentation using a projector. All the experiments I have carried out are animated to show their full potential to create an immersive 3D effect without the need for external elements. This will allow us to show more than what can be seen on a static image.

This project is intended to be a start for the full exploration of the possible potential of the 3D environment created work as interacting and communicating with the viewer. Anamorphosis allows the illusion of depth to be enhanced and the message to be communicated in a more interactive way. It is possible to find ways to show more than what can be shown. More will be explained and specified later in this report.

This topic is intended to give an initial idea and introduce the main theme of this project, which is the exploration of what we call digital anamorphosis, the process of creating an anamorphic illusion in a digital environment and presenting it using electronic devices such as projectors or LED screens.

1.2.1 Base steps of the digital creative process

This topic is a brief introduction to what I consider to be the basic steps required to create anamorphosis in a 3D environment using CAD software as a design tool, where the resulting work is intended to be presented on projectors, but can also be shown on an LED screen. We took this initial information from the UEAZ YouTube series entitled Led Anamorphic Dooh (2022).

Firstly, we need to consider the point of view, the place where the illusion is perceived, in order to determine the perspective view, the place where the camera must be placed in the 3D environment so that we can render the project in the correct perspective.

Other calculations are necessary to avoid mistakes in the final output, and before we start modelling we need to determine the dimensions and angles of the presentation surface, that is, the screen(s) dimensions/resolution or, if projected, the projection surface, so that we can start modelling the scenery respecting the volume, so that the 3D illusion created does not disappear or take up the wrong position. All these measurements are made to ensure that the final result is as intended and to avoid extra work in post-production. (Figure 7)

When creating the design in a 3D modelling programme, tools are usually available to shape, modify, texture and colour objects to create the desired output. Some offer the ability to animate and create complete scenes with lighting, cameras, spatial effects and so on. Nowadays, 3D modelling software is well equipped with many tools that allow the creator to do almost anything they want with almost no limitations. Usually, the most common limitation has to do with the hardware being powerful enough to support the files that need to be processed, sometimes causing document loss and computer crashes.

At the end, the result can be rendered to deliver a presentation-ready output.

1.2.2 CAD software for the development of digital anamorphosis

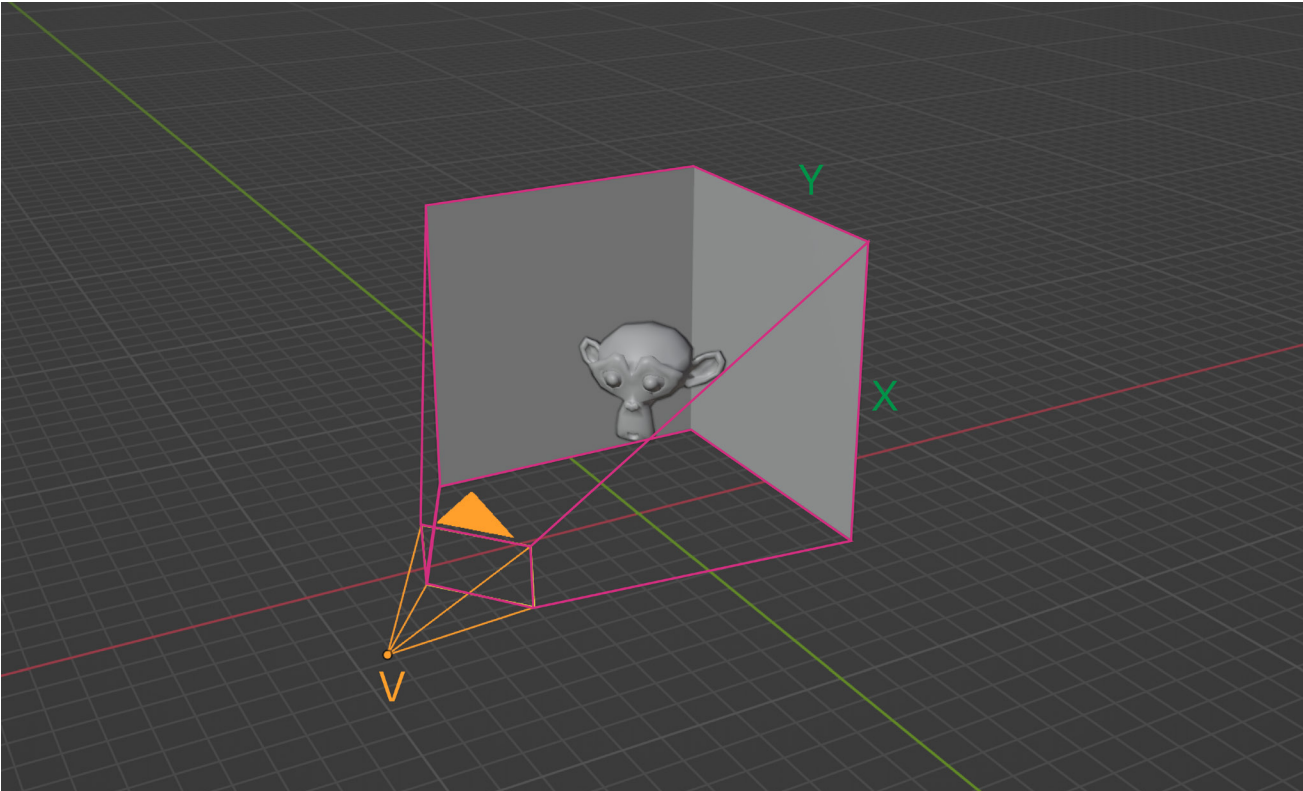


Figure 7: Demonstration of the virtual volumetric space, in magenta, obtained by the dimensions, X and Y assuming that the other side is equal, of the presentation surface or LED screens relative to the advantage point, V being the camera in the virtual space.

CAD programs will be one of the most important tools along the creation of this project. Formlabs website states that there are four types - solid, surface, polygonal and parametric modelling - and each with its characteristics a brief understanding of the capabilities and purpose is important to know which to explore and the most apropos for the making of this project.

Solid modelling is easier to understand because it is easier to model. It is more restrictive as it treats the virtual design as a manufacturable object and allows the designer to create solid objects by adding or removing material using CSG (Constructive Solid Geometry) techniques. Solidworks, Fusion 360 and Solid Edge are some examples of software that allow the designer to create sketches of the parts and through actions such as extrusion, rotating or twisting around an axis, or sweeping a shape through a conductive line, among many other features, allow for the creation of manufacturable models.

Creating an object from surface modelling gives the designer more freedom to modify in ways that solid modelling does not, due to the undefined properties of mass and thickness. The creation of a virtual object from a set of surfaces is carried out from its connections until it is “watertight”, meaning that all the surfaces are correctly connected and there are no breaks in the object, and if not then it can be converted to a solid body. Alias, Creo and Rhinoceros are some examples of programs that produce results from sketched surfaces and through blending and trimming, with interacting surfaces, complex designs can be achieved. It is possible to produce models using surface modelling alone, but most real world applications also require a solid modelling relation.

Spatial sites claim that the difference between solid and surface models is how a designer can interact and manipulate an object in a CAD system.

Wireframe, polygon or mesh modelling programmes are the most appropriate for this project. Their creative process involves shaping a mesh by manipulating its elements: vertices, edges and faces. The ability to add modifiers that affect the entire wireframe of the model allows actions such as blending, twisting, smoothing, morphing shapes, and so on, to be performed. The features and tools that some of these programs offer allow for more creative output, as they encourage more inventive and experimental types of work. The following list contains the top 10 3D animation programs that artists should consider before entering the field: Autodesk Maya, Blender, 3D Studio Max, Cinema 4D, Houdini, Lightwave, Modo, Maxon Cinema 4D, and NewTek LightWave (Hendriyani & Amrizal, 2019). These programs allow creators to texture, animate, and render designs.

With these features mentioned above, I was able to explore the anamorphic illusion in different ways and choose an animated result. In addition to all the features mentioned above, one of the most relevant and crucial to the anamorphosis process is the ability to place viewpoints or cameras in 3D space, allowing different perspectives of the different viewpoints to be simulated if necessary (Figure 8). For this purpose, and given the range of features and creative freedom offered by mesh modelling programs, the choice was obvious.

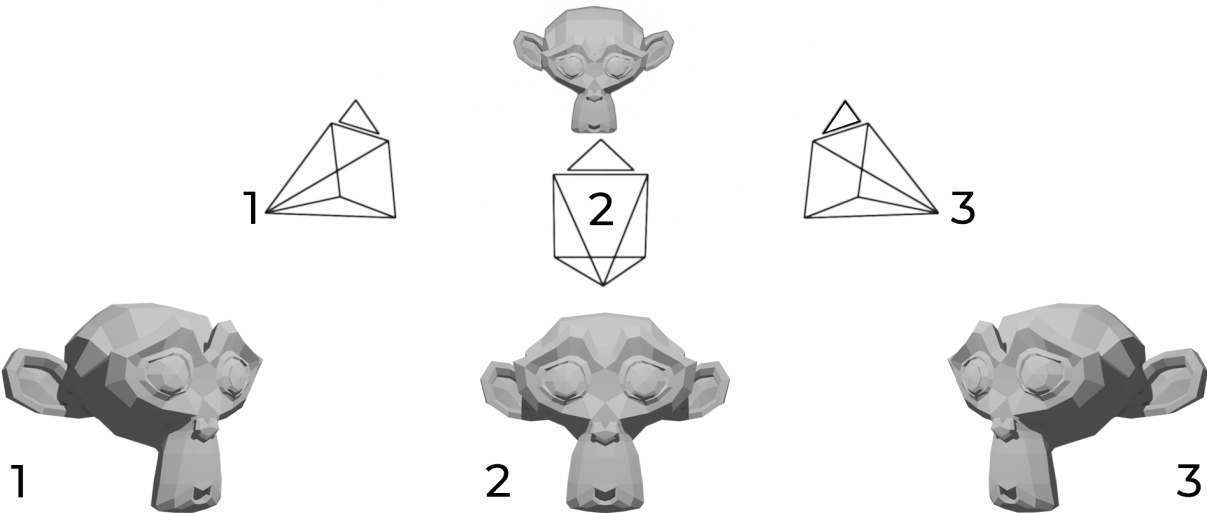


Figure 8: Visualisation of the use of multiple cameras in the same 3D space, simulating different viewpoints. Each camera as a different output according to each number.

1.2.3 Analysis of different presentation technologies

When presenting a digitally created anamorphic illusion, it is important to consider the conditions in which it will be displayed. Of course, the first consideration must always be to achieve the best possible result, bearing in mind that all previous work has been done according to the specifications of the screen or presentation surface. As I have already mentioned, there are two technologies available for displaying the anamorphic illusion: screens, preferably LED screens because they have a higher resolution, which is always better. The other method is to use a projector, which I have chosen for its lower cost, ease of transport and ability to adapt to surfaces, which is very important for this project.

Of course, these technologies have their advantages and disadvantages. But both benefit from a controlled lighting environment. The best conditions are achieved in what we call a ‘black box’, where almost no light is emitted except from the projector or screen, and none

of it is refracted and bounced around the room. The simplest example of a near-perfect condition is a cinema. Although these are the preferred conditions, this does not prevent the work from being displayed in daylight. In general, it is preferable to be in a controlled environment where we can adjust the lighting conditions to suit our needs.

Projectors can be more difficult to work with than an LED screen (Jiyoung P. and Myoung H. K. 2015). However, their projection can adapt to different shaped surfaces, is easier to transport, provides a large image from a smaller device, and helps to create a more immersive experience. When using projectors, the first thing to consider is brightness. This is the most important factor in achieving higher contrast, as it improves image quality for the viewer.

To choose the right brightness, and therefore the most suitable projector, it is important to understand what lumens (lm) is. Lumens is a measure of luminous flux (a measure of how much light is emitted in a given period of time). The brightness of a projector is measured in lumens or, more commonly, ANSI (American National Standards Institute) lumens. To make the measurement system easier to understand, we know from the ViewSonic website that on a sunny day, up to 100,000 lumens can typically be emitted, and normally a typical projector, as far as we can tell, varies between a three and four digit number. So the machine is less able to project the kind of brightness needed to get a good image quality. In other words, projectors are better suited to indoor use, where lighting conditions are more favourable for better image quality.

Based on a practical relationship between ambient light and lumens, we created three groups using information from two projector manufacturers, ViewSonic and Xgimi:

Low light environments: Usually these are rooms with tightly controlled to low ambient light where we can manage the light sources, such as artificial lighting and we have windows with coverings. We can choose any projector that is under 3000 lumens. Ideal for home use for example.

Low to medium light environments: These are typically rooms where ambient light can not be blocked out, such as classrooms and home entertainment rooms. Obviously, a projector with a higher brightness rating is required, which can vary between 600 and 4000 lumens depending on the lighting conditions, image size and distance between the projection and the projector. In most cases, these variables are interrelated and it is easy to understand that the larger the image, the higher the brightness required. The closer the projector is to the screen, the brighter and smaller the image, and vice versa.

Medium to bright environments: Typically, a projector of 2,000 lumens or more is appropriate, and anything over 4,000 lumens is usually adequate for large audiences because it is easier to see. Projectors of this brightness are suitable for multi-purpose rooms, commercial venues, auditoriums, etc. These areas typically have a lot of ambient light and minimal control over light sources.

Taking all these factors into account, I have found that choosing the right technology comes down to the purpose and intentions of the creator, combined with the specifications of the environment. It is a matter of understanding what the requirements are and choosing the most appropriate LED or, for this project, projector to present the output. For example, if a presentation is to take place in an open space at night and needs to be large in scale and adaptable to the environment, such as a façade, a projector would be a good option to consider. The purpose of this example is to give the idea that it is really up to the analysis of the variables mentioned above and to decide on the most appropriate option.

Some cases of what is being done with LED screens and projectors can be seen from the examples presented. The three cases show different implementations (Figures 9, 10 and 11), with different formats, used to present different types of content that rely on the anamorphic illusion to create engaging work. Note that they achieve a 3D effect through the positional difference between the elements that make up the video. This shows that there are many ways to present, explore and demonstrate what can be done with the illusion of depth created by anamorphosis.



Figure 9: Nike, Nike Air Max Day's 3D billboard, Japan. In Japan, Nike created an ad that simulated the illusion of floating shoes. This illusion was achieved by using a huge curved L-shaped screen.



Figure 10: Renaissance Dreams by Refik Anadol, Palazzo Strozzi, Florence, Italy, Refik Anadol 2022. The particles coming from inside a white box helps to give depth to the illusion created on a flat LED screen.

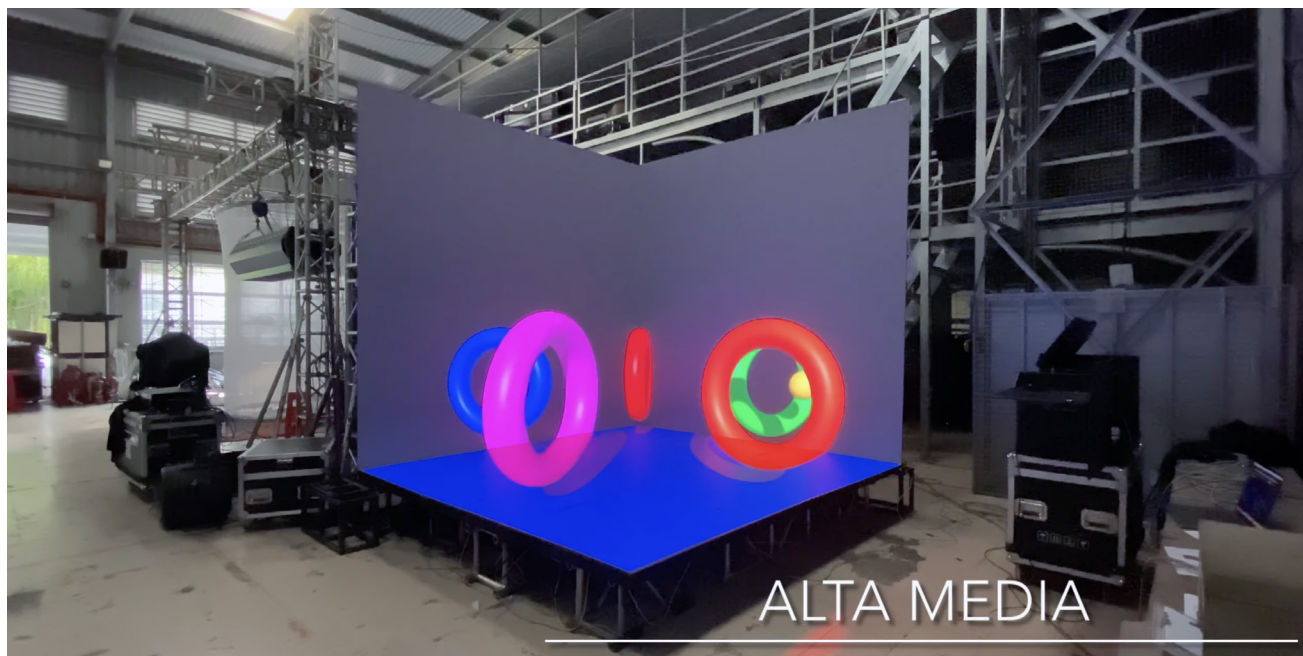


Figure 11: Alta media, tri-planar anamorphic display. To create the illusion of a ball passing through a series of doughnut-shaped geometries, three panels/areas are used.

1.3 Projection mapping

An understanding of how projection mapping works is necessary to properly explore this project, as one of the presentation methods is, as the title suggests, projection. This is used in conjunction with anamorphosis, or vice versa, and in this project I have only referred to some of the techniques to make the projection more easily adaptable to the surface.

Projection mapping is a process that culminates in an interaction between the virtual and real worlds through the precise mapping of a projection and the surface to be projected. The creative process begins by copying the real space in a virtual 3D environment, with a virtual camera placed in the exact position where the projector will be. The video image can be specifically adapted to the different characteristics of the projection surface. When the virtual space is projected onto its physical twin, if all dimensions and coordinates are respected, the exact trace of the virtual world is reproduced in the real world. Any changes to the virtual space, lighting, media content, physical changes, textures and so on will be replicated in the physical space. Basically, a virtual mask is created and is applied to a surface via a projector to change its appearance. (Jung, Biocca and Lee, 2015 and Rowe A. 2013).

The result is a hybrid fusion of real and virtual information, perceived by the audience as a mixed reality experience. However, for this to be fully effective, the viewer's position must be known, or at least "forced" to assume the position of the viewing point. (Rowe A. 2013)

Raskar, Welch, and Fuchs (1998) defined the term spatially augmented reality specifically for this form of un-mobile, projector- based mixed reality experience. (Rowe A. 2013)

For the project report, this technique allows us to adapt anamorphic illusions to surfaces, increasing the impact and creativity of the presentation. It allows a deeper exploration between illusion and reality.

1.4 Observations

All of the concepts and methodologies briefly outlined above contribute to the creation of a project that seeks to explore different ways of presenting anamorphic illusions that go hand in hand with the technology at my disposal. I am aware that other types of technology could be used, that could contribute for a broader exploration of the technique and its interaction with the viewer. It as been taken into account the quality of the development in relation to the time and the availability of resources that is why I am focused on one end and not several, not ruling out future explorations of these issues in different contexts. All the knowledge I have gathered so far will be further developed and explored, allowing for a richer result in the testing phase. However, all creative work will be documented step-by-step, as we lack information about the virtual process.

The virtual project is all created using a mesh modelling programme called Blender. Blender is an open source software, meaning it is free, and was chosen as my main tool because of its features and capabilities. Because it is free, Blender has a huge community that shares techniques and workflows that I have draw on to solve future problems that I may encounter.

I understand that the testing phase is where it will be solved most of the creative problems and will define the right process of creation; it is where interactions with different shapes and animations will be tested.

2.0

Visual references

2.1 Living Architecture: Casa Batlló

Living architecture: Casa Batlló is a project by the artist Refik Anadol. As mentioned by Sofia Lekka Angelopoulou in the article “Dynamic NFT of Gaudí iconic Casa Batlló by Refik Anadol sells at Christie’s for \$1. 38M” for the designboom website (2022), the artist used the façade of Antoni Gaudí iconic Casa Batlló in Barcelona to project a digital artwork that embraces the façade to create an incredible illusion of the building taking on different shapes and forms, created by using Augmented Intelligence to change its shape in real time according to the climate data collected. This interaction between a digital and physical environment is the first UNESCO World Heritage building to be reinterpreted in an NFT.

With this work, I took into account and studied the iteration created between his work and the participants. The decision to use a projector is obviously for a more immersive experience, as the light projects perfectly onto the large and complex façade (Figure 12) and only transforms the desired target, enhancing the reality of the animation. As can be seen in Figure 12, they used a countdown to encourage the audience to stay in the desired viewing position from the front to ensure the best experience.

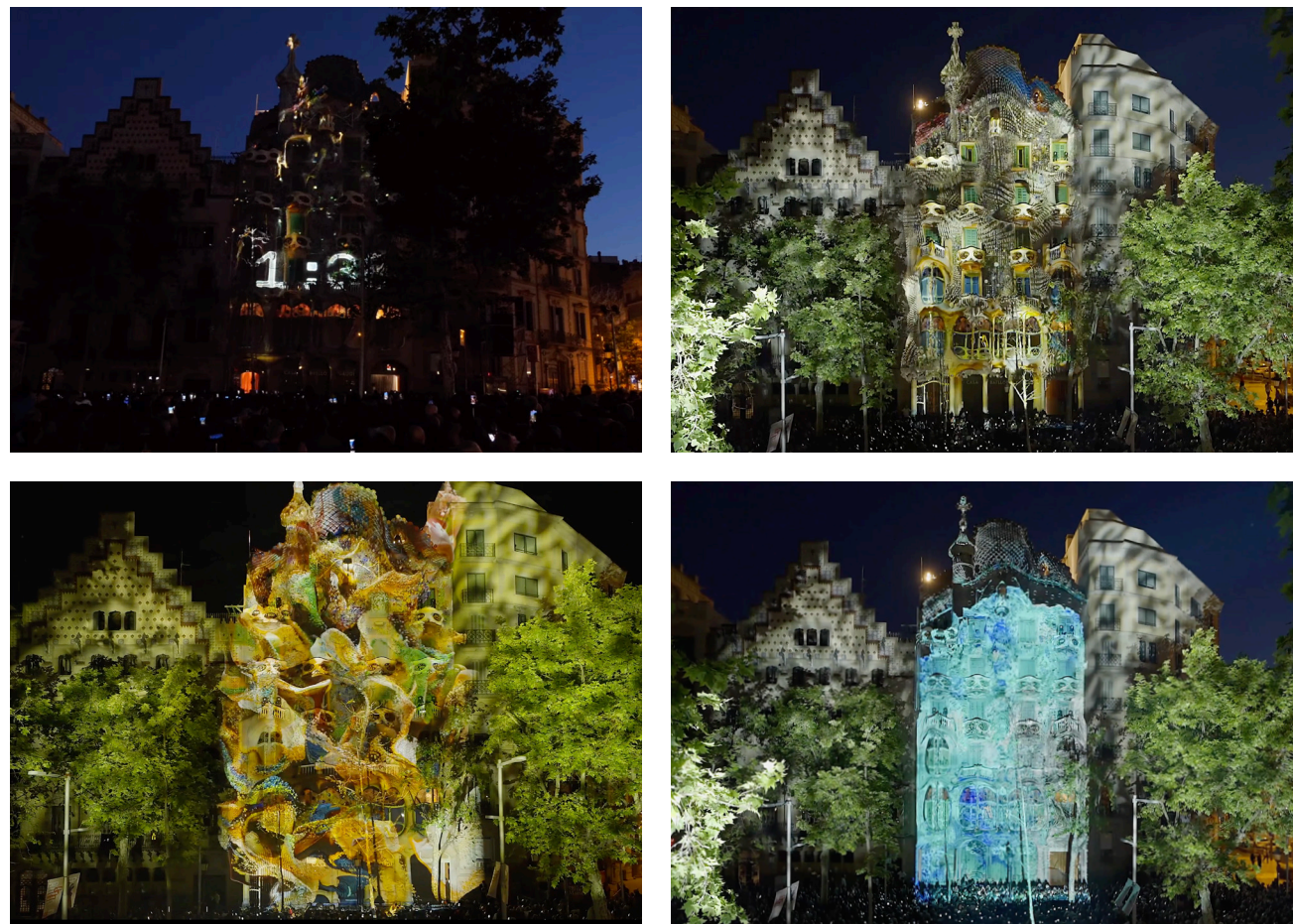


Figure 12: Frames taken from the Youtube video created for the presentation day of Gaudi Dreams, Refik Anadol, Barcelona 7th May 2022.

2.2 Public media art “wave”

“Wave” is a three-dimensional illusion created by d’strict studio. The animation of a wave washing inside a glass tank was displayed on a 90m wide by 20m high L-shaped LED screen. D’strict studio is a design company that creates user-centric experiences by integrating both content and digital media technology. CJ POWERCAST Co., Ltd, the client for this creation, stated on ifdesign’s website that the goal was to give people a sense of comfort when they felt exhausted by the Covid-19 pandemic. Therefore, they chose a scene at the opposite end of nature and sent an unimaginable wave through the middle of the city centre of Seoul, South Korea. The scene is made even more dramatic and realistic by the anamorphic illusion technique used for the three-dimensional waves that keep crashing.

These L-shaped screens allow for a realistic effect that really enhances the anamorphic illusion, as the content can be designed to mimic a 3D environment with height, width and thickness, with three spatial points (X, Y and Z axis) that create the same space as if it were created on the software. This allows the illusion to gain extra depth, increasing realism.



Figure 13: Frames taken from the Youtube video for the promotion of their first case of IP licensing, ‘WAVE’.

2.3 BOX

"Box" is the name of a short film collaboration between Bot & Dolly studio and Bradley G. Munkowitz. As revealed on the Gmunk website, this project is a unique achievement due to the combination of conventional graphic design and animation tools with robotic animation, projection mapping, automated cinematography and other technologies available at Bot & Dolly studio. This combination of robotic arms and projection mapping is what the Bot & Dolly studio calls a "kinematic projection platform", as Justine C. explains on the Motionographer website.

This project demonstrates the interaction that point of view can have in relation to the work, using the combined movement of the camera perspective with the position of the screens to create an immersive interaction with the viewer that enhances the illusion of depth. The movement of the screens and camera, combined with the interaction of lighting to match the lighting of the animated work, creates a unique production that has inspired and given ideas for future work on what can be achieved by combining different angles of presentation with different perspectives, all of which together make motion graphics animation a more interactive and entertaining experience.

"BOX" is a truly unique piece of work that pioneered the interaction of different technologies and fields such as motion graphics, graphic design, computer engineering, projection mapping and others to create an amazing piece of art.



Figure 14: Frame taken from the video of the project "BOX".

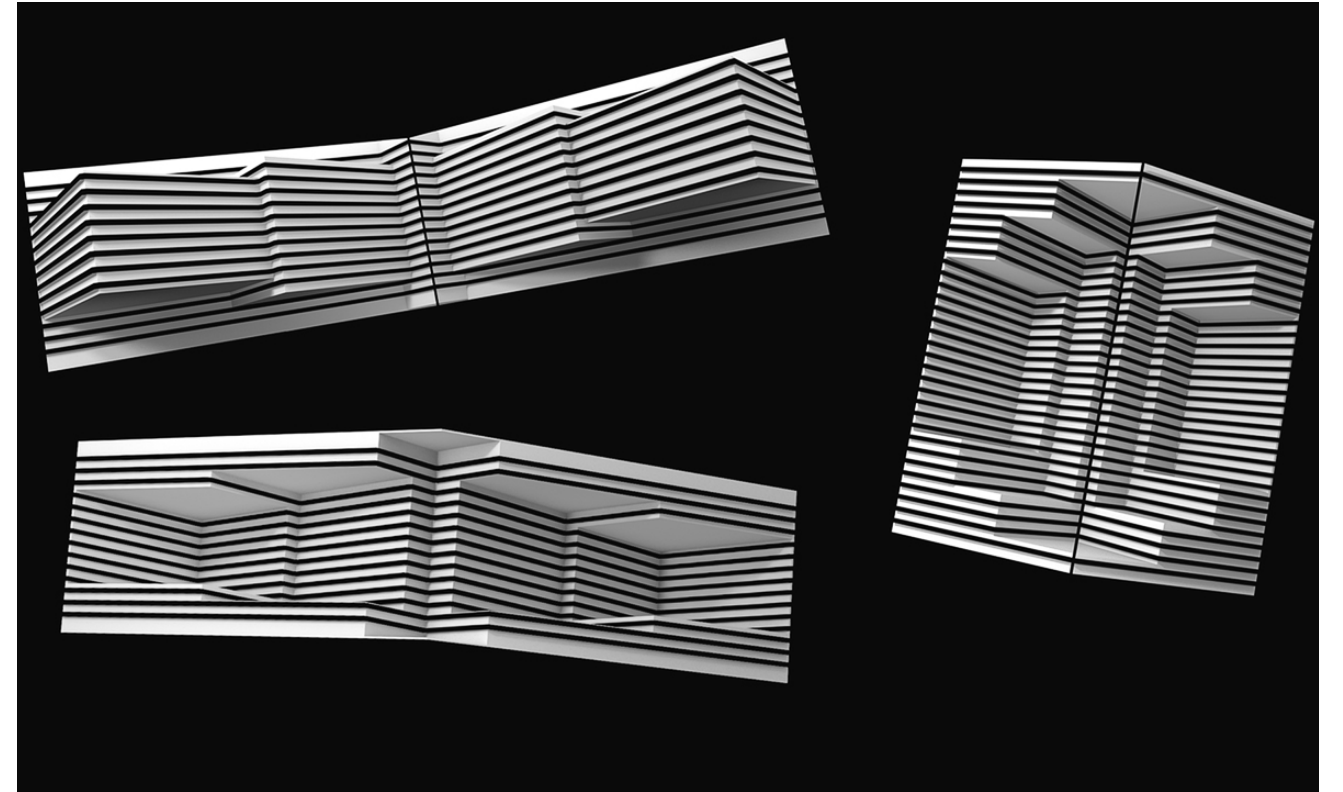


Figure 15: Design created for the "Intersection" phase of the "BOX" project.

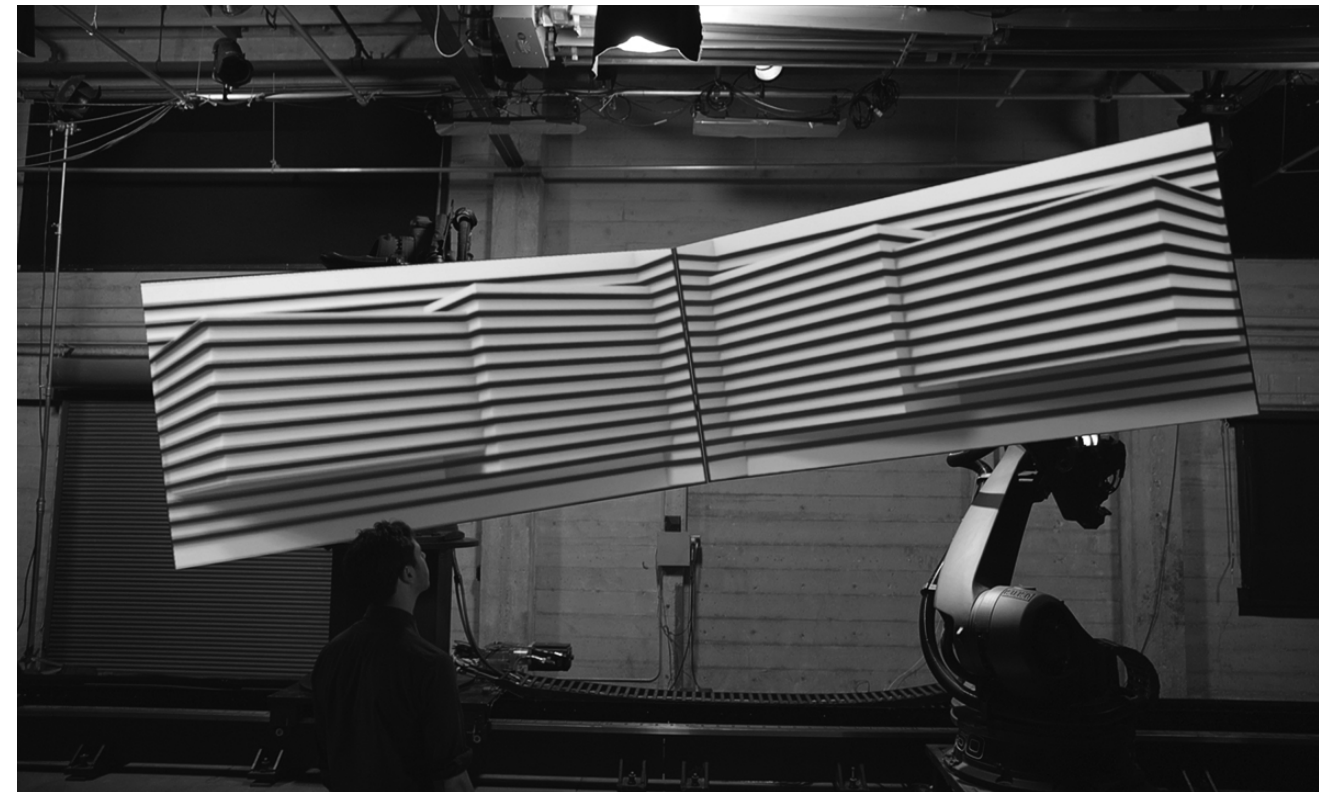


Figure 16: Frame taken from the video of the project "BOX".

2.4 SSG Dutyfree media display

It was difficult to find any information about this project to contextualise its origins and what it was about. Despite the lack of information, I found the originality of the way it was placed on the ceiling and the interactions that the animation could have with viewers.

It's unusual to see screens on the ceiling, but this ambiguity is what makes it interesting, because it allows a new creative approach to developing the output design. With this in mind, they created a screen with 3 faces, which allows for a very rich illusion, an anamorphic effect that I think can easily grab the attention because of its innovative look and the wow factor created by the shape of the screen and the anamorphic animations.

Although it is a piece of technology that is beyond our reach, the ideas that can be gleaned from this piece are enlightening. It can also help to understand the concept of creating content using three interfaces for future exploration.

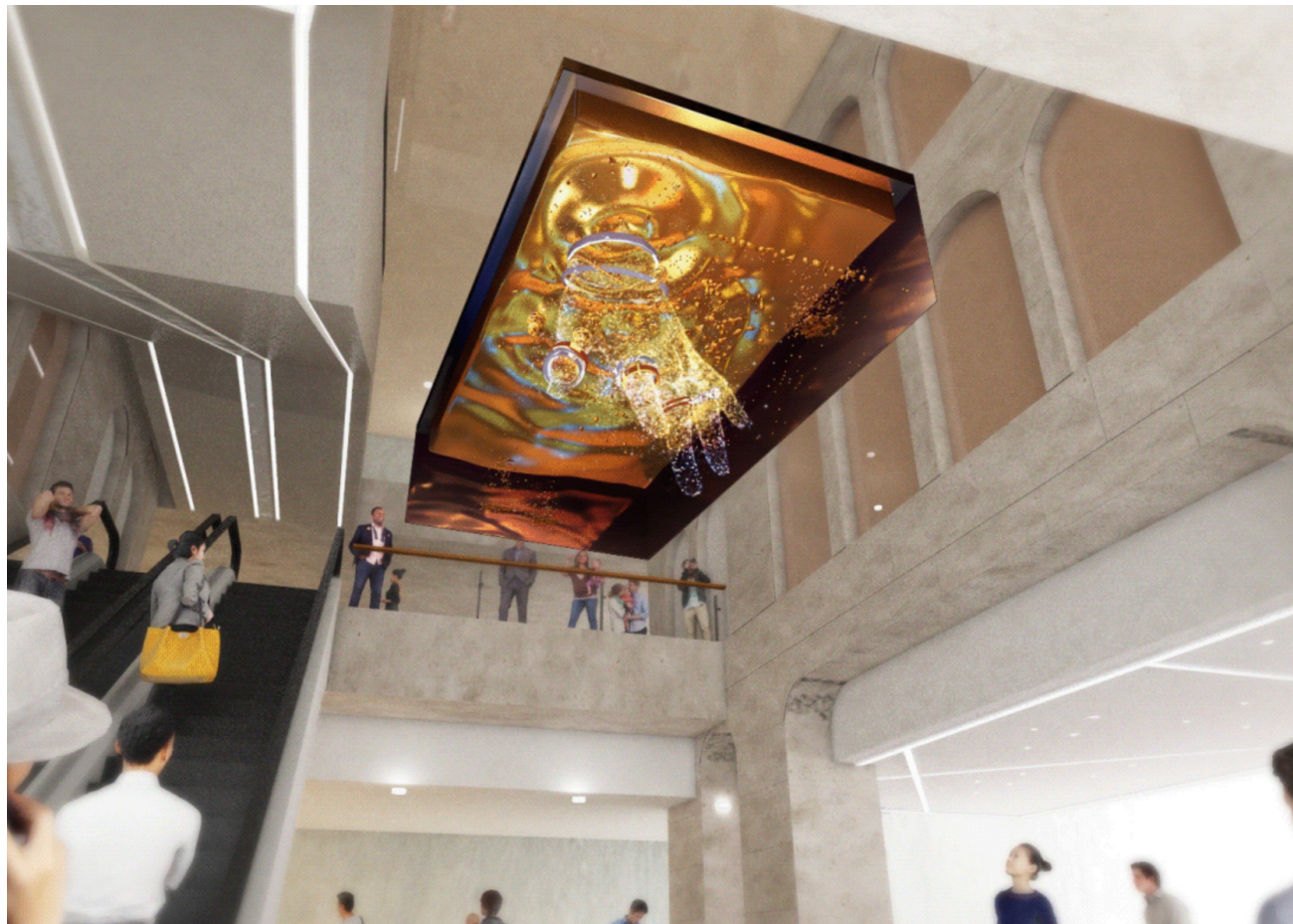


Figure 17: SSG dutyfree media display mock-up render.

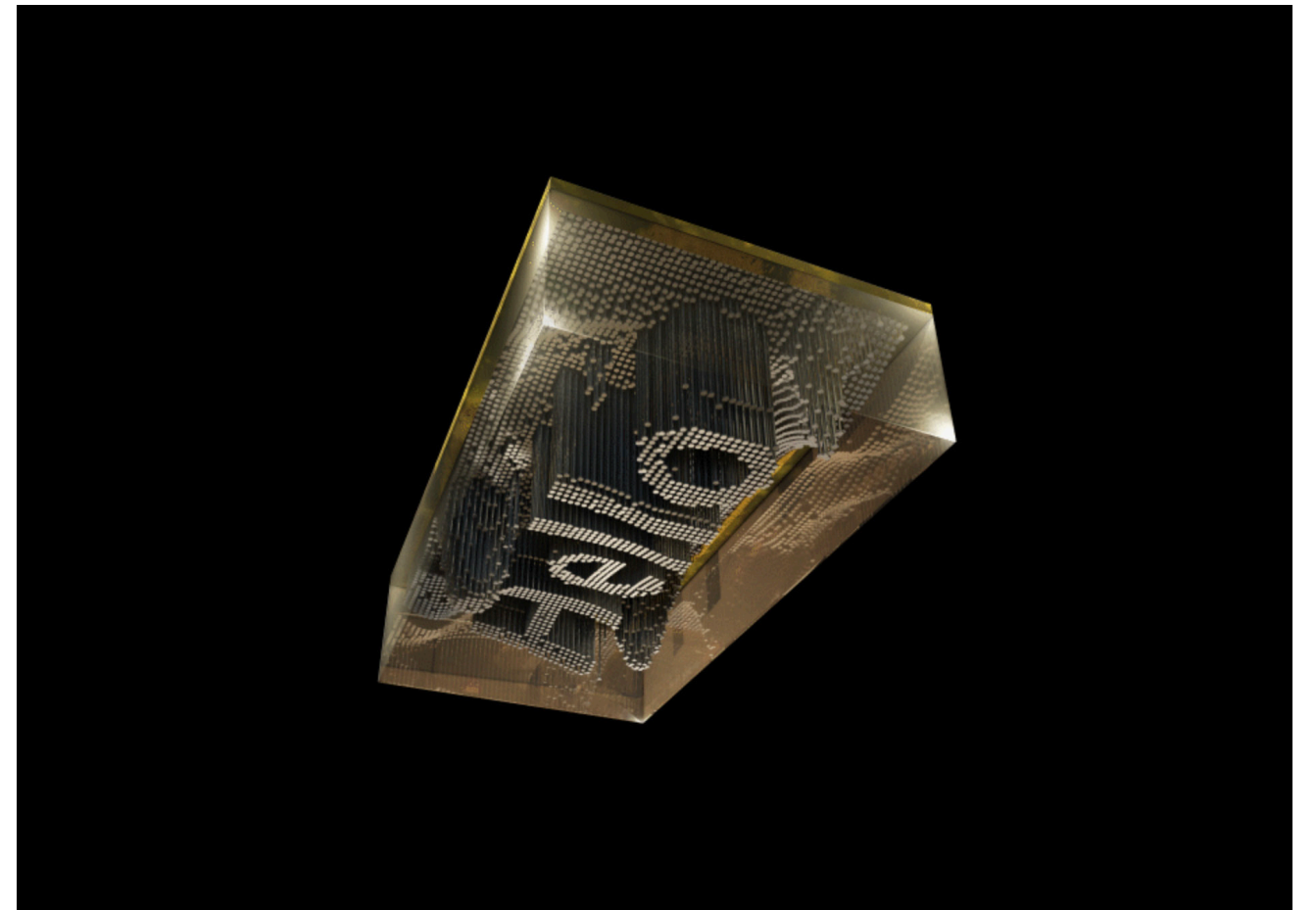


Figure 18: Frame design for the SSG dutyfree media display.

3.0

Tools, technical and graphical considerations

The purpose of this chapter is to explain the technical and graphical terms and methodologies that I consider useful for the creation of the creative process registered, on this report. I proceed to explain some terminology and technical procedures applied to the process and the software used, although there could be some similarities in terminology and concept applied to other tools. In this case and as already mentioned, the main tool that will be used to realise the 3D content, for the anamorphic illusion, is Blender and other add-ons related to the programme and the final objective.

3.1 Starting point measurements and tools

As already mentioned in chapter “1.2.1 Basic steps for the digital creative process”, the distance between the advantage point and the place where the illusion is to be perceived, as well as the dimensions that the projection must occupy, must be known, and within the 3D software, the volume that the content can occupy based on the previous steps.

If the dimensions are known, there is no need to use this tool. Used correctly, F-spy makes the design process easier and allows the designer to produce everything more smoothly and quickly as it can create virtually everything from one image. However, care must be taken when using this tool, as the f-spy website warns us not to use photos taken with lenses with a high degree of distortion, such as fish-eye lenses; images where the perspective has been manipulated, for example by perspective control, 3D images rendered with an orthographic camera, stitched panoramic images.

In summary, F-spy is a tool that helps to estimate camera parameters from certain features in an image. These are in a perspective image where all parallel lines meet in 3D space, or vanishing points. With the vanishing point calculated, this program can take this information and obtain values that can be used to estimate the focal length, orientation and position of the camera in 3D space. For the methodology registered in the project, the calculated camera parameters can be used to obtain the correct viewpoint, so that the illusion can be easily produced without anyone having to measure or move to a particular location; from an image, the designer can recreate the scene and match it to reality. This means that most of the work can be done in advance and then adjusted during the presentation, making the process faster and more efficient.

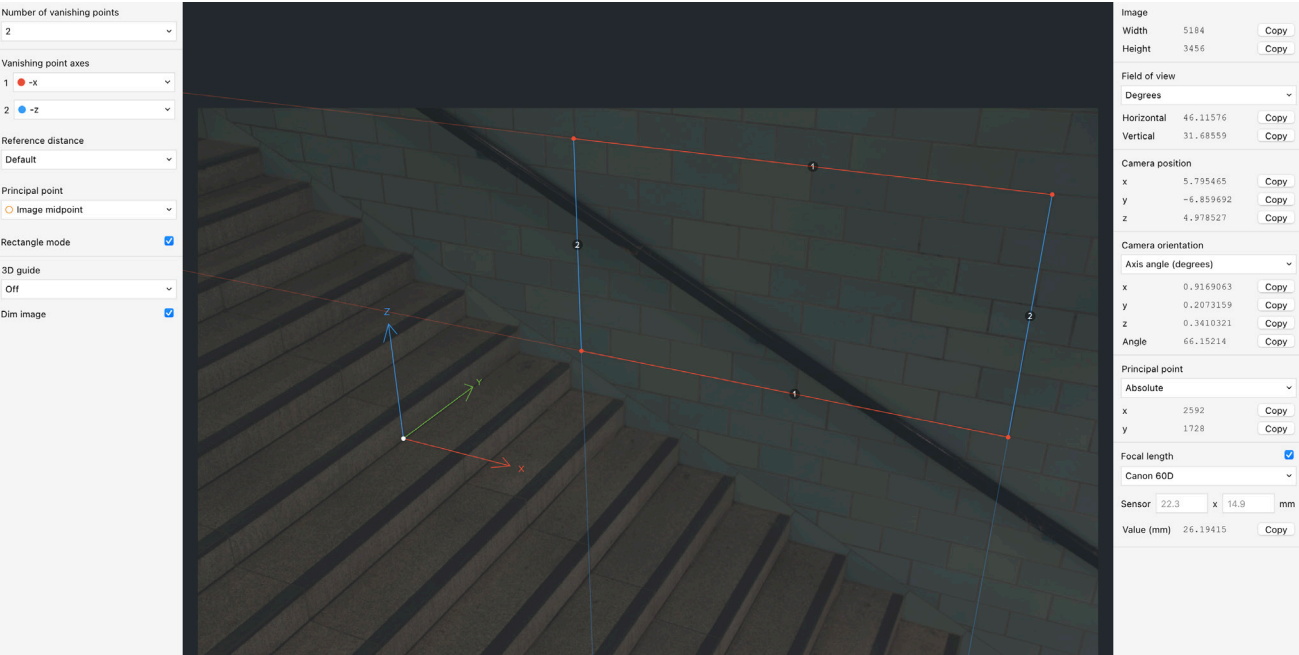


Figure 23: Fspy interface, where an image has been placed and the camera parameters calculated. As shown on the right, this is information that can be used to create the camera placement.

3.2 3D Content: design, animation and rendering

First things first, as with most creative projects, I start the creative process with a concept. Once I have the design idea, I move on to creating the content in Blender. Having a pre-established idea simplifies and speeds up the creation process. It is good to understand what I want to create when I animate, it helps to understand where to occupy the space.

Animation is one of the key components of this project as it takes the anamorphic illusion to the next level and helps create a immersive experience. There are three options to consider when animating 3D content: PRS (Positioning/Rotation/Scale), 3D Rigging and Point Level Animation (PLA). PRS allows to change the position, orientation or size of an object over time. This is done without changing the mesh of the object. Of the three, PRS is the easiest to animate because the information is not applied to individual mesh points of the 3D object, but to the entire object.

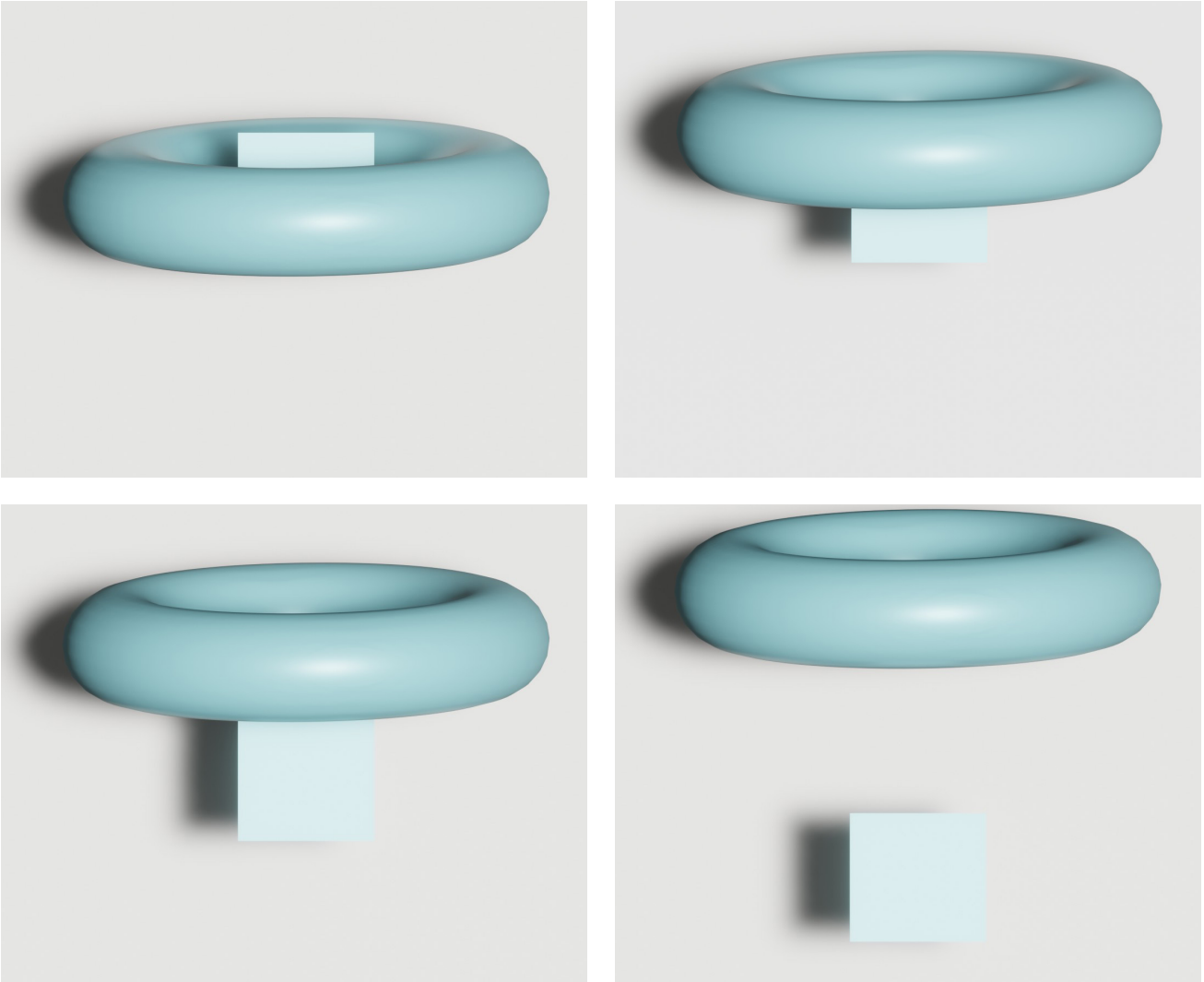


Figure 19: Frames from an animation where only PRS was used.

In 3D rigging, or inherited animation, the movement of the static object is based on the movement of another object created by a system of joints and handles (e.g. its parent, hook, armature, etc.) that are controlled to animate. (Figure 20) This is usually used to animate human characters or animals, but can be used in other ways. This project did not use 3D rigging as it did not suit the type of animation required. (Mendes S. 2020)



Figure 20: Example of the hand rig used for the main character of Agent 327, animated feature film by Blender Studio.

Another way to animate is through the individual vertices or control points of an object mesh, storing information in each one. (Figure 21) This may be called point-level animation (PLA) or deformation, and can be used to create more elaborate animations as long as the polygon count remains constant. (Mendes S. 2020)

The types of animation mentioned above typically work in conjunction with the use of keyframes. A keyframe is a marker assigned to a specific frame on the timeline that stores the value of a property/object.

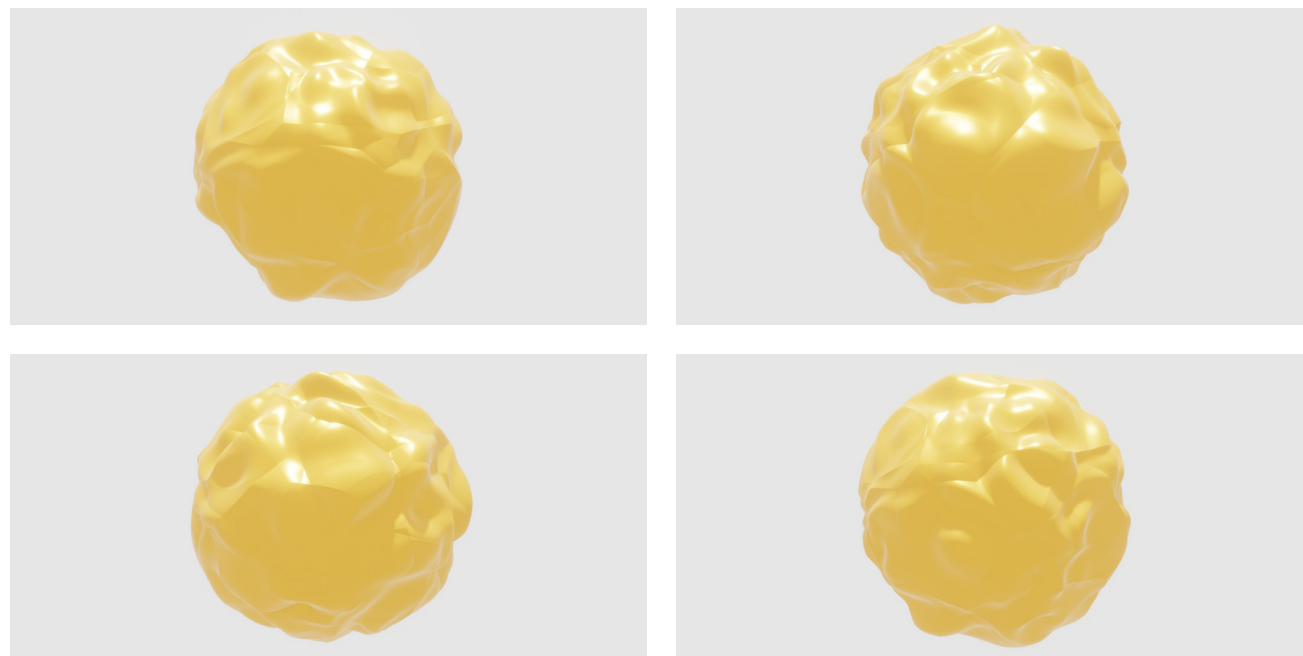


Figure 21: Above are frames from an animation that was created to illustrate what can be achieved by animating through the individual vertices or control points of an object mesh.

As mentioned on the doc.blender website, when we want to create a 2D image or video output from a 3D scene, we want to perform a process called rendering. In this case, Blender offers the option of using three rendering engines with different strengths: Eevee is a physically based real-time renderer; Cycles is a physically based path tracer; Workbench is designed for layout, modelling and previews. (Figure 22)

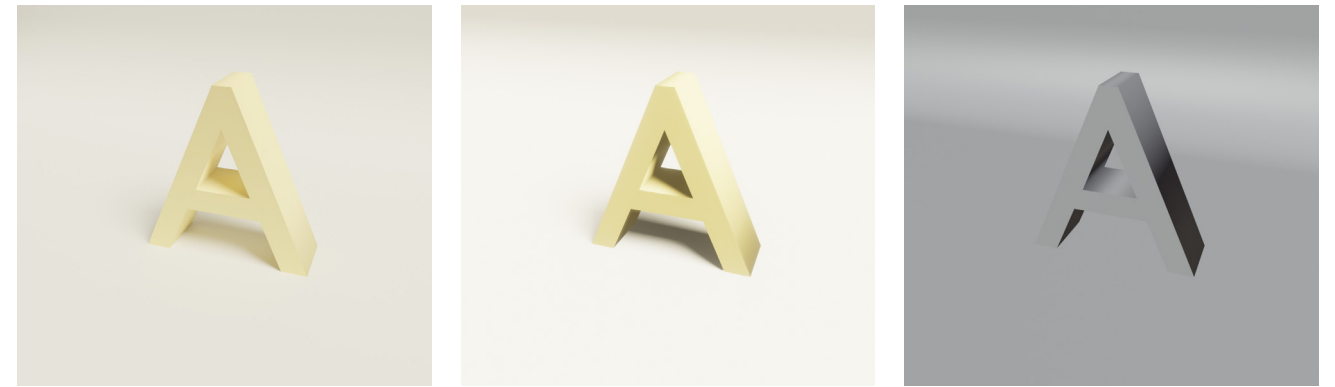


Figure 22: From left to right, we have the same image design with different outputs from the different rendering engines. All images were generated under the same conditions, including sample size, resolution and lighting conditions.

For the purposes of this project, Workbench was not considered as it did not meet the creative needs. Due to the lack of output quality. Eevee, is preferred by us, for its faster rendering time compared to Cycles and overall good output quality in a better time frame with a reasonable size and overall good performance. For me it is the most balanced choice between the three.

However, when rendering to create an anamorphic illusion, there is an extra step before the final output. So, once the render is created for the design, it is needed to create a UV projection on the surface of the 3D environment created earlier, so that the illusion matches the real surface as closely as possible. A UV projection is created from a UV map, as explained on the g2 website:

"UV mapping is the 3D modeling process of projecting a 2D image onto the surface of a 3D model to create texture mapping. The 3D object is unwrapped and the 2D texture is applied to it." (Calvello M. 2022)

Simply put, a UV map is a representation of a flattened 3D object that is used to wrap textures. In our case, the texture is a render of the final design and is then projected as a UV map onto the desired surface in 3D space using a tool called the "UV Project Modifier".

Imagine producing a 2D image created on a 3D environment, that adapts to a surface and, when viewed from an advantage point, creates the 3D effect. More will be explained exactly how it works, but at this stage it is more about technical and not so practical information to not extend and complicate the basic understanding of the project.

4.0

Creative process

This chapter presents a guide to the methodology used to create the anamorphic effect, all the programmes and initial tests to help understand some of the steps involved. Remember that this methodology has been developed with a projector in mind in order to present the final results.. All the steps are based on our research and previous software experience.

4.1 Tools used

When creating the content for this project, I decided that it would be better to do the entire creative process in Blender, which turned out to be the right choice, albeit with its complications. The fact that the software is open source helped a lot: Thanks to its large community, I was able to get information and video tutorials from forums and Youtube to solve problems and improve our methodology. Another advantage was the add-ons, which helped to achieve the desired results in a very practical and easy way. Thanks to the large community that continues to share their experiences and tools, I was able to improve my creative process and make it work.

The F-spy Blender add-on is a great help because it automatically recreates the information gathered by the program in Blender, creating the point perspective and aligning the image so that we can model the scenery from its point of view. Although I have not used it to create the mock-ups presented here, I have decided to mention it so that in the future, when it is not possible to control the dimensions to be used, the solution is already there to make this method more complete. The Osciart PBR Backer add-on allowed me to bake an animated texture, which is the video animation, applied to a surface, which will be the wall, and export it as a PNG.

Davinci Resolve, a free video editing software with advanced settings and excellent performance, allowed me to combine the entire PNG sequence obtained from the Osciart PBR Backer into a complete video. The video is then projected onto a wall creating an anamorphic illusion.

On some occasions I have used Adobe After Effects to simplify the keystone adjustment of the projector and to place the image correctly. It was really helpful because the software allowed me to set up the projector as a second screen so I could see the placement and preview the final result.

4.2 Process of creation

Some of the steps that make up our methodology are solutions found through experimentation during the testing phase of this project. Some solutions were found through trial and error, others through video tutorials on Youtube or forums such as blenderartists.org. This will be the subject of further discussion in chapter 4.3.

The first thing to do is to determine the viewpoint, as explained earlier, the viewer’s perspective from where the illusion is to be created. The position can be determined by measurement or by using fSpy in conjunction with the plug-in to import data from an image into Blender. When using the add-on, the viewer’s position and distance to the projection will be set automatically. Even when using the fSpy program, I advise you to set the volume of the screen manually to avoid any data errors, as this is our working space and is crucial for the illusion to work properly.

Once I have taken all the measurements and set up the volumetric parameters between the screen and the advantage point, I begin to set up the scenery. I start adding all the objects to be animated, always remembering that all movement must take place within the volumetric space established between the viewpoint and the projection. (Figure 23)

To avoid overshooting, I recommend adjusting the focal length and positioning the camera to get a framing shot before starting animating. For most of our mock-ups, I set the focal length between 80 and 100 millimetres.

Having set the animation parameters, all the lighting and other props that will contribute to the final output, I can now begin to render the scene from the perspective of the viewer.

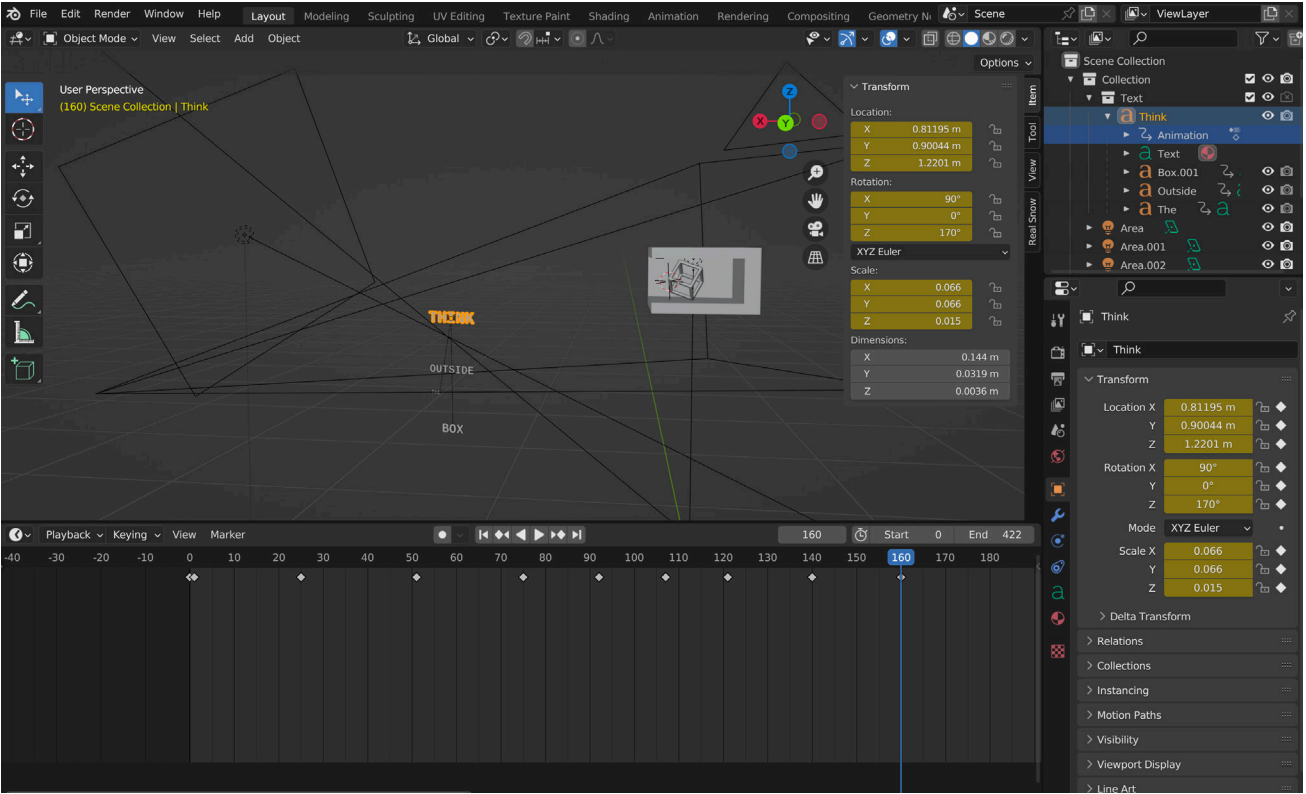


Figure 23: Screen shot of the Blender interface. At the bottom is a time line showing the frames in relation to the keyframes. The lusangle icon represents when and what action is taking place at that moment or over a period of time.

For this step I have chosen to render all unused backgrounds as transparent, which reduces the load on the graphics card and ensures that we do not end up with unusable content. All renders have been set to output as PNG and the resolution needs to be set to capture the whole scene at the highest possible quality, as it will be scaled down in the next steps and to ensure the final result is of good quality we need to set the output to a high resolution, or at least higher than it will need to be displayed, respecting the final aspect ratio.

Once I was satisfied that all the frames were rendered. The next steps were the most challenging for me. I was clueless at this stage as I had never done UV maps at this level before and was not sure how to go about it. This is a crucial step in creating the image that will be applied to the wall in order to create the illusion.

In order to create the “UV Map” I first started by selecting the object created to act as the screen. Then in the shading menu I start by deleting any additional shader nodes that might appear by default. So I can set up the following shader nodes: first we add a “Texture Coordinate” shader, which is connected by the “UV” option to a “Mapping” shader, which goes into an “Image Texture” shader, then is connected to an “Emission” shader and outputs to the “Material output” shader, which allows me to see the final result being presented on the object inside Blender.

On the “Image Texture” shader, I added all the PNG images from our frame-by-frame render that was done earlier. On the same shader I set the other options as follows: linear, flat, repeat, image sequence. I advise making sure that all frames are selected and that the start frame is set to 1, and that the options cyclic and auto refresh are selected.(Figure 24)

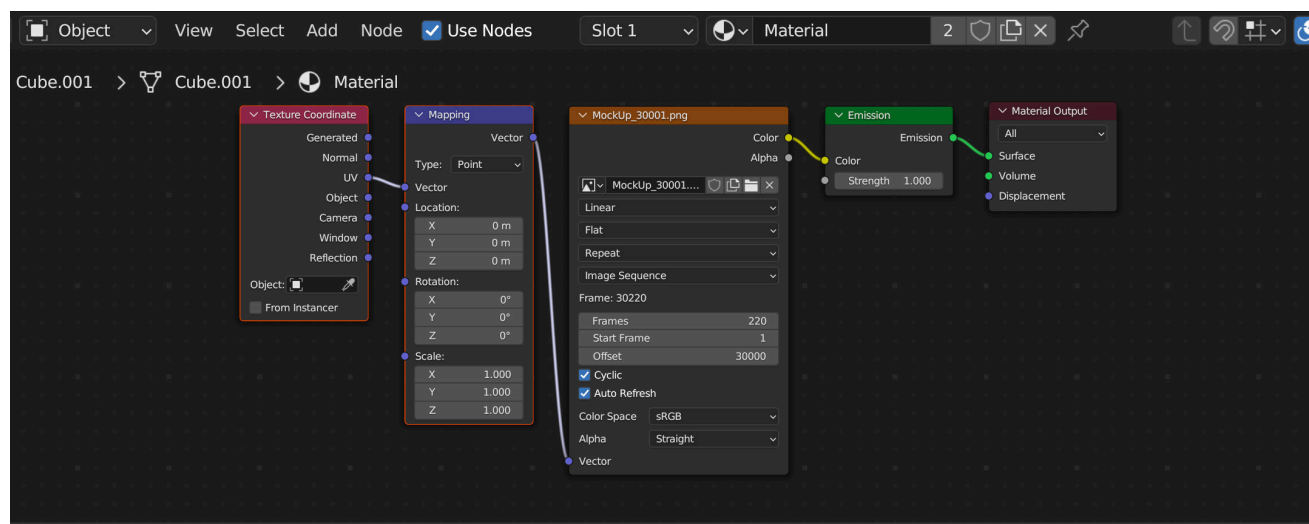
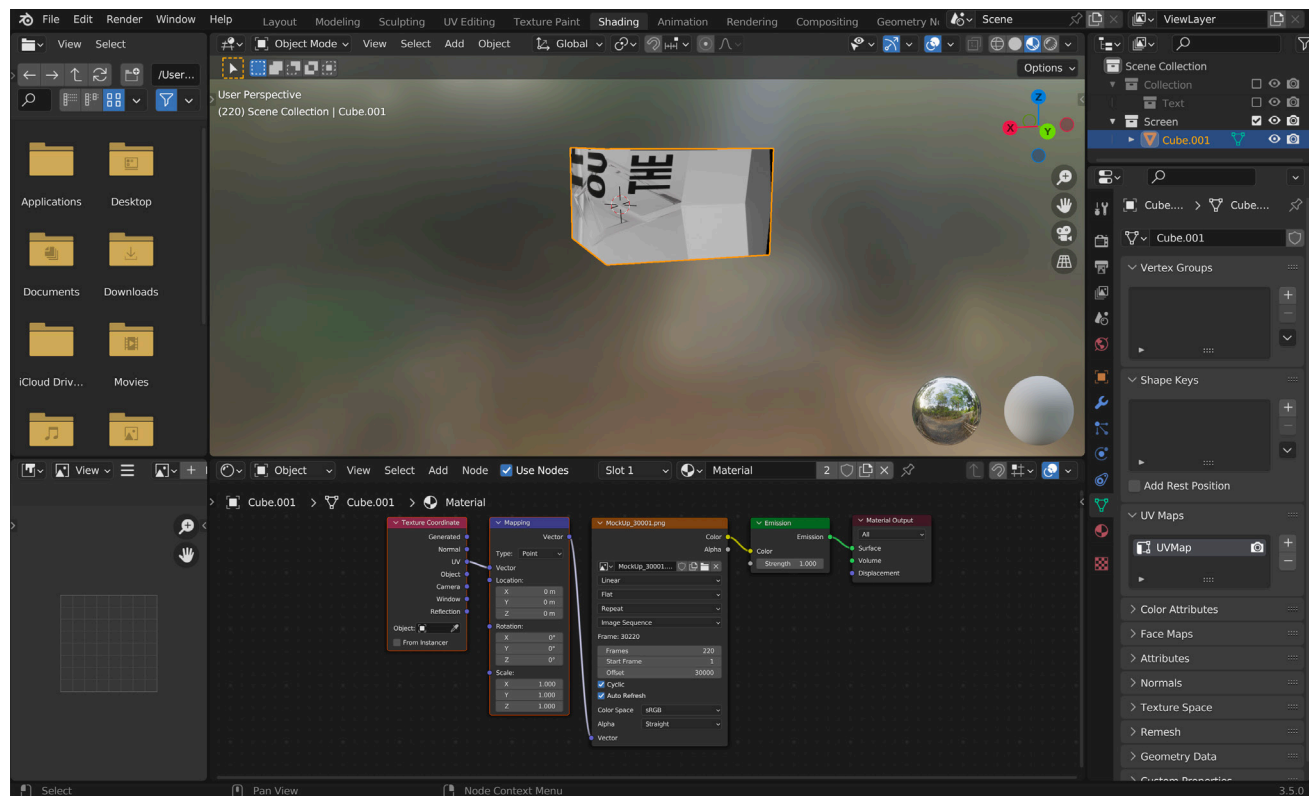


Figure 24: Close-up of the shaders, with the selection of frames from the animation applied to the image texture shader.

In the “UV Editing” layout, with the same object, I start to create the UV map by selecting the edges and marking them as seams, then I press “U” and choose “Unwrap” from the menu list to finish the flattening of the geometry. This will be assigned to the only active UV map that can be seen in the Object Data menu, and to avoid making any mistakes, I named the first map “Image_projection_1”, after which I added a second map by pressing the “+” button on the “UV map” list and named it “Image_projection_2”. With the “Image_projection_2” map selected and displayed (the map is displayed when the small camera icon to the left of the map name is white). (Figure 25)

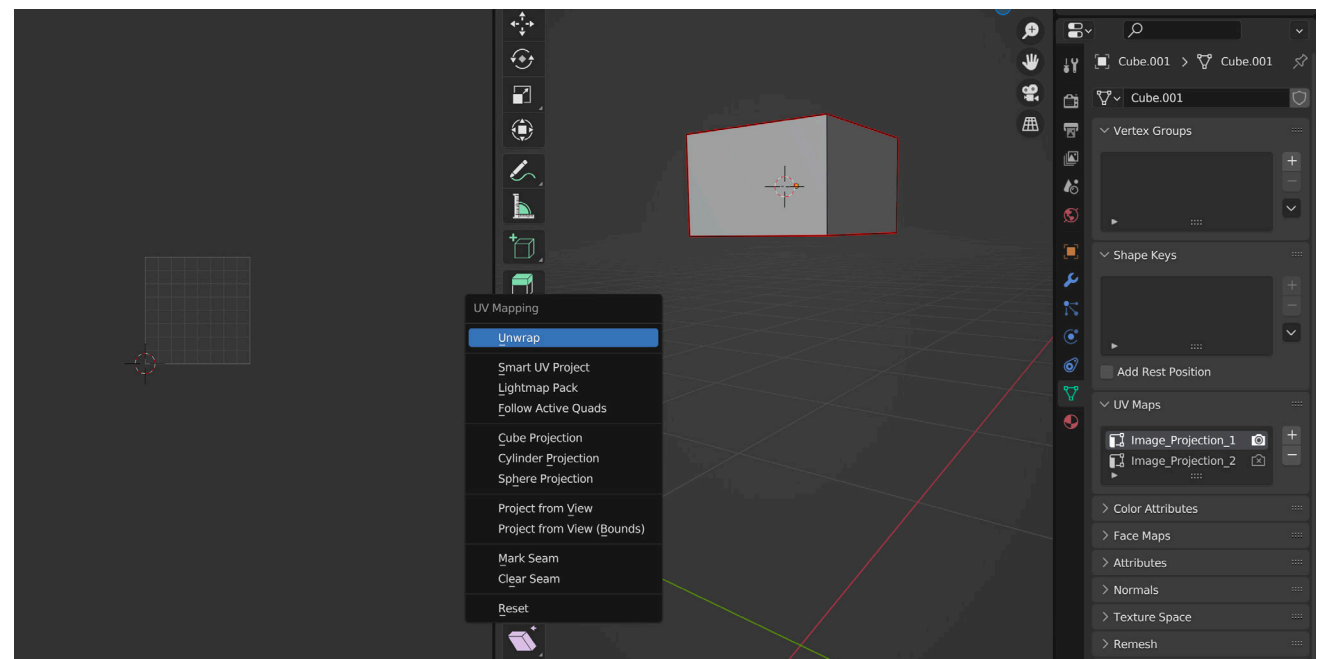
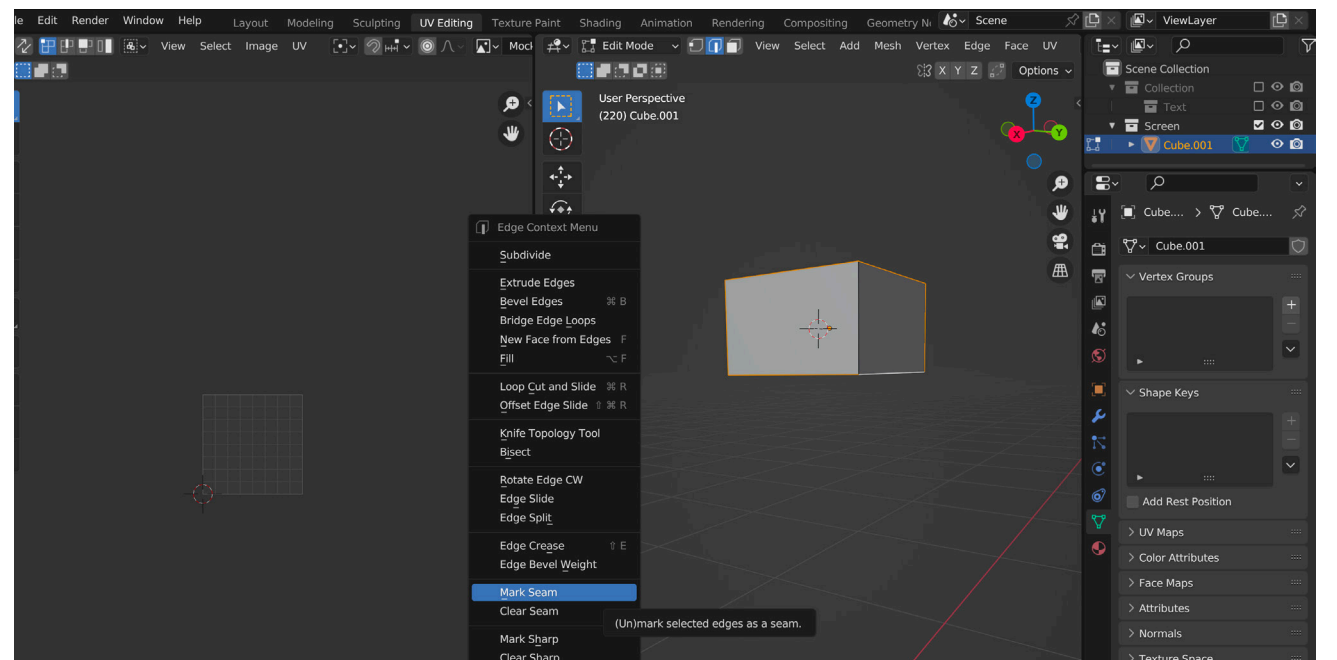


Figure 25: UV map editing. The process of creating a UV map for an object by marking the seams and unwrapping.

I then went to the ‘Properties Modifiers’ menu, and added a ‘UV Projection Modifier’. Then set the “UV Map” for the Image_projection_2, the aspect ratio is given by dividing the height by the width of the resolution size, in this case it was set to 1.6, on the “Aspect X”. If the screen is vertical, the aspect ratio should be set on the ‘Aspect Y’. Finally, the ‘Object’ must be set up as the camera from which the animation was previously rendered. (Figure 26)

I then added a “Subdivision Surface Modifier”, in simple mode with multiple surface subdivisions. The purpose of adding this modifier is to increase the number of reference points that the texture can read and correct itself, removing any undesired distortion.

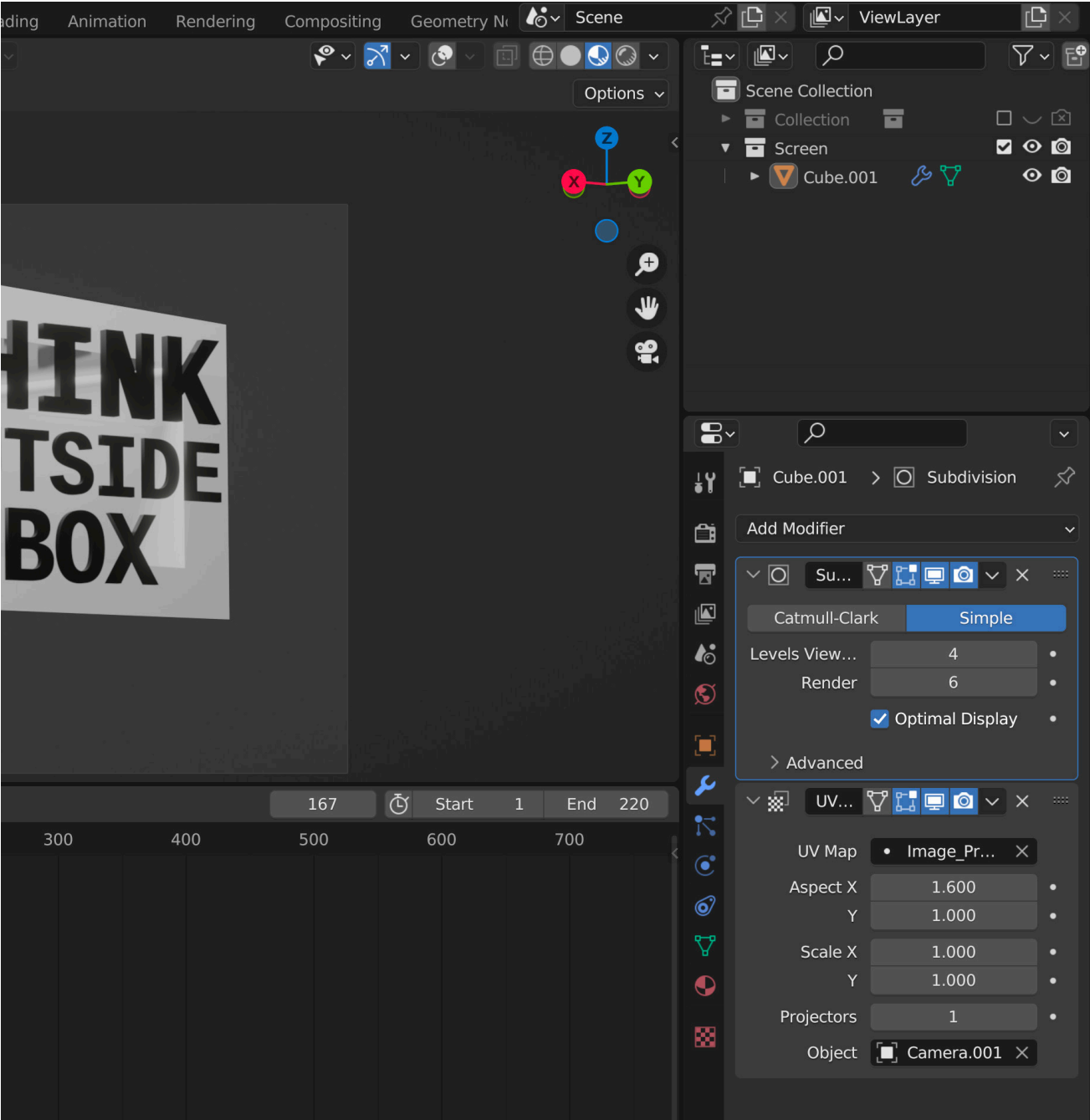


Figure 26: An example of how the modifiers should be applied on the object canvas. Note that the “Subdivision Surface” modifier must be placed on top first for it to work as intended.

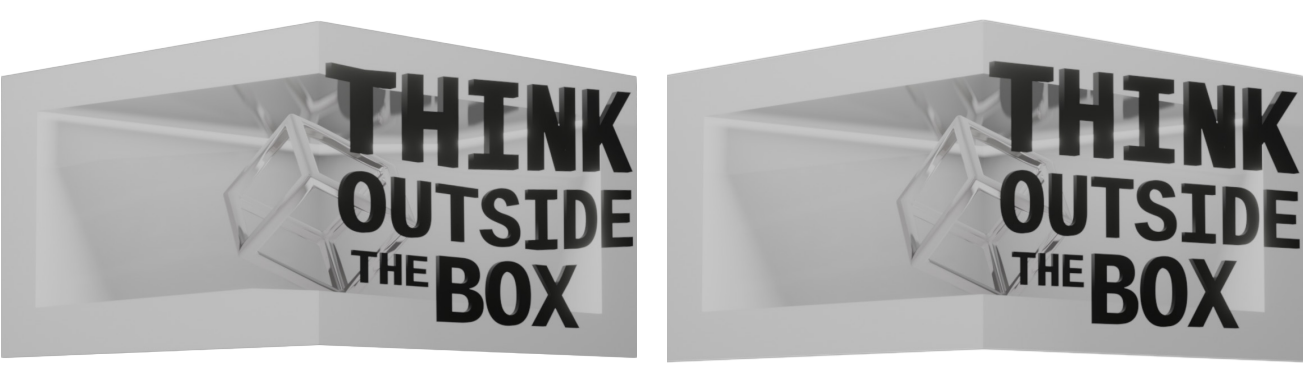


Figure 27: Comparison between the image texture applied without the Subdivision modifier, on the left, and with the Subdivision modifier, on the right. We can see that the image distortion has been resolved after we added the modifier.

In this step I want to get a flattened version of the animation, adapted to the shape of the surface. To ensure that the image covers the entire surface, I need to add a new image texture shader, in the “Shading” layout. Then, by adding a new image with the desired screen resolution, so that the programme knows the size to bake, and the shader must remain selected to maintain the path to this file. Then, in the “Object Data” menu, I selected the projection_1 and left the projection_2 visible.

In the “Render Properties” tab, I used the cycles engine, running with the graphics card and with the appropriate steps for the desired result. In the “Oscuart PBR backer” tab, I simply selected the “Emission” option, set the resolution as required and checked the option to save a copy as PNG. (Figure 28)

Using DaVinci Resolve, a free video editing programme, I imported the file folder into the media pull of the programme, which automatically converted the image sequence into a video ready to be rendered. This video is the final file, ready to be projected onto a wall.

When I was setting up the images to be projected, I felt there was a lack of options for adjusting the keystone, such as scaling, rotating, angling or moving the images. I felt that if I had these options, there would be less need to pick up the whole setup and move it around, as I could simply do a larger projection over the location and simply adjust via software to the intended size and location. This idea was made possible by using Adobe After Effects, After Effects allows all these options to be adjusted as well as some more. Using it helps to ease the process, it is not obligatory and I think it helps to obtain a better result faster.

For this report I have been working and testing with a projector to present the designs. The reasons being that with projectors are generally cheaper, easier to move around and their ability of project images through light means that they can adapt to any surface, allowing us to experiment with a greater variety of shapes and angles.

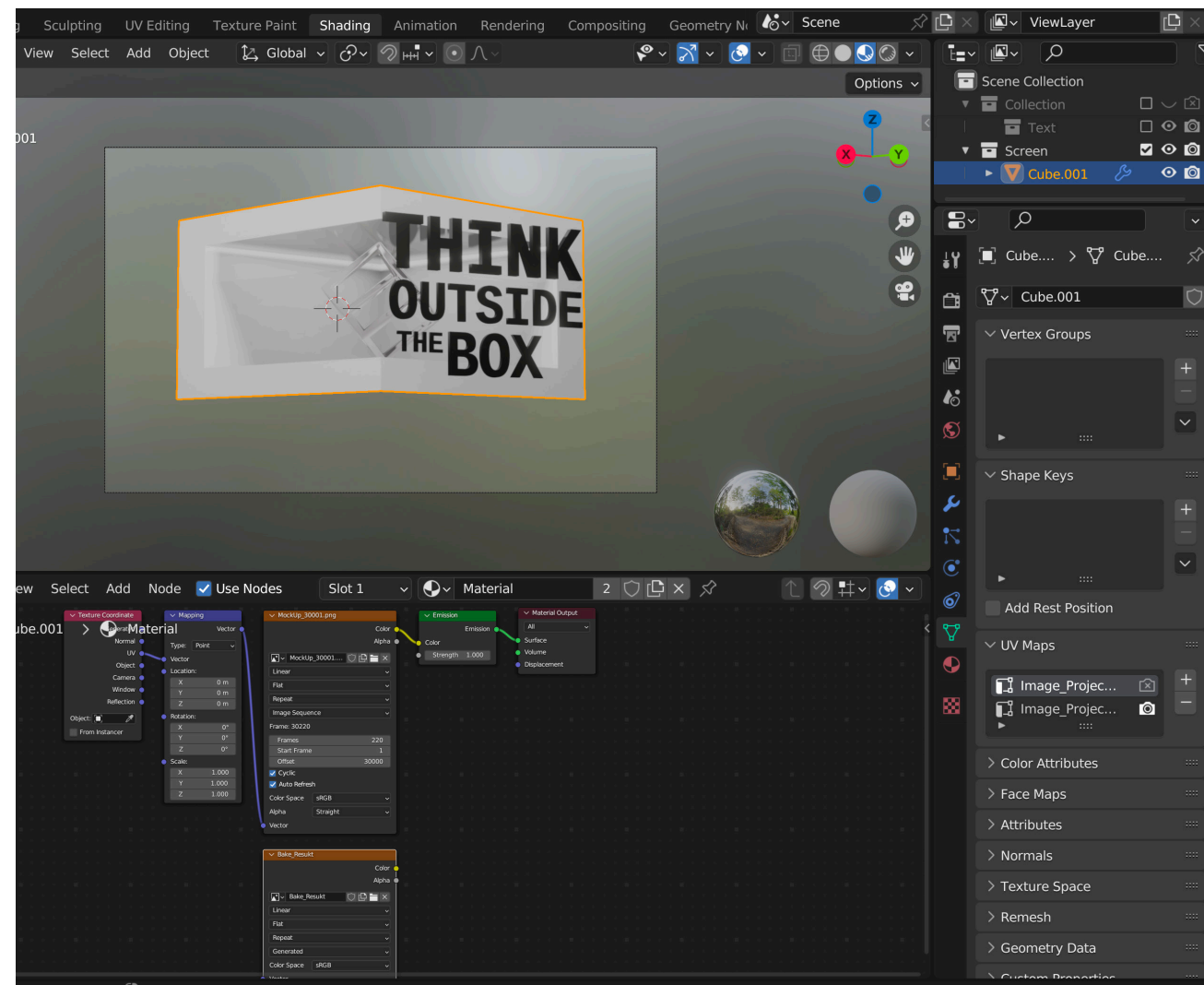


Figure 29: Output from the first render before being backed.

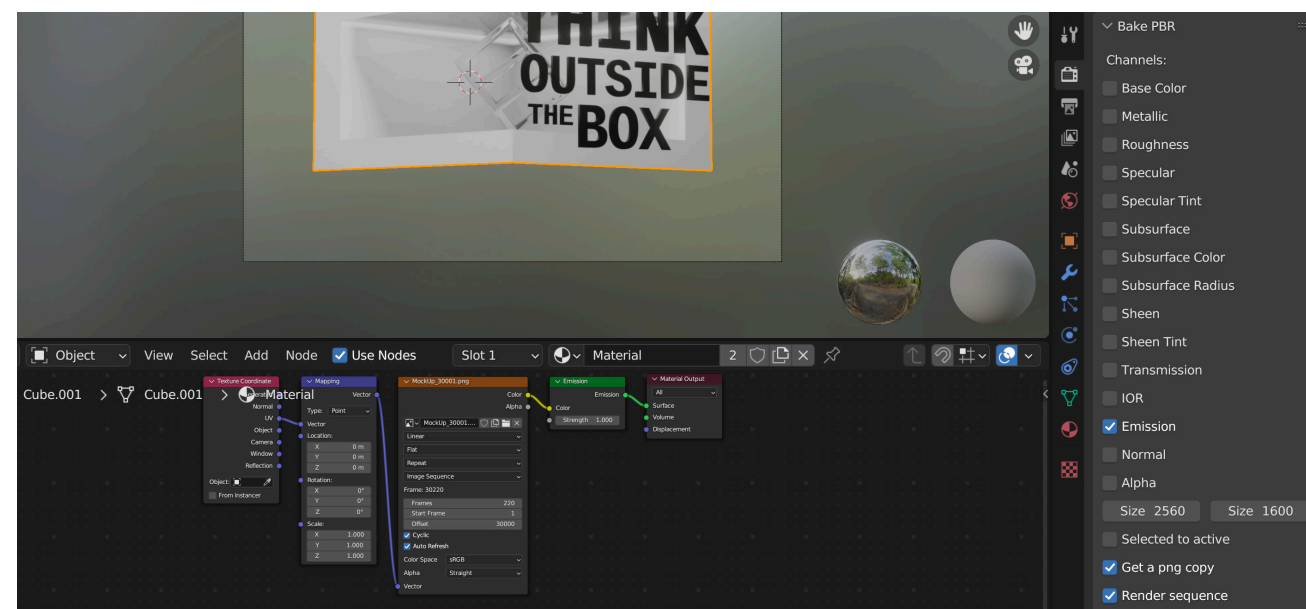


Figure 28: Blender layout of the backing phase, using the external add-on "Bake PBR".



Figure 30: Final output after backing.

4.3 First tests

The first tests allowed me to experiment with different techniques to create the method described above. They were very important in improving our creative process.

My very first attempt was a simple animation of a single 3D object, consisting of 2 words “Hello World”, turning around, in and out of a green box. The whole modelling and animation process went as expected. I then proceeded to place the rendered animation on a flat surface in Blender that mimicked the screen on which it would be presented. The output was not as intended, as can be seen in the right image in Figure 31, there is a black border around the green box. It is assumed that the entire image must be filled to get the correct result. Otherwise, the fitting is not correct as it does not match the measurements that have been made, which means that the output is incorrect and will not work.

At first I thought it was due to rendering the scene with the background, as can be seen in the rendered result in Figure 31. In this case I tried rendering with the Transparent option enabled. The final result was still the same, with the message appearing only in the centre and the rest filled with black. However, I’ve included this step because it improves rendering performance by not rendering the rest of the image, only what is needed from the first renders, thus reducing the time it takes to render.

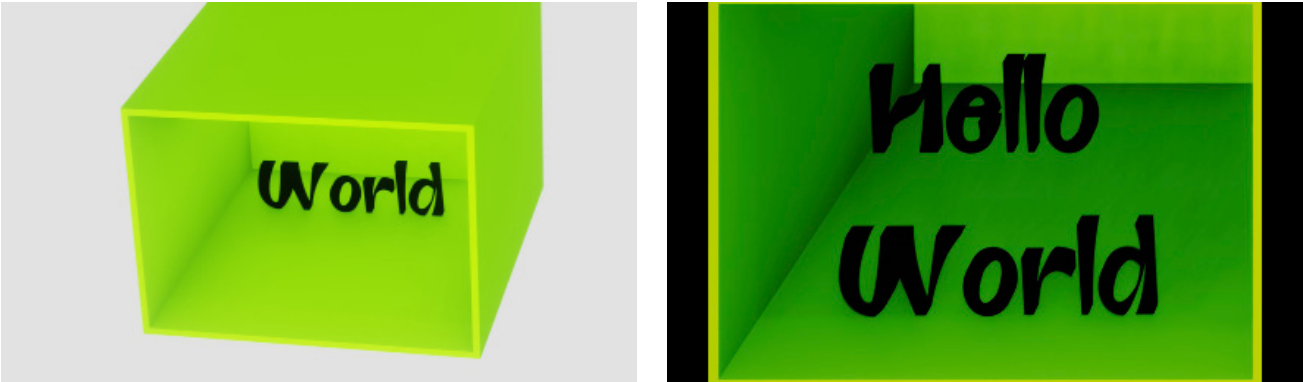


Figure 31: Left side image shows the rendered result of the first test. Right side image represents the final output.

However, I remained with the theory that the problem could be related to the fact that the captured image contains unnecessary information.

In Blender, the image filled the screen correctly from the correct perspective, so I knew I was making good progress. I could not extract the image as I wanted, which meant it was something to do with the background. After experimenting with the baked images, when I played them back in DaVinci Resolve, they appeared to have some pixelisation and were slightly out of perspective.

To solve the perspective problem, I found that the rendered images were not being correctly applied to the surface due to the reduced mesh surface. I discovered that the problem could be solved by simply applying a subdivision surface modifier, as shown in Figure 26, rather than manually adding edge loops. This means that the image now has more reference points to adjust to and remove the distortion.

In the second test, I went through all the stages up to rendering the scene and, as I had learnt before, the result was a faster render time and a smaller file size. Then I tried to correct the pixelisation effect mentioned earlier and to solve it the image was rendered at a higher resolution, but maintaining the aspect ratio. I recommend at least doubling the resolution for the final output, so that when applied as a texture it will be at a higher resolution in the same screen size.

I cannot guarantee that this is the right solution to the problem, as I was testing another option at the same time. In the previous test, the baking was done using the “Eevee” engine, and this time I tried using Cycles. The reason for this is that Cycles is the only rendering engine in Blender that can bake textures by default. Since I was using the Oscuart PBR baker, which works with both engines I thought best to try with both. After concluding that one of these solutions gave the desired result, I decided to include this step in our methodology as it ensured that no problems would occur either way.

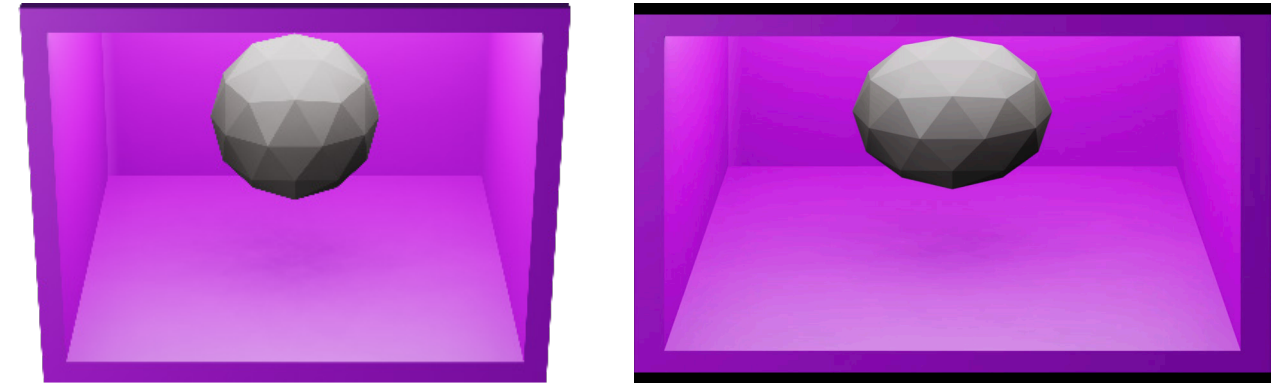


Figure 32: Left side image shows the rendered result. The image on the right is the final output, but still with the problem of black bars at the top and bottom, which changes the aspect ratio of the image, making it shorter. In comparison, however, we obtained a higher resolution output with no pixelisation.

However, the output remained with black borders around the image. As far as I knew, this could only mean that the UV maps were not correct. I investigated the problem in this direction and found a solution in the Youtube video “Blender 2.8 Bake camera mapped projected texture tutorial” created by the CG Matter channel. As I followed the steps shown in the video, I adapted them to our output. The first mistake I noticed was using only one UV map instead of two. Secondly, I superimposed the new baked image on top of the second one instead of creating a new Image Texture shader, giving it the correct resolution and then adjusting the map to the resolution so that it didn’t appear with the black edges.

In the Render menu I used the Cycles engine running on the graphics card, then I did the backing on emission only, adjusting the final output resolution and saving it as a PNG image sequence, using the Oscuart backing engine add-on.

The results of this experiment were very satisfying because it solved one of the main problems I had. Thanks to the large online community, I was able to find the solution I needed to continue our methodological process and develop what I consider to be a more coherent and correct implementation of the same. (Figure 33)

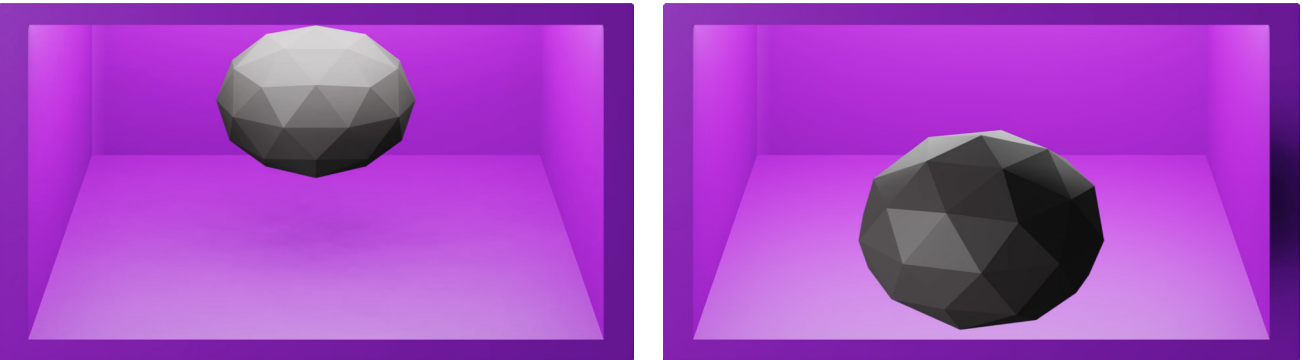


Figure 33: Images from the final output of the third registered test.

I wondered if the results of the previous test could be achieved by simply editing the image to the required resolution using external software such as Photoshop, and the logic behind this is much more complicated than it first appears. If I had not found this solution, the process would not be as seamless as it obviously is. Imagine editing every single frame of an animation that could have 200 frames or more, and that does not make for an efficient creative process. I believe that this hypothesis does not work, because although I could edit out the black bars, they compose the image generated from that perspective, but the adjustment of the image is affected by them, and that is why the whole process had to be implemented inside Blender, otherwise the perspective would never be right.

The third test presented allowed me to further experiment with the way a UV map is defined. I started with a scenario where a projection was placed on the outside corner of a wall. When the backed image was revealed, the result was not what I expected. The UV map looked as if it had been split in half and rotated separately. (Image 34)

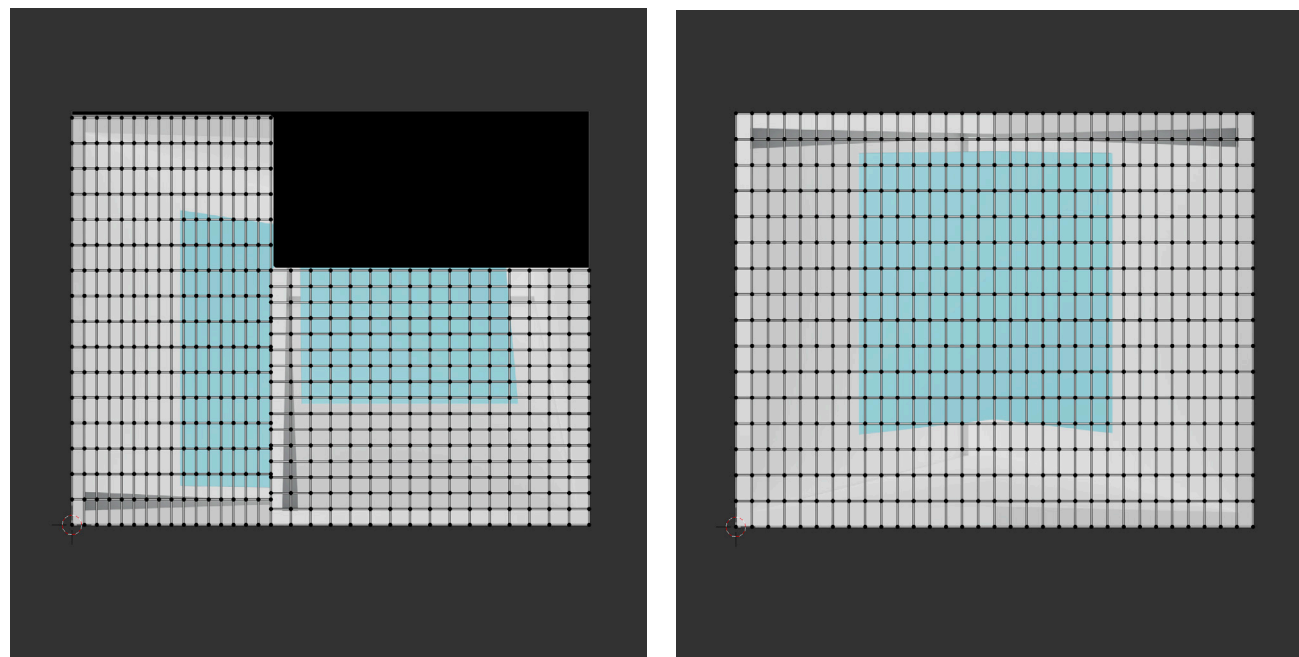


Figure 34: On the left we have an image of the UV map obtained from the first attempt where all the seams were marked and unwrapped. On the right we have the result from only marking the outer edges as seams, originated by thinking the final result has to be a plane.

After experimenting, rotating, scaling and moving the UV map, the results were the same. This led us to the conclusion that it was not the way the UV map was placed on the texture image, but the way it was generated. So if the defect was in the middle of the baked image, the problem would most likely be in the middle, where the middle edge was marked. Instead of a planification where all edges were marked, only the outer edge was marked as a seam, and the output was as intended. With this result, I concluded that all shapes can be thought of as simple planification, and that we must end up with a simple planar shape.

I concluded our testing phase by implementing all the above methods and applying them to a real case scenario. (Figure 35)

For our final test, I developed a simple animation to be projected onto the outside corner of a wall. When the animation was projected onto the wall, the keystone was not as wanted, and the limited setup was not helping. I had to find a solution to this problem because the conditions were not always so favourable, and for this project to be reliable, I had to overcome these complications so that it would work in almost any situation. After doing some online research based on projection mapping, I found that Adobe After Effects could be

used to mitigate the problem, as it is capable of using a projector as a visualisation screen, so when I manually adjust the parameters of the animation format, I can easily correct the framing.

Another discovery I made while producing the animation was that in order to create a more immersive experience, when an object approaches the point of view, as it gets closer, I recommend scaling it at the same time, so that the contrast between the beginning and the end is higher, giving a quicker and fluid interaction.

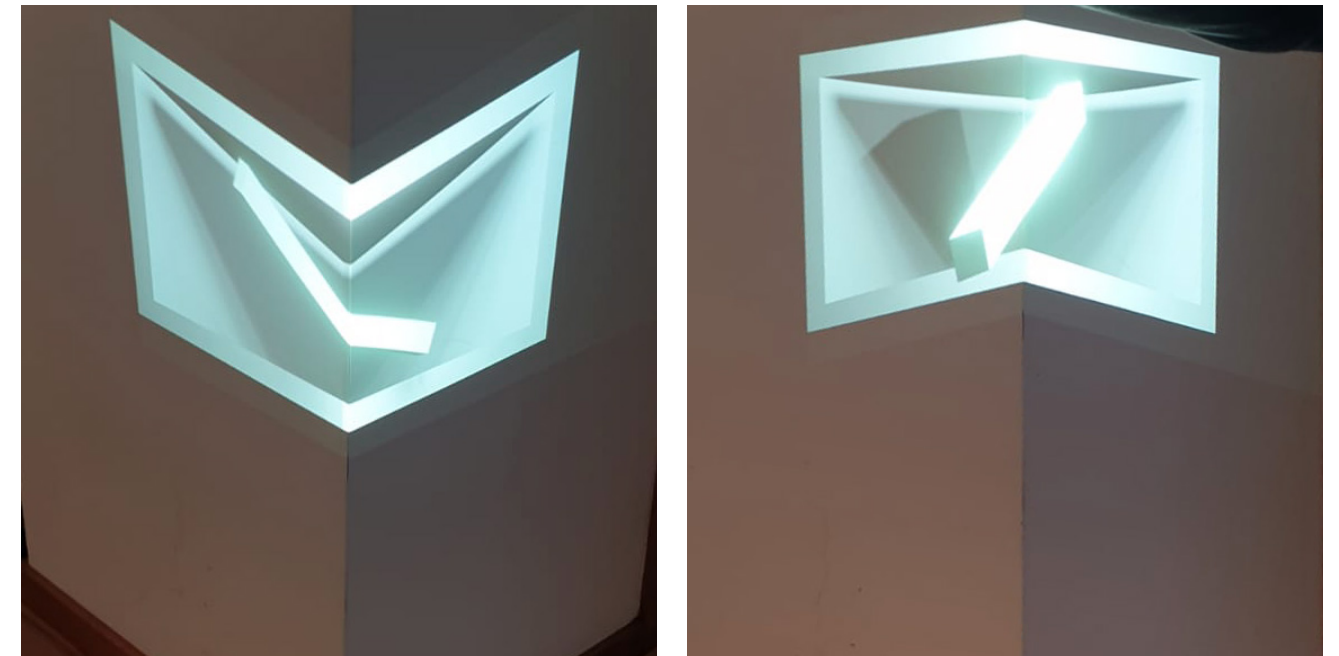


Figure 35: Photographs of the first attempt to project an anamorphic animation.

4.3 Observations

As simple as the process may seem, the result does not reflect the many steps I took to complete our methodology; it was not an easy research, as many tests were carried out, not all of which are described in this report, as some did not differ from those described or did not contribute much to the creative process.

The tests mentioned in this document either simplified our creative process or improved it in terms of performance or interactivity.

I would like to point out that this is not the only way to achieve the results I have, as this is our creative process, which I have achieved based on the knowledge I have gained from previous experience with the programme and the research I have carried out, mostly through online forums and video tutorials. It is safe to say that I enjoyed the whole process of learning and discovering as I carried out all the tests and mock-ups.

All the registered steps carried out in the previous chapters were only focused on the methodology of my final goal, which was to create an anamorphic illusion using a 3D modelling software, in this case Blender. This is a step-by-step guide, focusing only on how to create the images for the anamorphic illusion. I will not explain how to create the scenery, how to model the objects, as this would be too extensive and complicated to continue with this report.

5.0

Mock-ups

#1 – DON'T DESIGN FOR DESIGNERS

The first mock-up I presented allowed me to see details of the image composition that I had not foreseen. The importance of the composition of the light is just as important as the position of the objects in order to create a more pronounced illusion of depth when crossing the edge, which allows for a 3D anamorphic illusion. In this first project, I experimented with adapting a typeface to a twisted parallelepiped shape that transitions from the inside to the outside of a box and pivots around itself, revealing the message “Don’t design for designers” while giving the illusion of floating outside the projected space. I perform this anamorphic illusion through the different mock-ups, experimenting with different ways to deceive the eye and viewpoints. In this particular project, the point of view is above the projection.

The illusion that deceives the eye occurs when the cuboid crosses the white frame, the viewer initially assumes that the object cannot interact with this space, but when the object comes into contact with this zone, it simultaneously moves towards the viewer, creating the illusion that it is floating outside the projection.

“Don’t design for designers”



Figure 36: Frame of the final output. Obtained after backing, ready to be projected.

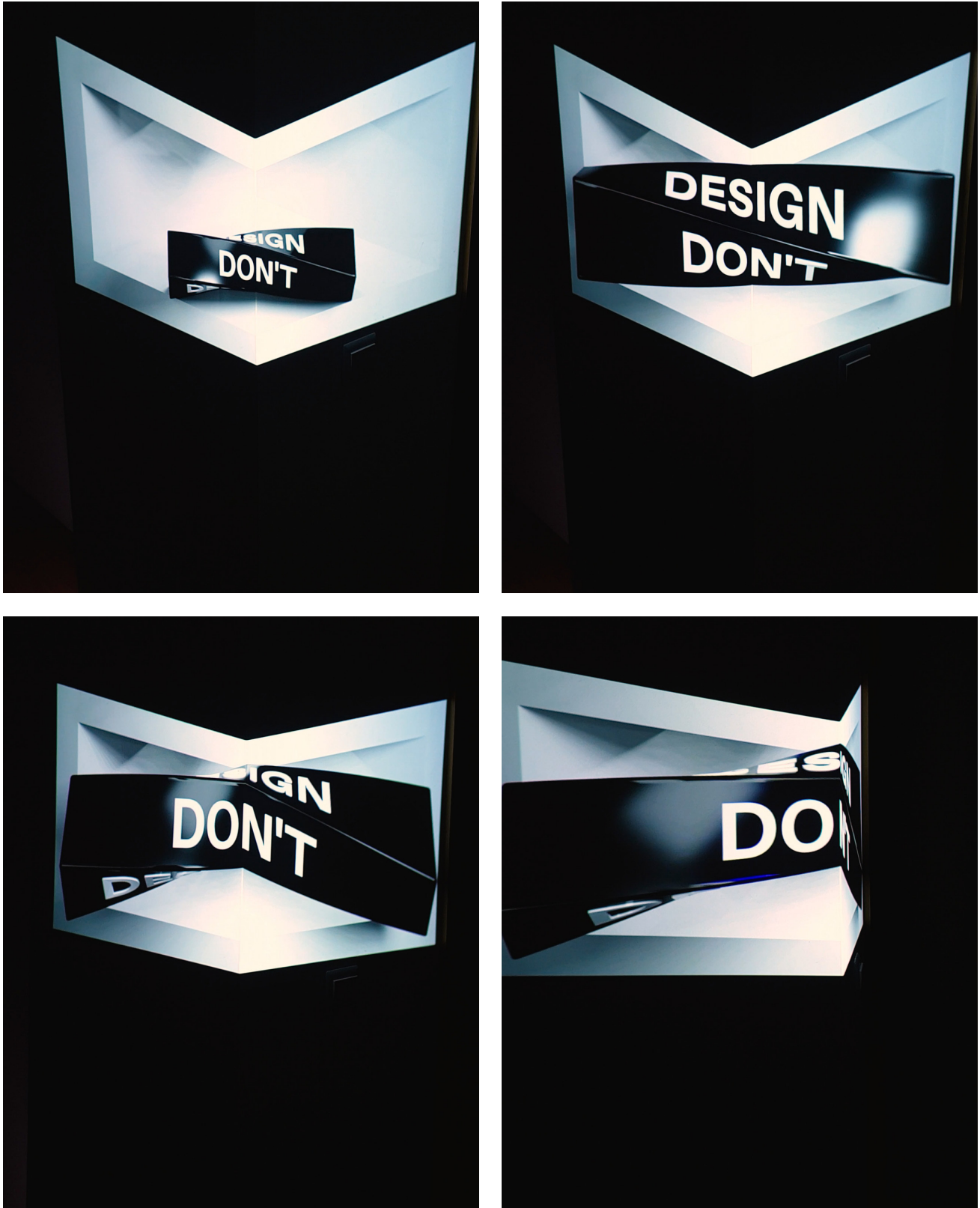


Figure 37: Beyond Perception mock-up #01. Stills from a recorded video of a real life wall projection.

The full video is available at [instagram.com/beyondperception2023/](https://www.instagram.com/beyondperception2023/)



Figure 38: Beyond Perception mock-up #01. Stills from a recorded video of a real life wall projection.

The full video is available at [instagram.com/beyondperception2023/](https://www.instagram.com/beyondperception2023/)

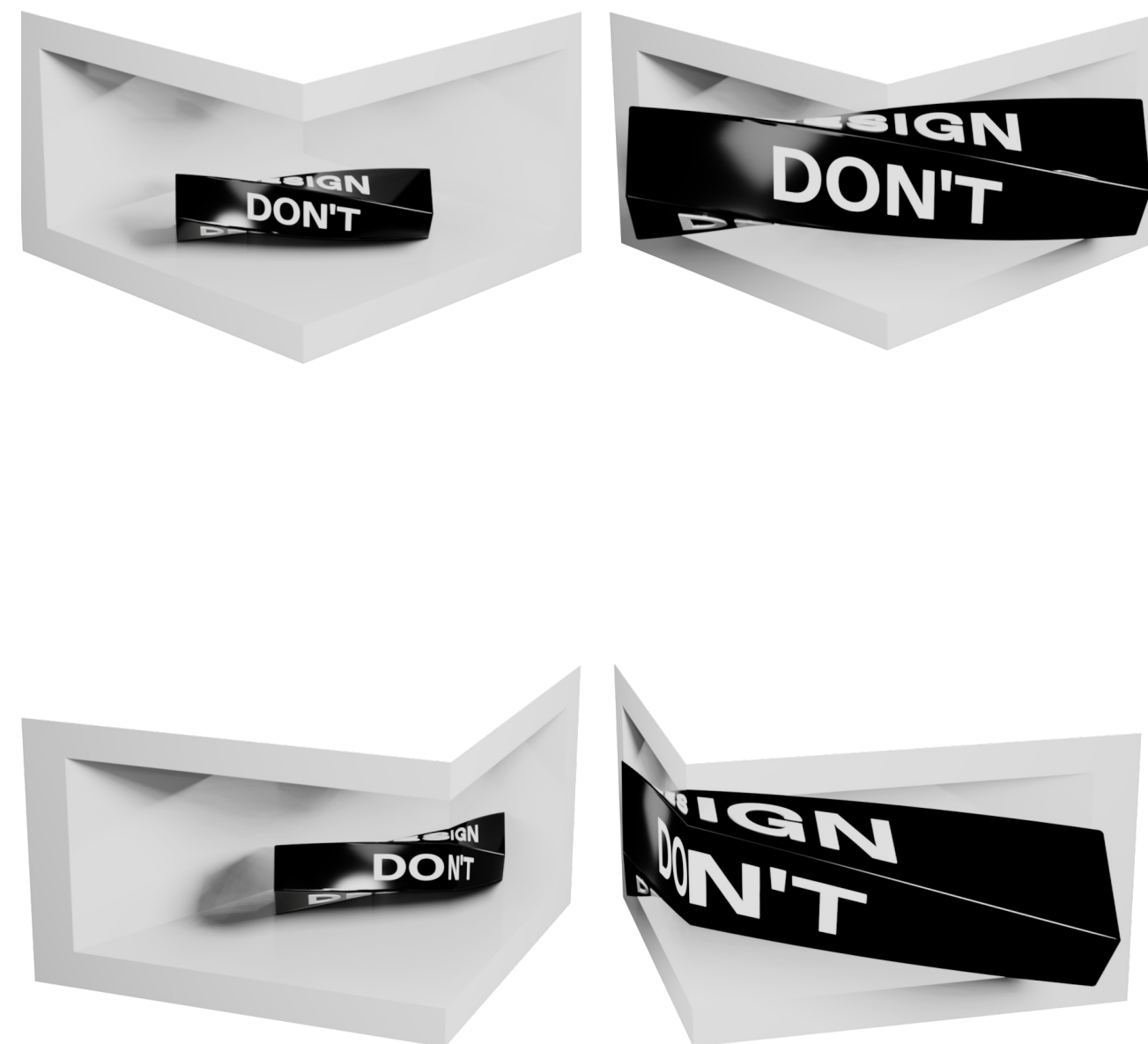


Figure 39: Beyond Perception mock-up #01. Frames from an animation that shows the effect of a projection on a wall.

The full video is available at [instagram.com/beyondperception2023/](https://www.instagram.com/beyondperception2023/)

#2 — TRANSPARENT DESIGN

For this project I decided to design a single face projection where the two words “obvious” and “transparent” appear from the top and bottom respectively, approaching the advantage point and then coming together to form the phrase “Good design is obvious, great design is transparent”. To emphasise the message more, rather than just give movement, I used different textures on the word “obvious” and on the word “transparent”.

This mock-up was created with the intention of understanding how the creative project would perform with a single surface projection. The result was very satisfactory, this animation creates an easy to present and immersive illusion. It was decided that the rotation should take place at the point where it stops, in order to emphasise the fact that the words are above the frame by casting moving shadows.

“Good design is obvious great design is transparent” - Joe Sparano

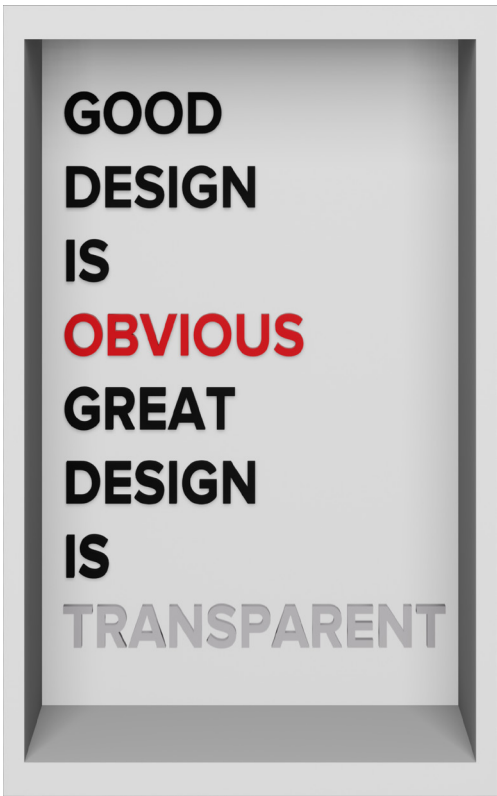


Figure 40: Frame of the final output. Obtained after backing, ready to be projected.



Figure 41: Beyond Perception mock-up #02. Stills from a recorded video of a real life wall projection.

The full video is available at [instagram.com/beyondperception2023/](https://www.instagram.com/beyondperception2023/)

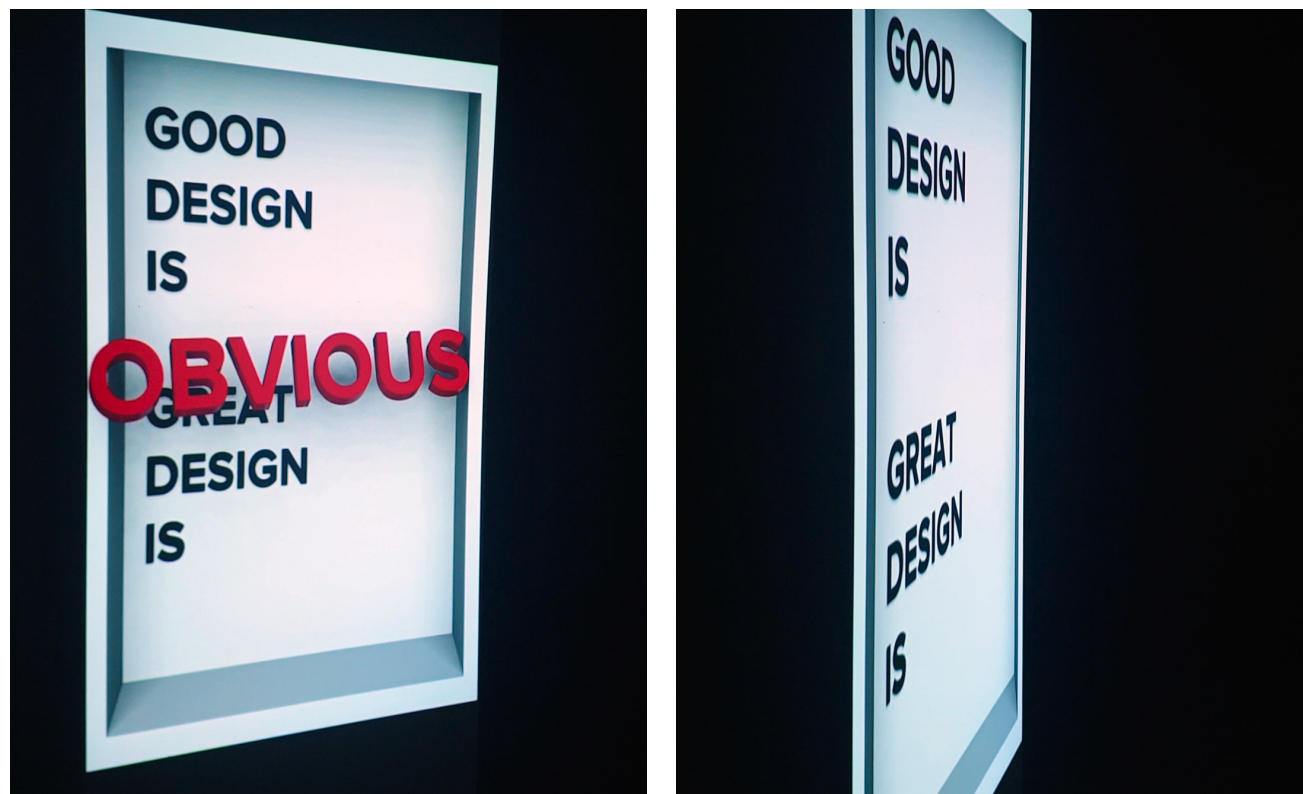


Figure 42: Beyond Perception mock-up #02. Stills from a recorded video of a real life wall projection.

The full video is available at [instagram.com/beyondperception2023/](https://www.instagram.com/beyondperception2023/)



Figure 43: Beyond Perception mock-up #02. Frames from an animation that shows the effect of a projection on a wall.

The full video is available at [instagram.com/beyondperception2023/](https://www.instagram.com/beyondperception2023/)

#3 — THINK OUTSIDE THE BOX

This third animation, in addition to creating the illusion of transposition from the “box”, was the first experiment between scale and position. This effect was created so that it could be seen from a lower point in relation to the projection. As the animation progresses, the text begins inside a glass-like cube and moves towards the upper edge, giving the illusion of depth at this point, ending in the “outside” right corner and positioning itself at the top of the whole scenery, while the rest of the phrase, “outside the box”, is added from below, corresponding to the positioning of the word “Think”.

This illusion is created not only by movement, scale and shadow but also by the prop, the glass-like cube, which helps to emphasise the idea of longitude by maintaining position, movement and scale as the rest moves and changes its interaction with the scenery and the prop acts as a reference point.

“Think outside the box”

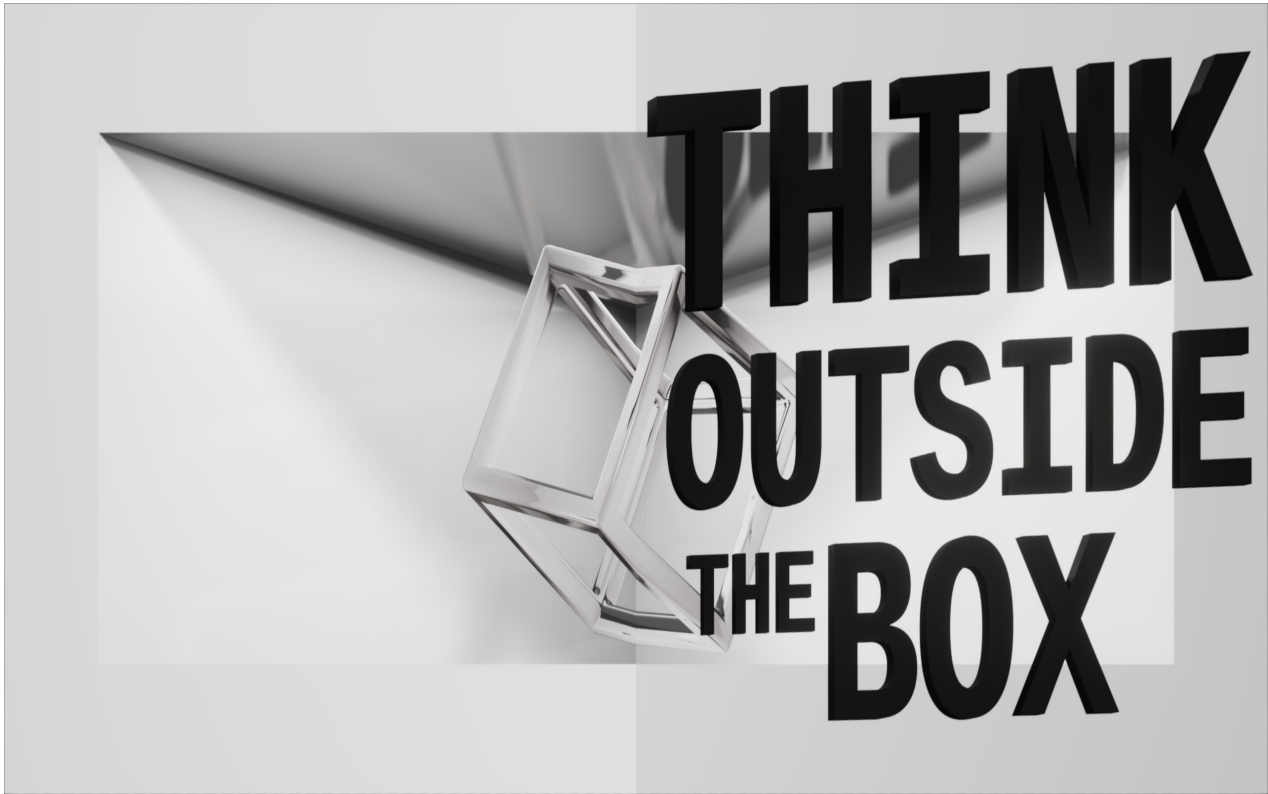


Figure 44: Frame of the final output. Obtained after backing, ready to be projected.



Figure 45: Beyond Perception mock-up #03. Stills from a recorded video of a real life wall projection.

The full video is available at [instagram.com/beyondperception2023/](https://www.instagram.com/beyondperception2023/)



Figure 46: Beyond Perception mock-up #03. Stills from a recorded video of a real life wall projection.

The full video is available at [instagram.com/beyondperception2023/](https://www.instagram.com/beyondperception2023/)



Figure 47: Beyond Perception mock-up #03. Frames from an animation that shows the effect of a projection on a wall.

The full video is available at [instagram.com/beyondperception2023/](https://www.instagram.com/beyondperception2023/)

#4 — WHEN NOTHING GOES RIGHT

In the fourth example, I created a borderless scene. This was the first time I had experimented with creating a 3D effect without superimposing the object on the frame, and in this case I found that there were limitations to the way I could create the illusion, as I had to think more about the movement. Instead of thinking about crossing the object with the scenario at a certain point. Without the frame, the illusion was created in such a way that the scaling had to be faster and of a higher value. To make the arrow look like it was coming out in some way. This interaction was achieved by making the arrow appear to fly towards the viewer when it reached the edge of the projection, rapidly rotating on the z-axis, the back, and at the same time scaling up to create the illusion. The lettering behind it helps to create a point of reference so that the viewer has an idea of the space. In the end the result were satisfactory, the projector low contrast reduced the quality of shadow perception what affected the depth effect.

"When nothing goes right, go left"



Figure 48: Frame of the final output. Obtained after backing, ready to be projected.

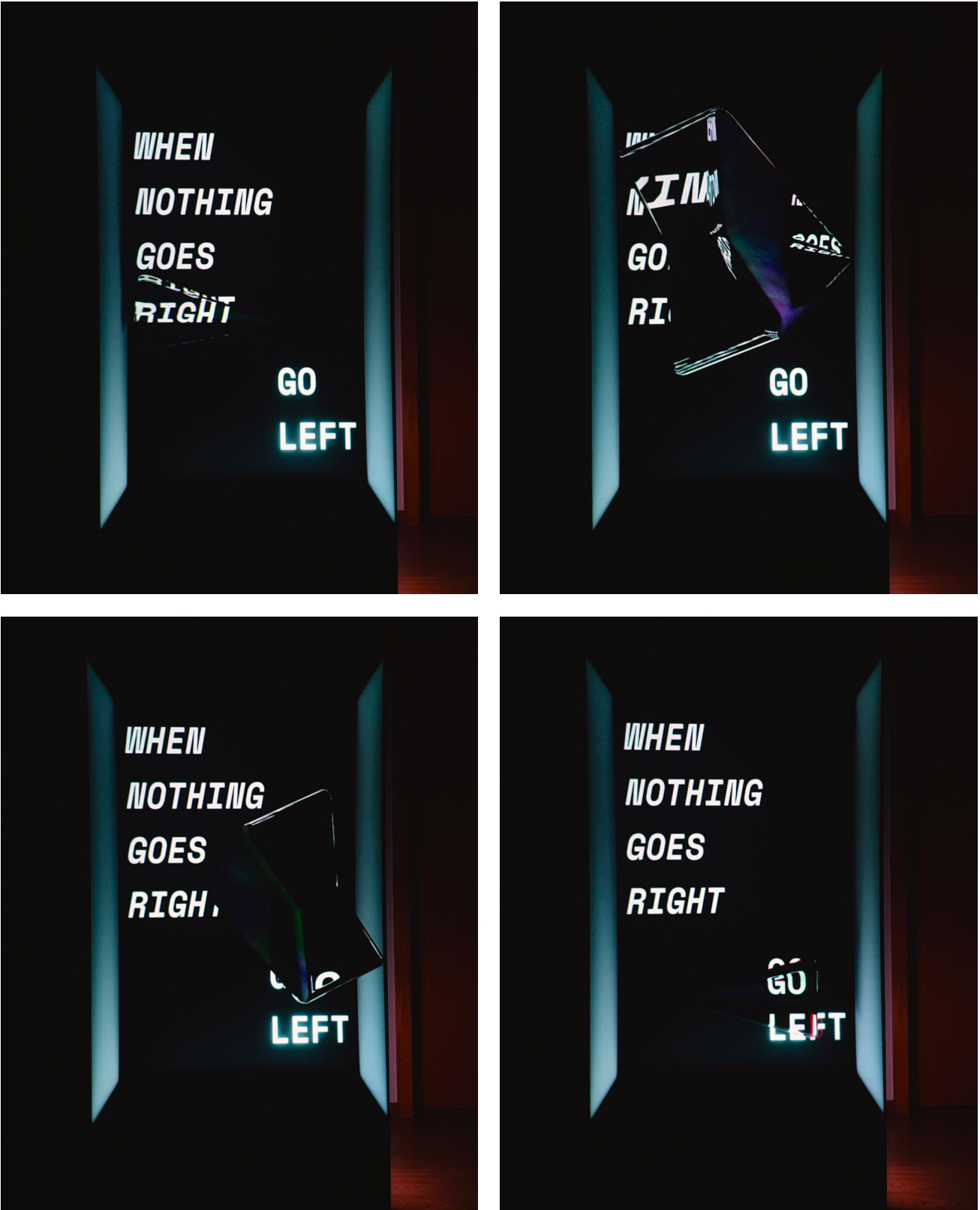


Figure 49: Beyond Perception mock-up #04. Stills from a recorded video of a real life wall projection.

The full video is available at [instagram.com/beyondperception2023/](https://www.instagram.com/beyondperception2023/)

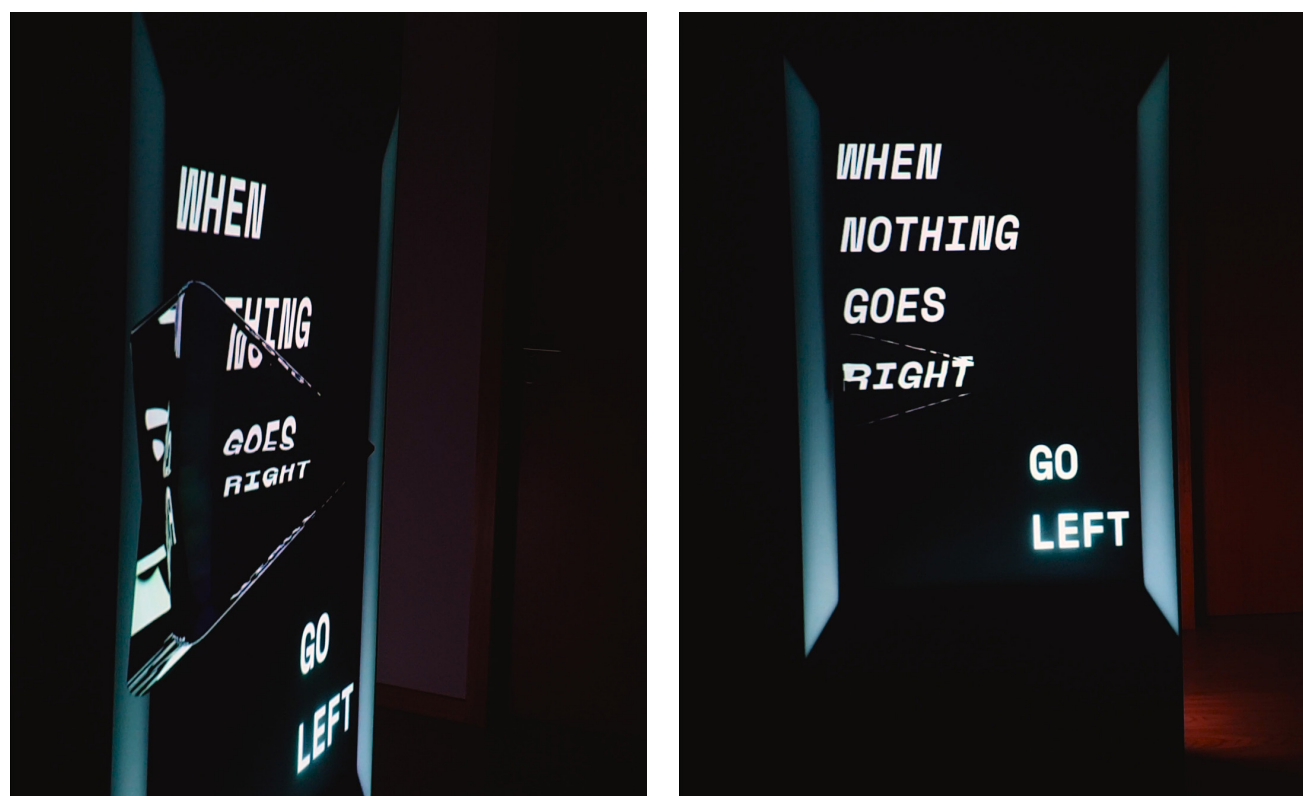
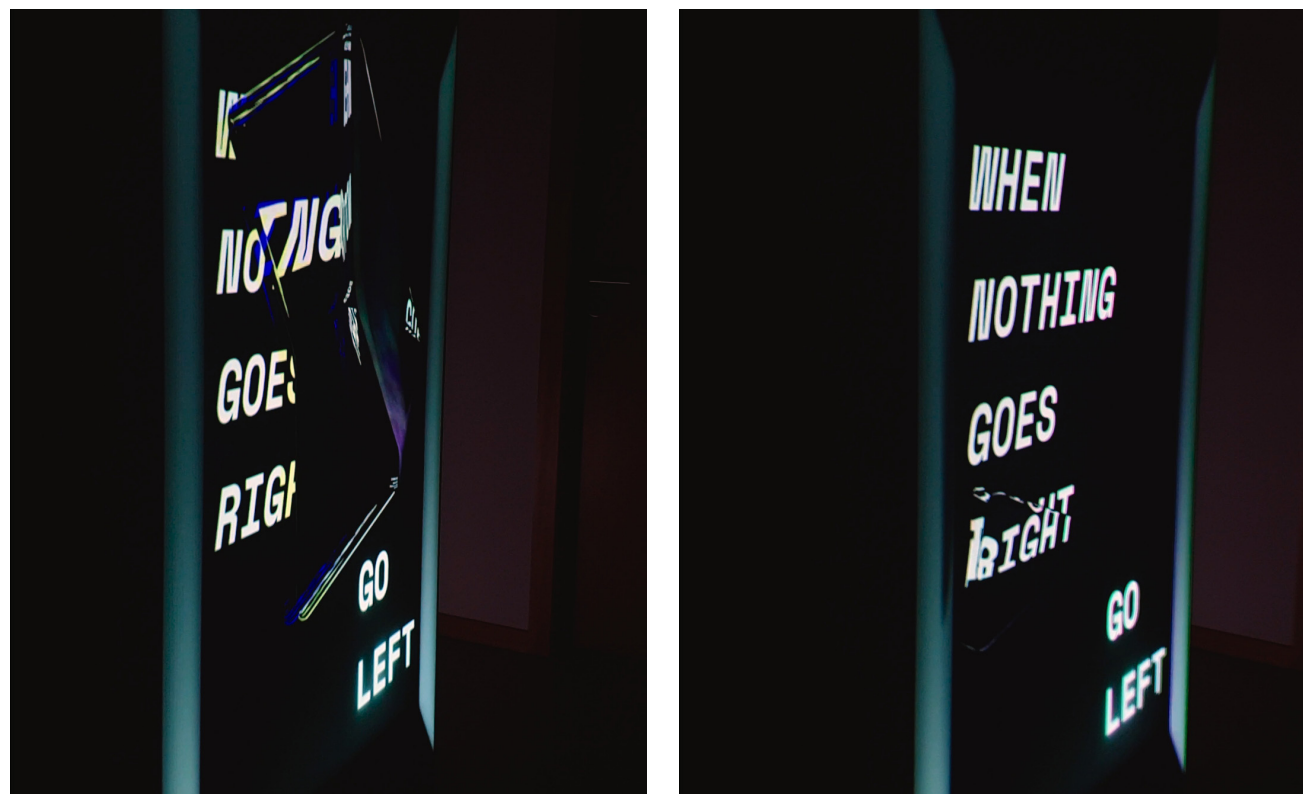


Figure 50: Beyond Perception mock-up #04. Stills from a recorded video of a real life wall projection.

The full video is available at [instagram.com/beyondperception2023/](https://www.instagram.com/beyondperception2023/)



Figure 51: Beyond Perception mock-up #04. Frames from an animation that shows the effect of a projection on a wall.

The full video is available at [instagram.com/beyondperception2023/](https://www.instagram.com/beyondperception2023/)

#5 —MAKE IT, SIMPLE BUT *

This animation starts with the word “Significant” falling to the ground, floats towards the outside of the frame, unnoticeable at first, reaches the point where it cycles through different words, finally revealing the character “*”, which creates the wow factor of this short video by flying towards the viewer, as it gets bigger it moves towards the top of the frame, reaching the point where the viewer understands the position of the object and is led to believe that it is coming out of the projection. By crossing the “*” object over the edge of the frame, the viewer is deceived into thinking that the object has come out of the projection and is moving inwards, at the same time shrinking and placing itself next to the “but”. The idea behind the movement itself is nothing new to explore. In this case I wanted to try out a new form of scenario, as it can be seen that the left side is shorter than the right, simulating a greater depth towards the far side.

“Make it simple, But Significant” - Don Draper

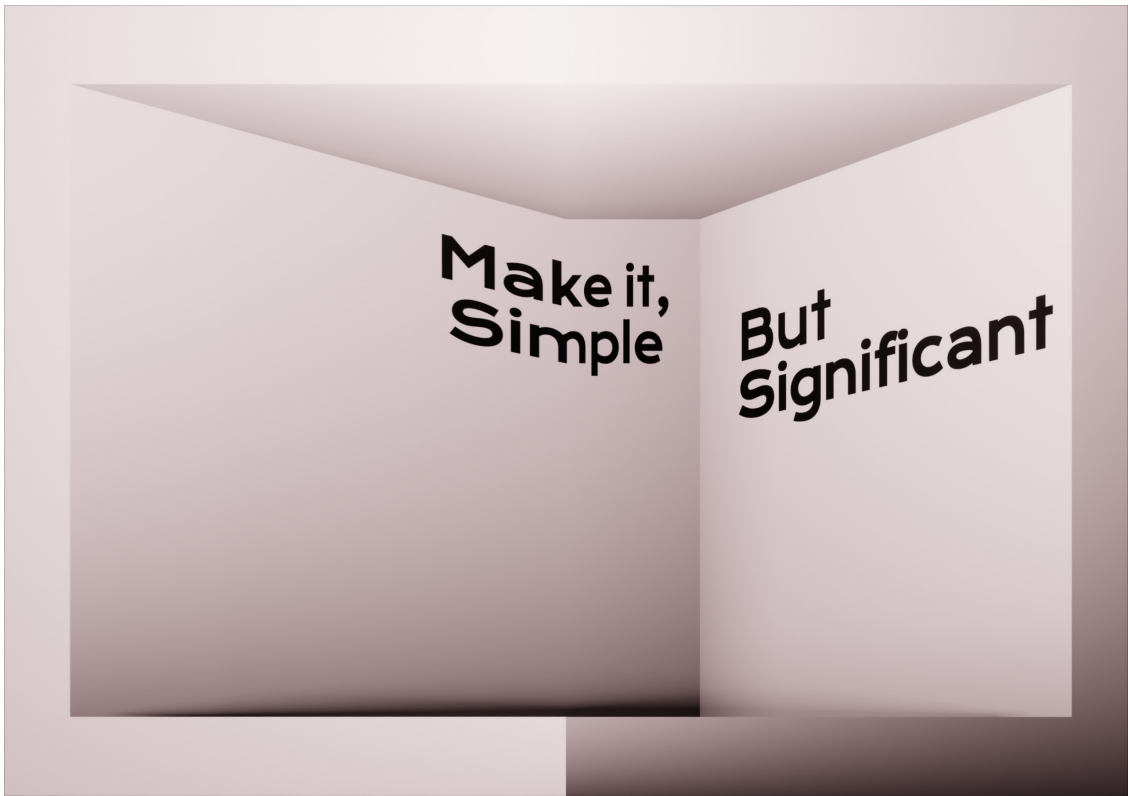


Figure 52: Frame of the final output. Obtained after backing, ready to be projected.

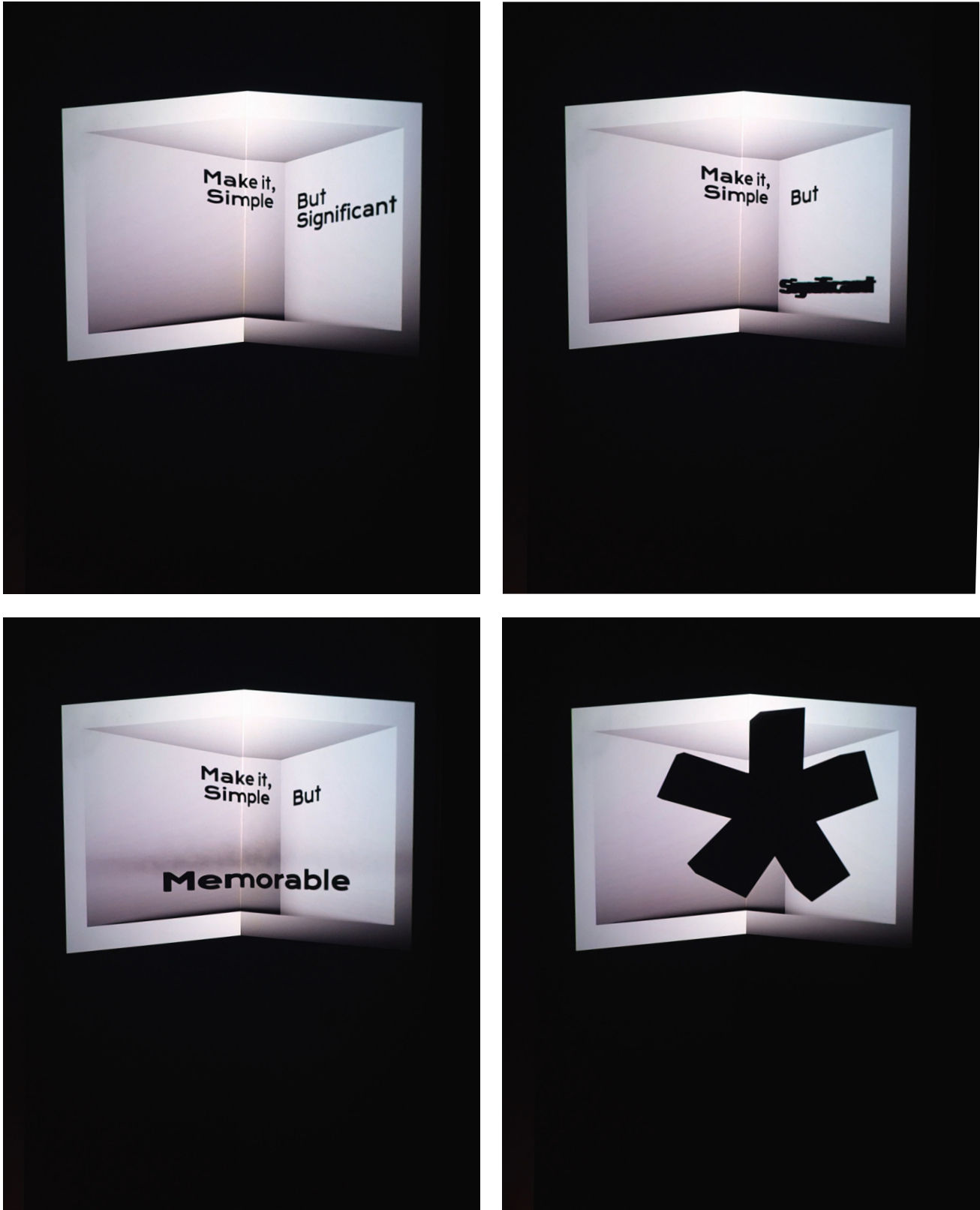


Figure 53: Beyond Perception mock-up #05. Stills from a recorded video of a real life wall projection.

The full video is available at [instagram.com/beyondperception2023/](https://www.instagram.com/beyondperception2023/)

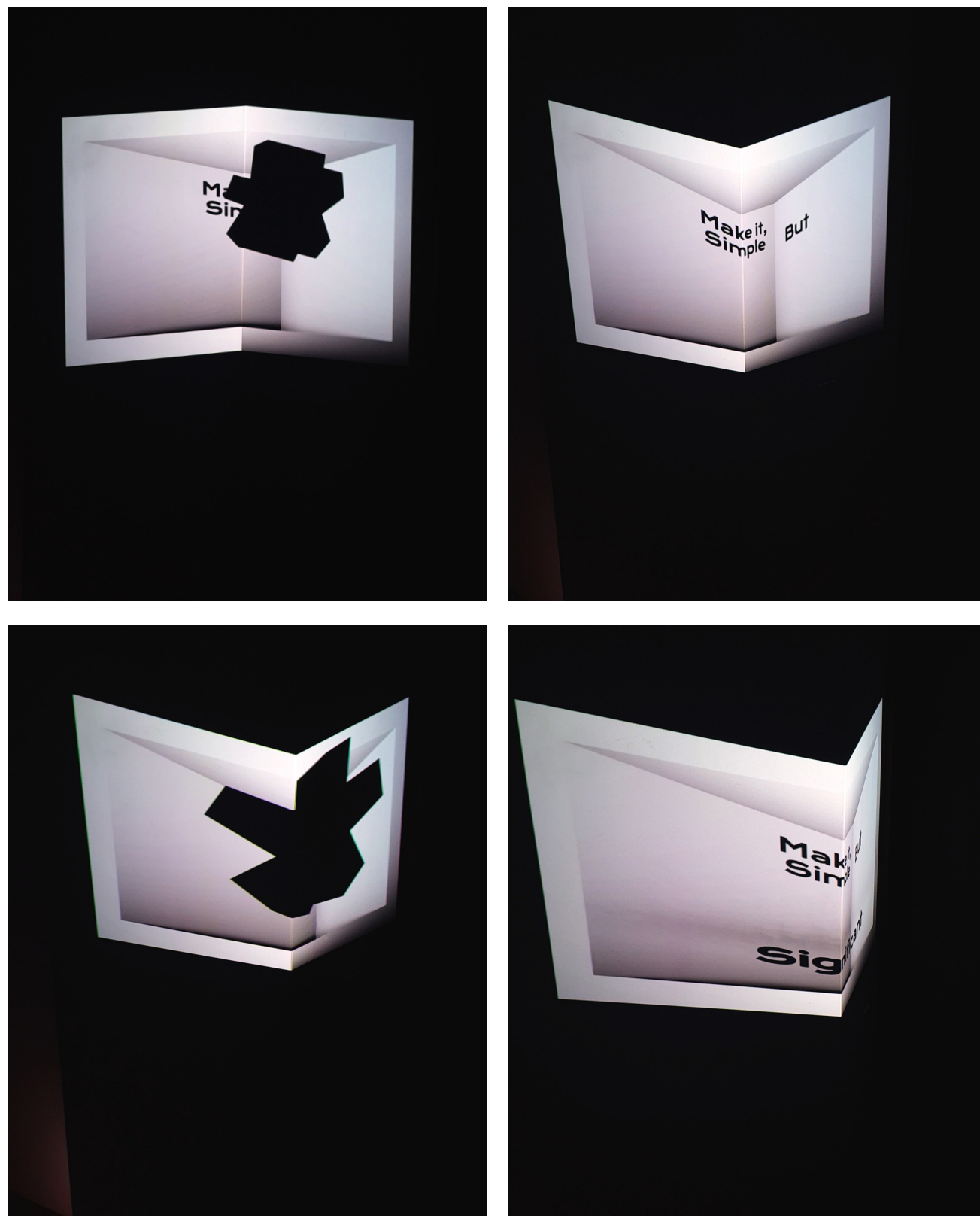


Figure 54: Beyond Perception mock-up #05. Stills from a recorded video of a real life wall projection.

The full video is available at [instagram.com/beyondperception2023/](https://www.instagram.com/beyondperception2023/)

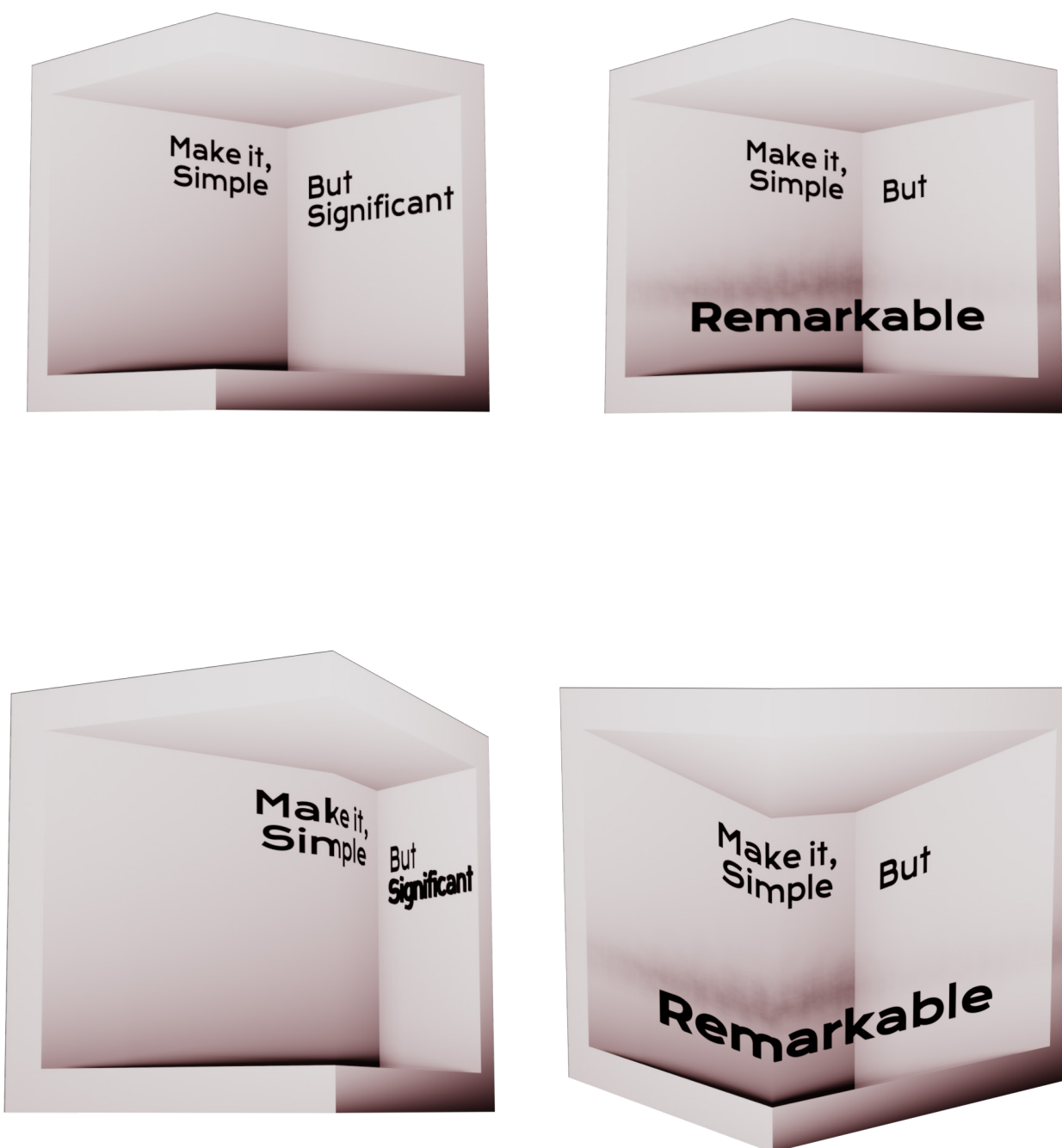


Figure 55: Beyond Perception mock-up #05. Frames from an animation that shows the effect of a projection on a wall..

The full video is available at [instagram.com/beyondperception2023/](https://www.instagram.com/beyondperception2023/)

#6 — DESIGNERS THOUGHT

Mock-up number six was inspired by the experience of typing on a computer. The parallelepiped is meant to simulate the typewriter platen, which first sits against the wall waiting to be typed on. It then moves outwards, with one end facing the camera as it is scaled up, creating the illusion of depth. One end of the bar gets bigger as the other gets smaller as it moves closer to the camera. The bar then begins to type the message “In design, thinking wrong is right”. The message in front of the scenario ends the illusion by occupying the entire screen, the absence of shadows projected on the scenario helps to end the illusion. Another idea that contributes to the understanding of how to create a more immersive illusion, or simply for it not to happen.

“In design, thinking wrong is right”- John Bielenberg



Figure 56: Frame of the final output. Obtained after backing, ready to be projected.

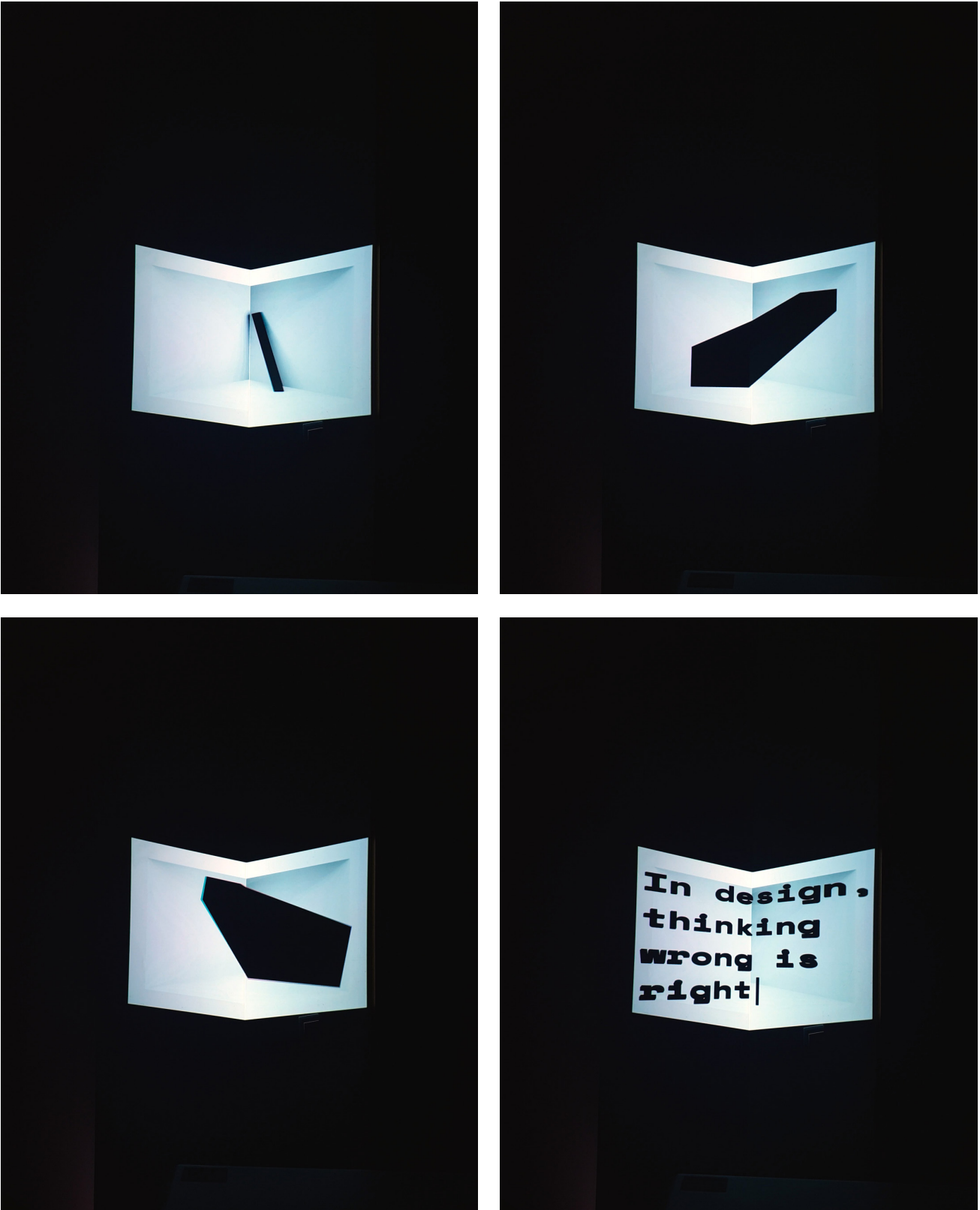


Figure 57: Beyond Perception mock-up #06. Stills from a video of a real life wall projection.

The full video is available at [instagram.com/beyondperception2023/](https://www.instagram.com/beyondperception2023/)



Figure 58: Beyond Perception mock-up #06. Stills from a recorded video of a real life wall projection.

The full video is available at [instagram.com/beyondperception2023/](https://www.instagram.com/beyondperception2023/)

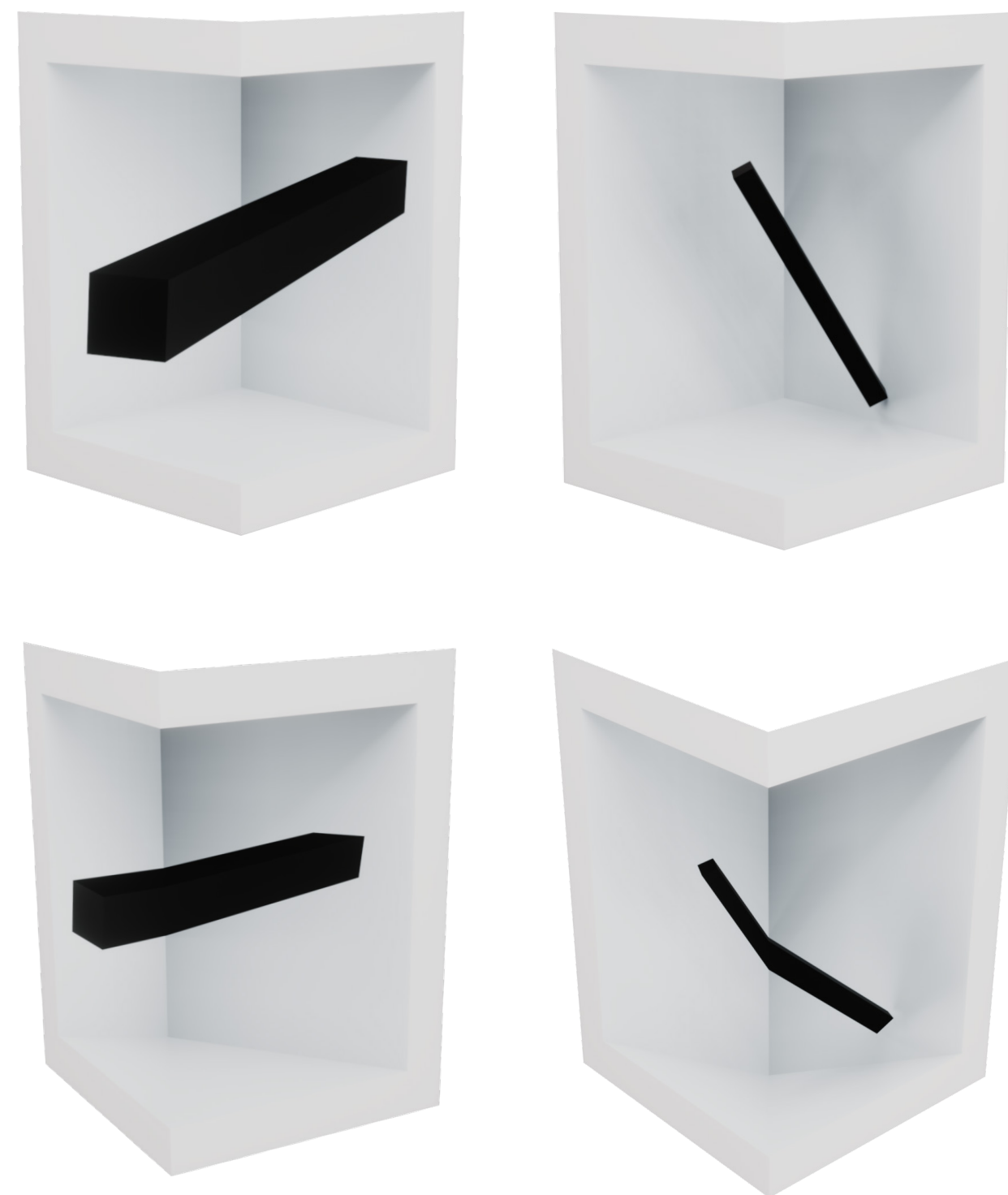


Figure 59: Beyond Perception mock-up #06. Frames from an animation that shows the effect of a projection on a wall.

The full video is available at [instagram.com/beyondperception2023/](https://www.instagram.com/beyondperception2023/)

#7 — DESIGN IS THINKING MADE VISUAL

The text in this experiment is the only one that shapes itself as it follows a path and as motion blur to add the effect of speed as it moves. At the closest point to the path, the letters become larger and cross the frame as they bend towards the inside of the scene. At this point, the eye is deceived and the perception of depth is altered, leading the viewer to believe that the letters are spinning around outside the projection.

“Design is thinking made visual”- Saul Bass



Figure 60: Frame of the final output. Obtained after backing, ready to be projected.



Figure 61: Beyond Perception mock-up #07. Stills from a recorded video of a real life wall projection.

The full video is available at [instagram.com/beyondperception2023/](https://www.instagram.com/beyondperception2023/)



Figure 62: Beyond Perception mock-up #07. Stills from a recorded video of a real life wall projection.

The full video is available at [instagram.com/beyondperception2023/](https://www.instagram.com/beyondperception2023/)



Figure 63: Beyond Perception mock-up #07. Frames from an animation that shows the effect of a projection on a wall.

The full video is available at [instagram.com/beyondperception2023/](https://www.instagram.com/beyondperception2023/)

#8 — EXPLORE NEW IDEAS

“Explore new ideas”, this message is carried within a bobble that bounces off the wall, changing trajectory and coming towards the advantage point, all the movement was very well thought out to simulate the bobble floating. I had to try different timings during the animation to get a more realistic effect. After discovering the timing to simulate the floating of the bobbles, I started to place the bobbles to be animated. When the objects were moving, I found that adding a little rotation on the X and Y axes at the same time gave a more realistic look to the bobbles due to the reflections and refractions caused by the lighting. When the main bobble carrying the message moves on the X and Z axes, coming out of the scenery, the illusion of depth is not very noticeable due to the deep black background colour. I admit that the initial movement was not as intended, but the look of the scenario was very pleasing and I wanted to solve this problem without simply changing the texture or moving the light. So I experimented with keeping the bobble coming up the scenario and scaling it at the same time as it was rotated, on the X axis, to delay its arrival at the top and scale it as it crossed the frame, so that the effect created was more noticeable. The bobbles in the background help to locate the main object and add character to the scene, as well as emphasising the transition from the interior to the exterior. This mock-up suffered from the same problem as “#4 - when nothing goes right”, the low contrast made this illusion not perform as desired, the bobbles in the background were not very noticeable as shadows, reducing the depth effect.

“Explore new ideas”



Figure 64: Frame of the final output. Obtained after backing, ready to be projected.



Figure 65: Beyond Perception mock-up #08. Stills from a recorded video of a real life wall projection.

The full video is available at [instagram.com/beyondperception2023/](https://www.instagram.com/beyondperception2023/)



Figure 66: Beyond Perception mock-up #08. Stills from a recorded video of a real life wall projection.

The full video is available at [instagram.com/beyondperception2023/](https://www.instagram.com/beyondperception2023/)



Figure 67: Beyond Perception mock-up #08. Frames from an animation that shows the effect of a projection on a wall.

The full video is available at [instagram.com/beyondperception2023/](https://www.instagram.com/beyondperception2023/)

#9 – CONTRAST

The ninth mock-up, entitled “Contrast”, is one of the designs of the entire mock-up collection, based on minimalism, contrast, simplicity and ease of understanding, so that the viewer can observe the entire design without overwhelming the eye, allowing him to analyse the whole combination of graphic design, animation and illusion. The word “Contrast” begins by approaching the camera, increasing in size so that it takes less time to reach a size that allures the eye in such a way that the word seems to emerge from the projection. The light bouncing off the white as this movement happens reveals the space where the word is coming to where it is going, helping to carry out the idea of a larger space, helping at same time to give an immersive and eye-catching animation. When the word reaches the point where the eye is focused, the letter ‘T’, sweeps across the entire image as it expands, creating a greater sense of depth.

This effect is enhanced by the light refracting off the letters as they become brighter, adding to the 3D effect. The animation ends with the word returning to a vertical position to rotate three hundred and sixty degrees, on the z axis, while multiplying itself and maintaining the rotation until it stops, completing the animation. This was a project where I wanted to experiment more with lighting, to try another variation of a single plane projection. The image quality was affected by the low contrast, the illusions with deep blacks and light reflections were all the more compromised by the performance quality of the projector.



Figure 68: Frame of the final output. Obtained after backing, ready to be projected.

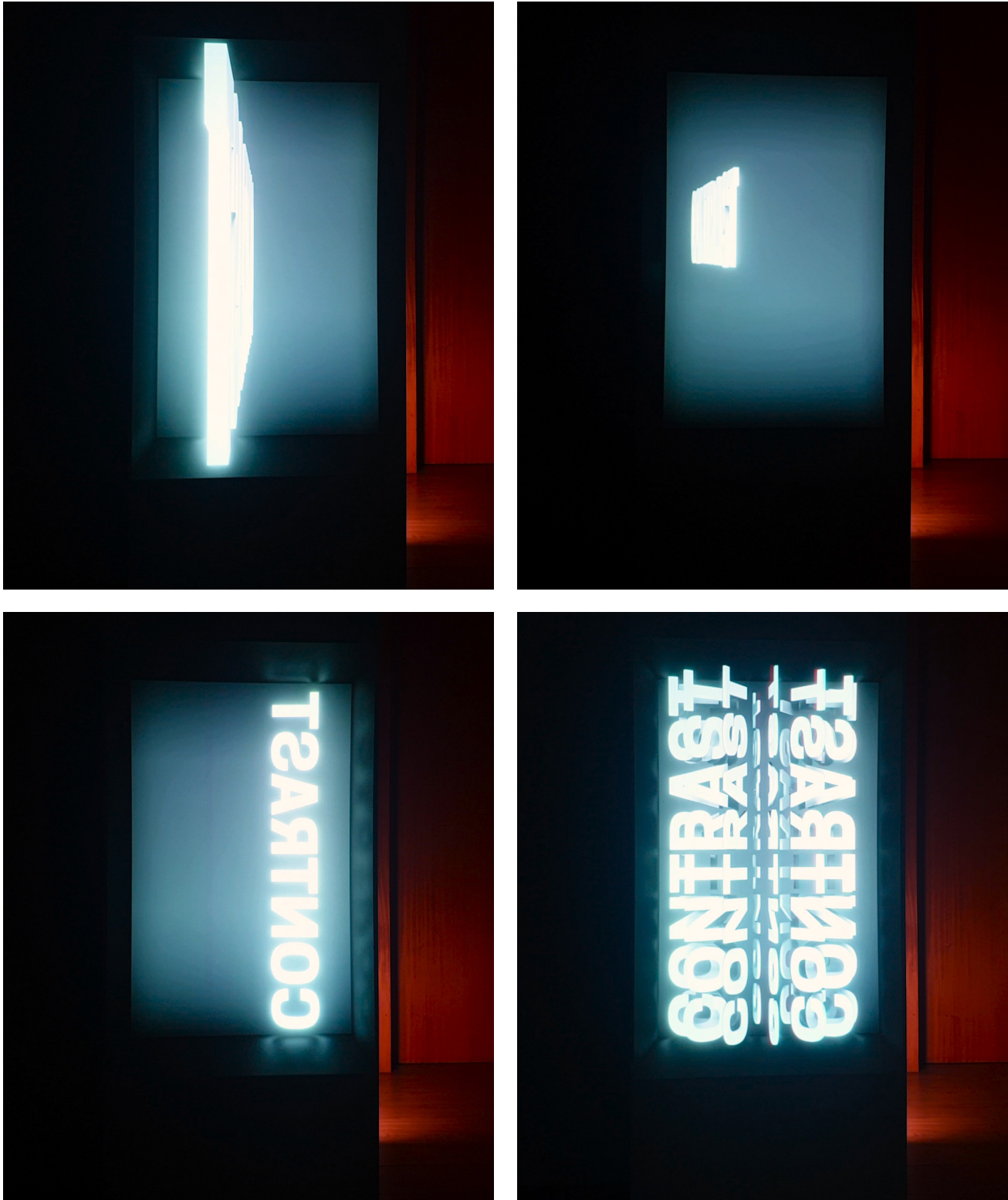


Figure 69: Beyond Perception mock-up #09. Stills from a recorded video of a real life wall projection.

The full video is available at [instagram.com/beyondperception2023/](https://www.instagram.com/beyondperception2023/)



Figure 70: Beyond Perception mock-up #07. Stills from a recorded video of a real life wall projection.

The full video is available at [instagram.com/beyondperception2023/](https://www.instagram.com/beyondperception2023/)

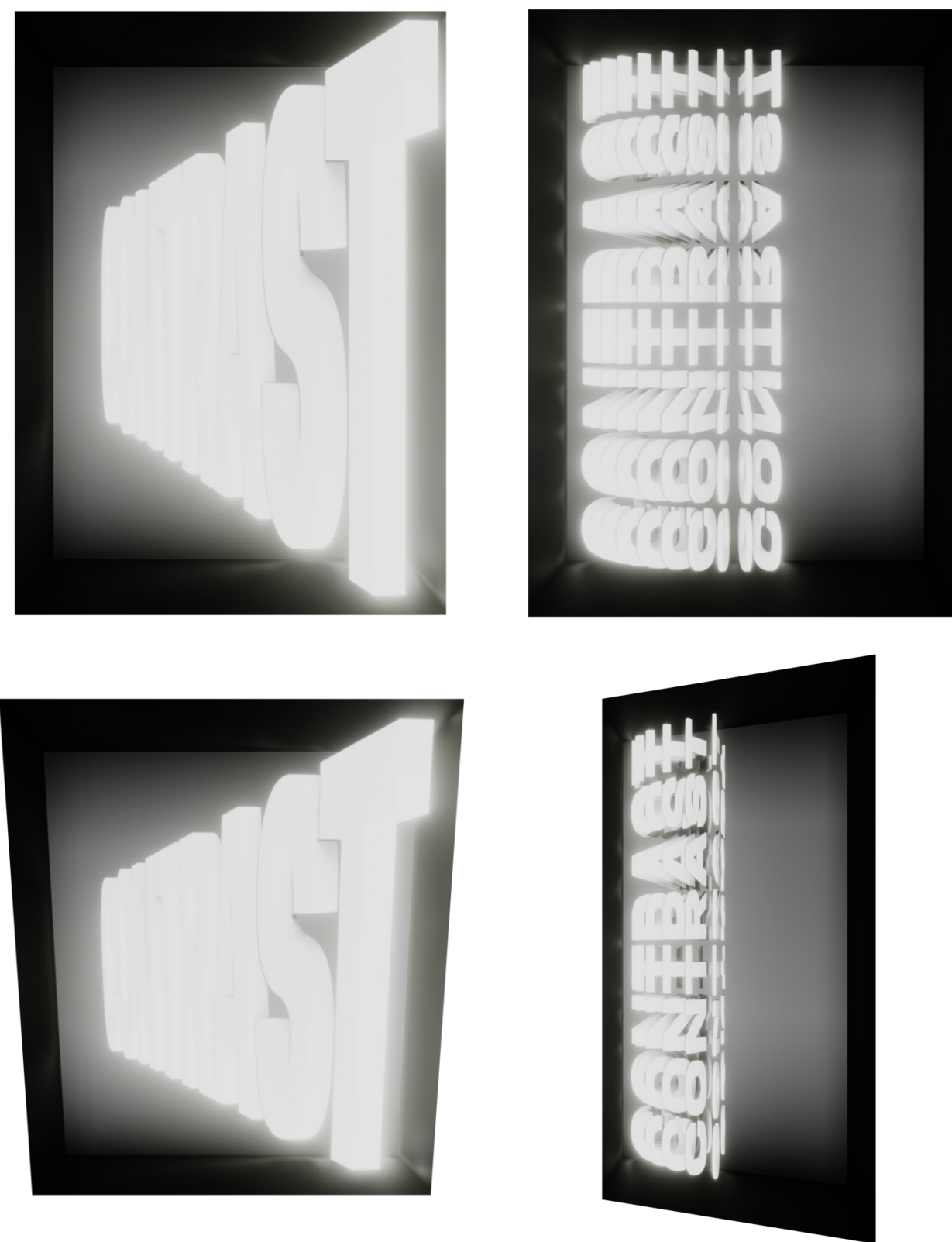


Figure 71: Beyond Perception mock-up #07. Frames from an animation that shows the effect of a projection on a wall.

The full video is available at [instagram.com/beyondperception2023/](https://www.instagram.com/beyondperception2023/)

Final consideration

From learning to doing, this report has been a great experience as a designer, not only have good results been achieved, but new skills have been learnt along the way. The main focus was to create a methodology that could be used by a large mass, so most of it was developed using free software, such as Blender to create the animations and Davinci Resolve to edit them. The projector was chosen as the presentation medium because it is affordable, easy to transport and allows more creative freedom thanks to its ability to adapt to any surface. If it had been done with a screen, the cost would have been much higher and we would have been stuck with its format, as the screen format cannot be changed. Nowadays it is easier to get reasonably priced projectors that can create these illusions.

The point is not that the cheaper the better, but that this project does not require high costs to achieve great results. As has already been said, it has to do with our judgement and what is the best option to achieve the expected result. In this case, the equipment I used was borrowed from the school and was not in as good a condition as expected, with low image contrast and brightness, a lamp at the end of its life, and poor image quality due to poor colour calibration, as the projections had a blue hue, which was not noticeable in the video stills shown earlier, as they had been edited to make them more pleasing to watch. Yes, it has to be admitted that a projector with a brighter image and higher contrast could improve the image quality for a more immersive experience, as shadows are more noticeable and the image is larger, creating a greater impression. Nevertheless, the difficulties were overcome in order to continue the experiments of this project. In some cases a better choice of textures would have improved the contrast of the animation, but due to the short time frame it was not possible to test this hypothesis. Either way, the illusion worked, and as creatives we sometimes need to be aware of what can be done with what is available.

It is important to remember that the basis of this report was to write and develop a working process based on the research and compilation of information carried out to create a guide that could then be used by others and serve as a reference to be further explored and developed to work with other types of shapes, surfaces, screens or simply to be presented on printed form that could be used for advertising or art. In this case, the focus was on a single objective to achieve the best possible results in the given time frame.

The mock-ups presented are from a designer perspective and are intended to inspire other designers to add this “tool” to their “toolbox” and use it for their creative needs. This technique offers another way of interacting with the viewer. It is important to say that more can be done and explored, the projects presented above were created in a short time frame. In this sense, it was not possible to explore other creative ways of animating or projecting. Nevertheless, the results show what can be achieved when this technique is applied, and yet with little time and limited resources the mock-ups turned out to be a great achievement and a solid result.

The aim was to simplify the process as much as possible, as it is understandable that there will be a big learning curve for some. The creative process reported in this document explains how to achieve the anamorphic effect with Blender and demonstrates how it can be applied.

This is a fairly new technique that is being used more and more and is growing because of its use in advertising by big name brands like Samsung, Netflix, Vodafone and Mercedes-Benz to name a few. I believe it is here to stay as it becomes more popular and in demand.

Beyond Perception is a project that will continue on a personal level, experimenting with other techniques and developing content to draw more attention to this type of work, maintaining and adapting to advances in technology and keeping alive this journey that has just begun.

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