NATIONAL AUTONOMOUS UNIVERSITY OF MEXICO

TECHNICAL MANUAL

COMPUTER GRAPHICS HUMAN-COMPUTER INTERACTION

ACCOUNT NUMBER:
317231117

SUBJECT:
Computer Graphics
Human - Computer Interaction

GROUP: 05

SEMESTER: 2023-1

Faculty of Engineering

CONTENT

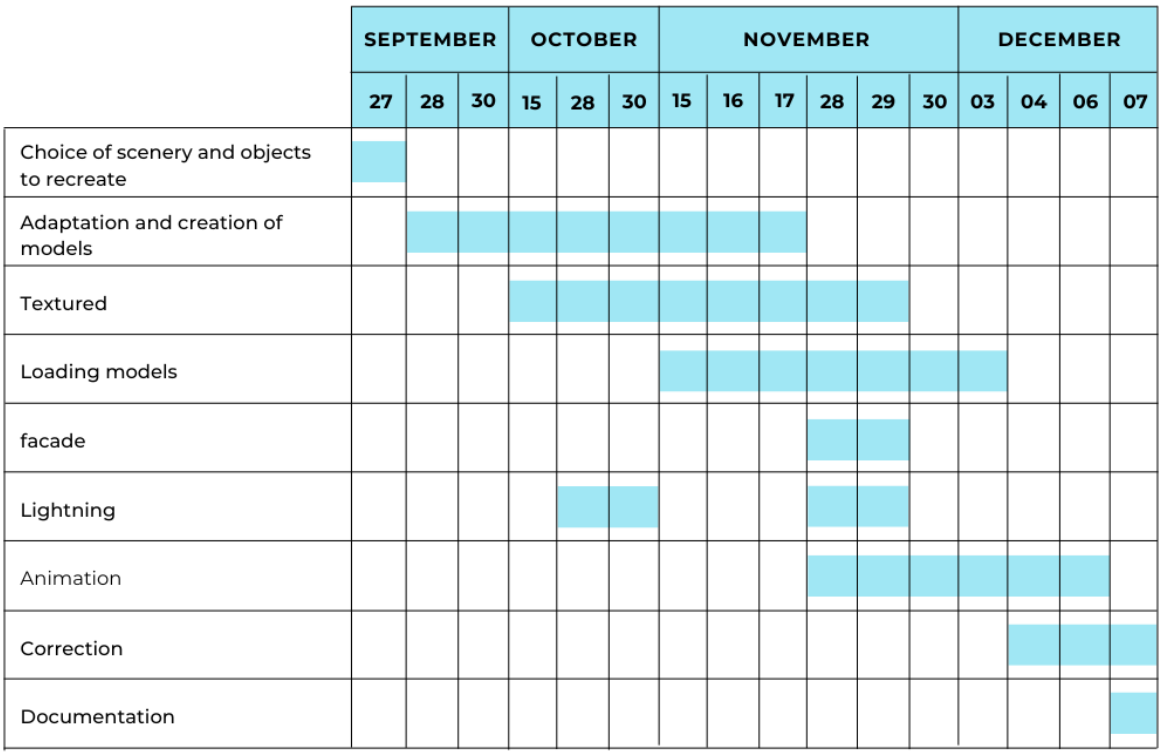
FINAL Project

OBJECTIVE

Application and demonstration of the knowledge acquired throughout the course. More specifically, the recreation of 10 elements inside an ambient space is sought and which must be within a façade corresponding to it. It is intended that a good modeling is carried out and good techniques of texturing animation and lighting are applied on it to obtain greater realism according to what is presented as an image and what is sought to recreate.

In this way, the different forms of creation and rendering of computer graphics will be used and applied, thus reinforcing the knowledge obtained throughout the course adapted to a personalized form by each of the different students.

GANTT CHART



PROJECT SCOPE

This is a project with great scope at the academic level because it allows us to reinforce all the knowledge acquired throughout the semester, it is a good option and with this project we can adapt different models to what we want and it is a way in which we can have the bases to make creations with greater complexity. That is, we are acquiring the basis for the customization of computer graphics as well as their creation, and the way we want them to be seen on screen.

In agreement and in this way we are acquiring the ability to adapt different models to a series of requirements and make them acquire complexity by involving certain animations on them through the use of OpenGL which is precisely this allows us to process computer graphics, allows us to learn and see how it works directly our computer the visualization of the different models and the animations created throughout the project.

Undoubtedly, this can lay the foundations for us to create larger projects, since this project gives us precisely the capacity for abstraction that we need to be able to recreate scenarios and objects within a digital space. We know that modeling is undoubtedly one of the most time-consuming processes, because it involves the creation of objects through geometric shapes, so you must have enough ability to recreate and adapt them to what you are looking for.

So, this project has a fairly large scope so that we have the bases to generate simple computer graphics and also that we can have interaction with them, with this, when deepening we can see that we can create much more complex things and with greater realism, but above all that are visually pleasing.

Now also, by understanding the operation and use of OpenGL, we can use it to make projects that involve a graphical interface that needs to be friendly and that is visually attractive to the people who are going to use it, then OpenGL beyond only being used for this purpose, modeling and animation, can be used in the creation of software to create user interfaces, since it has great adaptability and a fairly good deficiency. In the end, many of the graphics creation softwares make use of this to be able to process all the information and generate what we are looking to visualize.

LIMITING

One of the biggest limitations is that we can not graphics so realistic, first because we do not have in the equipment with enough capacity to do it and the second because it is a fairly laborious process, as we know first all objects must be modeled and a modeling with enough detail implies a greater polygonage, which makes the level of processing or rendering that implies is quite large and for our teams is Quite difficult to do this in a short time.

In addition, we know that the modeling process is undoubtedly the most complicated since all the figures are built based on surfaces that come from different polygons, then the texturing follows, this is not such a difficult process but nevertheless, it is a process that is quite laborious to be able to adapt the different textures to our different objects, In addition to taking into account the characteristics that these will have, since here the color and brightness that they will have is described.

Finally, an animation is sought, this also involves a lot of processing, since for example if we want to animate a figure we also have to involve in it the control that will enable this animation, in this case when working directly on OpenGL, we can really make complex animations but involve many equations that could be done more easily with some animation software, However, they give us the basis to understand how this process is working inside the computer.

Finally we can say that we have lighting and rendering, movies or different video games we can see that they make use of lighting techniques that are quite realistic and complex, which thanks to that project we can already understand in a better way how they work. Precisely these were the limitations of our project, the time we were given to be able to do the modeling, the equipment we are using.

Not only the limitations of the team for the modeling part but also for the animation part. Since many times it depends on the equipment and the processing that has the speed that our animation will have, this more than a problem was to look for an adaptability, since in computers with less processing the animation is very slow, while in the computer with a greater processing it may be that the animation that looks normal in another computer in this one looks very fast or almost imperceptible, That is why we must find a way to adapt our project to these changes.

COSTS

Below is a monthly cost estimate over a three-month period in which the entire project was completed.

			MONTH 1	MONTH 2	MONTH 3
FIXED COSTS	Payment of electricity		188.00	-	179.00
	Gas payment		-	702.00	-
	Water payment		79.00	-	99.00
	Internet Payment		389.00	389.00	389.00
	Computer Equipment		250.00	250.00	250.00
	Transport		1,000.00	1,000.00	1,000.00
	SUBTOTAL		**1,906.00**	**2,341.00**	**1,917.00**
VARIABLE COSTS	Licences	Maya	3,087.00	3,087.00	3,087.00
		Photoshop	399.00	399.00	399.00
		Visual Studio	850.00	850.00	850.00
	Programming		9,000.00	9,000.00	9,000.00
	SUBTOTAL		**13,336.00**	**13,336.00**	**13,336.00**
	TOTAL COSTS		**15,242.00**	**15,677.00**	**15,253.00**

Based on the table, we can obtain an approximate cost of the project, for this, we must know that, within the table, the payment of licenses and a charge of $ 150.00 per hour of programming are being considered, if a total of 4 hours is worked for 15 days of each month, we would be charging a total of $ 9,000.00 per month taking the account only the programming.

Taking into consideration, the costs of each month we have a total of $ 46,172.00. It is important to know that it is case that you work as a freelancer, this money would be entirely for us, however, it is if not, it should be considered that royalties of between 10% to 15% plus the fixed salary are paid, so, if we consider a salary according to the labor or the scheduled hours, We would be earning a total of between 31,617.2 to 33,925.8 for the entire project. However, this would be a somewhat high price considering that it is a project carried out for academic purposes and whose licenses were obtained for free. So, in the following table, the actual cost that I imply is shown.

	MONTH 1	MONTH 2	MONTH 3
Payment of electricity	188.00	-	179.00
Gas payment	-	702.00	-
Water payment	79.00	-	99.00
Internet Payment	389.00	389.00	389.00
Computer Equipment	250.00	250.00	250.00
Transport	1,000.00	1,000.00	1,000.00
REAL COSTS	**1,906.00**	**2,341.00**	**1,917.00**

As we observe we are only considering the expenses that were made throughout the project and that were necessary for both the implementation and for the creation, it is important to mention that here we are not directly putting what we would charge for this type of project, that is, what our hours as a programmer are worth.

		MONTH 1	MONTH 2	MONTH 3
FIXED COSTS	Payment of electricity	188.00	-	179.00
	Gas payment	-	702.00	-
	Water payment	79.00	-	99.00
	Internet Payment	389.00	389.00	389.00
	Computer Equipment	250.00	250.00	250.00
	Transport	1,000.00	1,000.00	1,000.00
	SUBTOTAL	188.00	-	179.00
VARIABLE COSTS	Programming	9,000.00	9,000.00	9,000.00
	SUBTOTAL	**9,000.00**	**9,000.00**	**9,000.00**
	TOTAL COSTS	**10,906.00**	**11,341.00**	**10,917.00**

Now taking into account, that the real cost of the project is $ 33,164.00, a good price would be a total of ***$ 35,000.00***, this especially for the time spent in the creation and adaptation of the models, which is undoubtedly one of the most difficult and time-consuming stages to develop.

TECHNICAL ANALYSIS

Throughout this document will mention the different libraries, variables and functions used for the operation of this program, along with the mention of the different softwares used for its creation.

LIBRARIES AND HEADERS

	NAME	USE
LIBRARIES	**iostream**	Processing inputs and outputs in the form of a sequence of bytes. Inputs from a device to the main memory and output from this to the screen.
	cmath	Set of functions to perform mathematical operations.
HEADERS	**GL/glew.h**	Provides efficient runtime mechanisms for determining which OpenGL extensions are supported by the target platform.
	GLFW/glfw3.h	Allows you to create and manage windows.
	stb_image.h	Image processing.
	glm/glm.hpp	Use of different libraries given by C.
	glm/gtc/ matrix_transform.hpp	Defines functions that generate common transformation matrices.
	glm/gtc/type_ptr.hpp	It manages the interaction between pointers, vectors, and matrices.
	SOIL2/SOIL2.h	Performs texture loading within OpenGL.
	Shader.h	A program defined to run at some stage of a graphics processor.
	Camera.h	Name given to the virtual position of a spectator within a scene.
	Model.h	Loading models into OpenGL.
	Texture.h	Loading textures into OpenGL.

FUNCTIONS

NAME	USE
KeyCallback ( )	Keyboard reading.
MouseCallback ( )	Reading the movement of the mouse.
DoMovement ( )	Viewer movement.
animacion ( )	Using an animation.
camera ( )	Define the position of the camera.
main ( )	Inside it are loaded models, shaders, skybox, lighting models, textures, and animations.

VARIABLES

			TIPE	NAME	USE
		Lighting	**bool**	**active**	Activation of the defined pointligth.
			vec3	**Ligth1**	Position and calculation of the pointligth.
			vec3	**lightPos**	Attributes of light.
			vec3	**pointLightPositions**	Initial analysis of the pointligth.
Animation	Simple	**Drawer**	**bool**	**animC**	Animation for the opening of the drawer.
			bool	**animC1**	Animation for the closure of the drawer.
			float	**traC**	Increases or decreases for the transfer of the drawer in opening or closing.
		Exterior Door	**bool**	**animPE**	Animation for the opening.
			bool	**AnimPE1**	Animation for closing.
			float	**traPE**	Increases or decreases the rotation in opening or closing.

		Interior Door	**bool**	**animPI**	Animation for the opening.
			bool	**AnimPI1**	Animation for closing.
			float	**rotPI**	Increases or decreases the rotation in opening or closing.
	Complex	**Wands**	**bool**	**animRV**	Animation for counterclockwise rotation of wands.
			bool	**animRV1**	Animation for rotation of wands clockwise.
			float	**rotV**	Displacement of wands by means of a half-circle path.
			bool	**mostrar**	Animation for the transfer of half circumference of the wands, as well as their rotation.
			float	**movVarX**	Parametric movement of the circumference traced by wands on the X-axis.
			float	**movVarY**	Parametric movement of the circumference drawn by wands on the y-axis.
			float	**rotVar**	Rotation for float simulation.
			float	**tempB**	Augmentation for the movement of wands in a set range.
			bool	**varita1**	First quarter of a circumference.
			bool	**varita2**	Recognizes whether the wands will be moved again.
			bool	**varita3**	Return to the initial position, by moving in the form of a quarter circumference.
		Fishe	**float**	**movPezX**	Parametric motion of the ellipse traced by the fish on the X-axis.

			float	**movPezZ**	Parametric movement of the ellipse traced by the fish on the Z-axis.
			float	**rotPez**	Rotation of the fish while swimming.
			float	**tempA**	Increase for the movement of fish in a set range.
			bool	**nado**	Animation for swimming fish.
			bool	**nado1**	First quarter of an ellipse.
			bool	**nado2**	Second quarter of ellipse.
			bool	**nado3**	Third quarter of ellipse.
			bool	**nado4**	The final path of the ellipse.
			float	**pi**	Number π, used for parametric translation.
		Drapes	**float**	**speed**	Speed at which our curtains will wave.
			float	**tiempo**	Undulations that can be observed in a certain time.
Display and controls		**Skybox**	**vec3**	**cubePositions**	Definition of the positions of the cube where the different images will go.
			GLfloat	**skyboxVertices**	Mapping of the vertices for the application of the corresponding textures.
		Frames	**GLfloat**	**deltaTime**	Time between the current frame and the last frame.
			GLfloat	**lastFrame**	Time of the last frame.
		Camera	**GLfloat**	**lastX**	The position of the camera on the X-axis.
			GLfloat	**lastY**	The position of the camera on the Y-axis.

		bool	**keys**	One-key press recognition.
		bool	**firstMouse**	Control of mouse movements so that it is always in the center of the screen.
	Drawi	**GLuint**	**indices**	Used to be able to draw the different figures on the screen.
	Size	**int**	**SCREEN_WIDTH**	Screen width.
		int	**SCREEN_HEIGHT**	Screen height.

SHADERS

NAME	USE
Anim	Objects whose color is solid and have a constant movement defined in it.
lighting	Solid models or with transparency and that makes use of previously defined lighting.
SkyBox	Background of the virtual space.

NATIONAL AUTONOMOUS UNIVERSITY OF MEXICO

USER MANUAL

COMPUTER GRAPHICS HUMAN-COMPUTER INTERACTION

ACCOUNT NUMBER:
317231117

SUBJECT:
Computer Graphics
Human Interaction
Computer

GROUP: 06

SEMESTER: 2023-1

Faculty of Engineering

CONTENT

INTRODUCTION

SPECIFIC OBJECTIVE

Application and demonstration of the knowledge acquired throughout the course. More specifically, the recreation of 10 elements inside an ambient space is sought and which must be within a façade corresponding to it. It is intended that a good modeling is carried out and good techniques of texturing animation and lighting are applied on it to obtain greater realism according to what is presented as an image and what is sought to recreate.

In this way, the different forms of creation and rendering of computer graphics will be used and applied, thus reinforcing the knowledge obtained throughout the course adapted to a personalized form by each of the different students.

GENERAL OBJECTIVE

The recreation of the house of Timmy Turner belonging to the series of TheMagic Godfathers is sought, so that it is similar to the original and where different elements belonging to it can be observed. An example of this are elements such as the different basically main characters that we see throughout the series, such as Timmy, Poof, Cosmo and Wanda.

Taking as reference different images sought to create three-dimensional models of these elements, among which we will find, the habitación of Timmy and the recreation of the room and in which you can navigate to observe in detail how it is that it was sought to recreate realistically and attached to the series each element. It is important to mention that the design involves several stages, first we will have the modeling, then the texturing and, finally, on the creation of software, that is, on the code, we generate the lighting and the different animations.

The animations are related to characteristic elements of The Magic Godfathers and general atmosphere, such as the opening of doors, the movement of curtains, the flote of the magic wands, the swimming of the fish and the brightness in the crowns of these, all with the aim of setting and making more complete, Attractive and interactive this project.

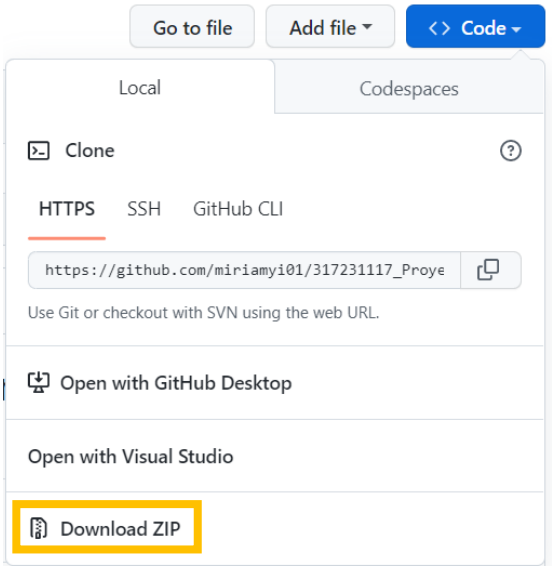
USE OF SOFTWARE

INSTALLATION

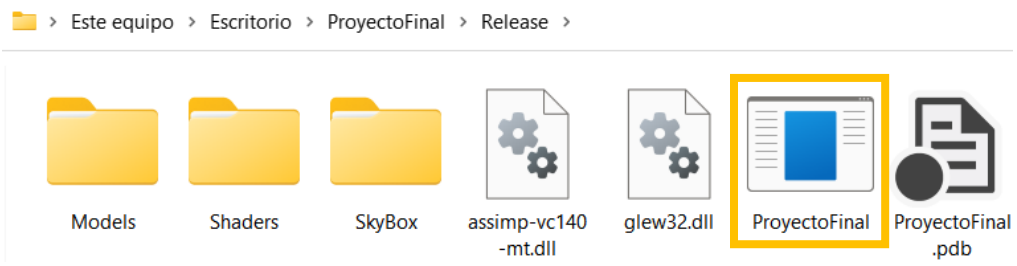
To be able to visualize and interact with the project, just go to the following link:

https://github.com/miriamyi01/317231117_ProyectoFinal_Gpo05.git

Within this, we will go to the *Code* option and click on *Downoald Zip*.



Once downloaded we will unzip the file and inside the main folder, we will go to *ProyectoFinal/Realese*, we will find a file with an extension *.exe*, that is, an executable file. Just click on it so that our project can be used (the time occupied by its execution depends on the performance of the team), once this action is done, it will be ready so that you can interact with it virtual space and its different elements.

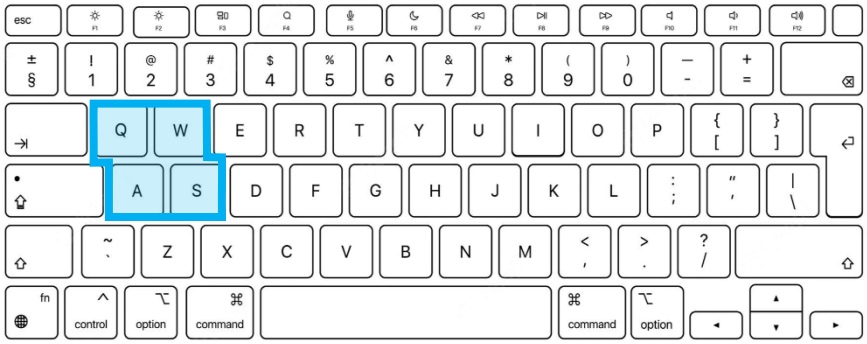


NAVIGATION AND USE

DISPLACEMENT WITHIN VIRTUAL SPACE

The mouse represents our view, where we move it, it will be the direction we will see, for example, if we make a lateral movement, our space will move to that side, if instead, our movement is forward we will see what is at the top.

We can join the movement of the mouse with the displacement on the space that is done with the keyboard so that we can observe in detail certain elements within our space and we can make the visualization inside it more practical and controlled by the user.



To be able to move within the virtual space we will make use of the four keys shown in the image, below, each of them will be described in greater detail.

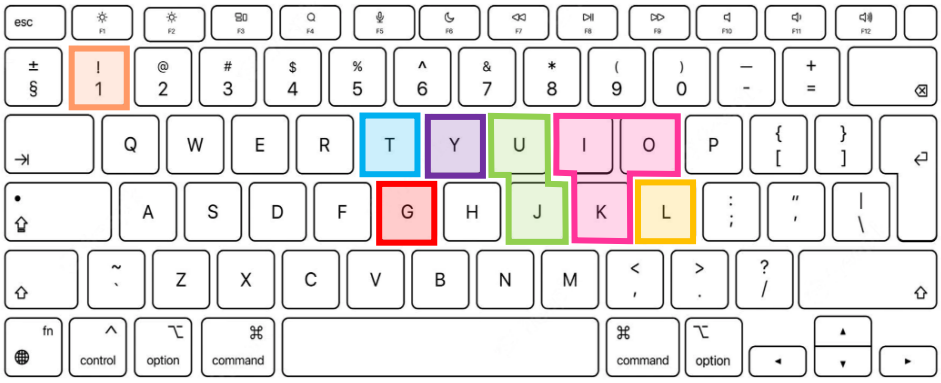
KEY	ACTION	SAMPLE
W	Approach	
A	Distance	

S	Shift to the right	
D	Shift to the left	

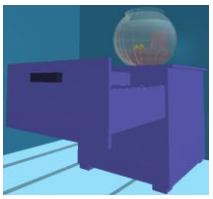
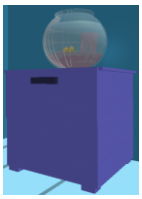
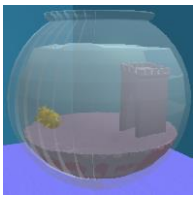
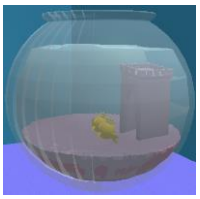
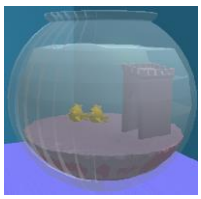
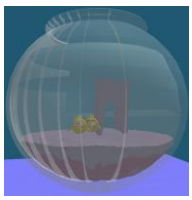
ANIMATIONS

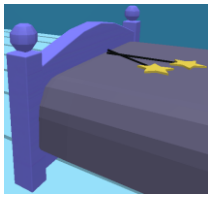
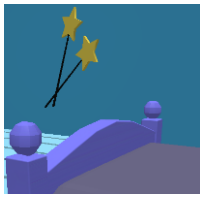
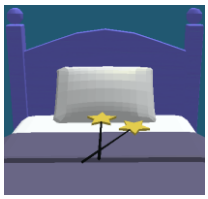
To interact with the space, there are a series of animations that are activated manually by the keyboard, including one that makes lighting control and one more that will always be running, which are the curtains that will move from left to right simulating the movement they would have by the wind, This is done to provide ambience and greater realism.

The others allude to different elements belonging to the recreation, this so that the user can have interaction with the various animations made.



As we see in the image, the keys shown are those that control the different animations, for each color we have a specific animation, as shown below:

ANIMATION		KEY	ACTION	MUESTRA
Door	Outside	T	**Opening and closing,** once the door is fully opened, it can return to its original position, that is, close.	 
	Interior	G		
Drawer		Y	**Opening and closing,** once the drawer is opened in its entirety, can be moved back to its original position, that is, closed.	 
Drapes			**Undulating movement** from left to right to simulate the movement of the fabric caused by the wind.	 
Fishes		U	**It activates the swimming of the fish, both, towards the same direction** and in the same direction, tracing an elliptical trajectory inside the fish tank.	 
		J	**It deactivates the swimming of the the fish**, they arestatic in the position they had when pressing. If you want to observe again, you need to press the corresponding key to reactivate the animation (U).	 

Magic wands	**I**	**Activate the animation for the displacement** of the magic wands, this should only be pressed once to activate, if this is already done, it is not necessary to do it again, since it will only activate it and show the first transfer which makes a half-circumference path to float the wands.		
	O	**Turn off the animation**, leaving the wands in the position they were in when you pressed this key. If you want to observe again, you need to press the corresponding key to reactivate the animation (I).		
	K	**Repite the transfer** once the animation is activated, you can perform this movement as many times as you want, when pressed, if our magic wands are floating we can return them to their initial position, that is, on the bed. Once there, we can press again to see its movement in the air.		

	L	**It makes a rotation in the opposite direction** to the one that is being executed or observed, so that when the magic wands are floating, so that, if they rotate completely we will see that their rotation will stop, so, with this option we can make them continue rotating.		
Coronas	**1**	**Activates the lighting in the crown of the fish**, being able to observe a flashing light in yellow color inside the fish tank.