



MODELING OF TRADITIONAL CHARACTERS USING 3D SOFTWARE THAT IDENTIFIES AND ENHANCES THE CULTURAL HERITAGE OF RIOBAMBA

MARÍA LORENA VILLACRÉS PUMAGUALLE¹, MIGUEL ÁNGEL DUQUE VACA², RUTH BARBA VERA³,
PATRICIO SANTILLÁN AGUIRRE⁴

¹ Facultad de Informática y Electrónica, Escuela Superior Politécnica de Chimborazo (ESPOCH), Riobamba, Ecuador. marial.villacres@epoch.edu.ec
<https://orcid.org/0000-0002-5909-9629>

² Facultad de Informática y Electrónica, Escuela Superior Politécnica de Chimborazo (ESPOCH), Riobamba, Ecuador. m_duque@epoch.edu.ec,
<https://orcid.org/0000-0001-9442-2420>

³ Facultad de Informática y Electrónica, Escuela Superior Politécnica de Chimborazo (ESPOCH), Riobamba, Ecuador. rbarba@epoch.edu.ec
<https://orcid.org/0000-0003-0272-171X>

⁴ Facultad de Informática y Electrónica, Escuela Superior Politécnica de Chimborazo (ESPOCH), Riobamba, Ecuador. juan.santillan@epoch.edu.ec
<https://orcid.org/0000-0002-8610-6724>

Abstract: *The new generations are losing the historical and cultural significance of the different characters that participate during the Christmas festivities in the city of Riobamba; the introduction of foreign characters through movies, series, animations, or other media has caused the loss of identity, history, and traditions in the city. The purpose of this research work is to present, rescue, and preserve the cultural manifestations of the town of Riobamba, relying on three characters identified for performing dances and dances of the local culture during the parade of the child King of Kings. The ethnographic or qualitative research methodology was applied, using observation as a data collection technique. Using the Autodesk Maya software for 3D modeling, it was possible to obtain high-quality images of the representative characters. The character modeling process followed the phases of the XP software development methodology. The survey was used to validate the results. It is possible to validate the three characters before a sample of 287 students of the Software. Graphic Design careers, identifying that the Identification and Similarity variables present values between 51.6% and 96.9%, equivalent to satisfactory and very satisfactory; the lowest point has the Chromatic variable. of the Curiquingue character with 43.9% that guarantees a redesign of the character for future works. The enhancement of the cultural heritage of Riobamba is achieved in public surveys since some students state that they do not know the modeled characters but are willing to use souvenirs to make more people aware of the culture and heritage of Riobamba.*

Keywords: *3D modeling, Software, Tradition, Cultural rescue.*

Table of Contents

1. Introduction
2. Theoretical Foundation
 - 2.1. Pass of the child King of Kings as intangible heritage in Riobamba
3. Methodology
 - 3.1. Phase 1. Semiotic analysis of the character
 - 3.2. Phase 2. Character design and customization
 - 3.3. Phase 3. Modeling
 - 3.4. Phase 4. Validation
4. Conclusions



1. Introduction

The need to generate digital content is increasingly recurrent, mainly due to the great acceptance of social networks and entertainment or commercial applications that, together with the massive use of mobile devices, have forced companies to develop new and better ways of sharing content. Therefore, terms such as virtuality, 3D, holograms, or augmented reality are prevalent when hearing about the technology that we can currently use in our devices.

3D animation used in film and television arose with the development of computer hardware and software (Tian & Chen, 2022). Commerce, communication, architecture, product design, and education, among other activities, from the fourth industrial revolution, implement technological solutions to provide solutions to the requirements of society, making them more dynamic, striking, and interactive their contents and magnifying their performance (Santillán-Aguirre, 2022). Different projects for disseminating cultural heritage have resulted from the generation of virtual models mainly because they allow such heritage to be brought closer to people without the need for them to be physically present (Gómez et al., 2015). Digitizing a contemporary sculpture is also possible using precision 3D modeling through non-contact techniques such as photogrammetry that, without damaging the sculpture, allows a 3D replica of the object to be obtained (Díaz, 2021) that can be used both for video generation and for its publication on the web, through augmented reality systems or applied to the documentation of material with a photographic detail to which a new dimension is added (Caro, 2012). In this research, virtual content is used to model traditional characters in 3D, achieve their recognition, and future application in dissemination and promotion processes that enhance the cultural manifestations of the study area.

3D modeling is considered a process with which the three-dimensional representation of one or several objects can be made in a virtual space. To accurately generate the object's 3D model of the object, the application of mathematical models and programming algorithms is necessary (Kefren, 2021). For example, one of the applications where greater accuracy is needed is when you want to represent human facial expressions in virtual characters using traditional methods that use markers or combined shapes or through new solutions that use geometric correspondences to reflect coincidences (Zhang et al., 2020). 3D models created with specialized software represent a three-dimensional object using a collection of points within 3D space connected by geometric entities such as triangles, lines, curved surfaces, etc. As a collection of data (points and other information), 3D models can be made by hand, through algorithms, or scanning.

The generation of the 3D model is possible thanks to the use of specialized 3D design software generally installed on computers, either laptops or towers, allowing the virtual representation of each face and surface of the object to be modeled. Depending on the software used for this purpose, there is a certain number of tools and the possibility of generating initial sketches of the object or creating a faithful representation for later analysis (Kefren, 2021).

The software selected to carry out the 3D modeling of the traditional characters complies with characteristics and functionalities that allow the objectives set out in this project to be met. In this case, Maya is used with a similar purpose to the one proposed in this study, which is the conservation and diffusion of a series of heritage houses in the city of San Gabriel where it is highlighted that Maya allows simulation, modeling, animation, manipulation, generation of keyframes, among other 3D modeling tasks (Gutiérrez, 2021). Although this software is very complex and requires a steep learning curve, it provides designers with a complete workflow without the need to use other software to perfect the work; another critical aspect to note is that it has a free version with educational purposes (Labschütz et al., 2011) for this reason, the software used to model the traditional characters in this work is Maya from Autodesk.

2. Theoretical Foundation

Different perspectives allow us to define what heritage means from a belonging approach; talking about heritage is talking about what is owned, the etymological sense whose Latin origin is the word *patrimonium* that is interpreted as what is inherited from the father (Zamora, 2011), from



the cultural perspective, it is based on certain principles (nature, history, and genius) that share an extra-cultural character and that legitimize the "sacrality" of any sensitive object or phenomenon that comes from or has been in contact with them (Prats, 2000). Precisely, they are the traditional and popular culture that, through its different forms such as language, literature, music, dance, games, mythology, rites, customs, crafts, architecture, and other arts, keep alive the tradition of the peoples and with this maintain the intangible heritage that will pass from generation to generation. For example, in Riobamba, the King of Kings child pass It is considered heritage due to its history and its impact on citizens, since it has remained in direct contact with them, introducing itself into their traditions and culture to such an extent that they have turned it into a lifestyle.

For its part, the UNESCO World Conference defines that "The Cultural Heritage of a people includes the works of its artists, architects, musicians, writers and scholars, as well as anonymous creations, arising from the popular soul, and the set of values that give meaning to life, that is, the material and non-material works that express the creativity of that people; the language, the rites, the beliefs, the historical places and monuments, the literature, the works of art and the archives and libraries", (Cabezas Bastidas & Ponce Alcívar, 2018) this definition that is presented in a titling project, is very valid for the present research project that considers enhancing the Cultural Heritage of the King of Kings children's festival based on the creation of the representative characters of this festivity, and also view its future use in awareness campaigns, fairs, digital games, pieces commercial, educational environments and other applications, will allow the current generations to know these characters, the relationships with the culture of their city and keep the tradition alive.

Tangible cultural heritage constitutes objects that have formed part of the culture and identity of a community in the past and have a special meaning. While intangible heritage is defined as: "the set of forms of traditional and popular or folk culture, that is, the collective works that emanate from a culture and are based on tradition" (UNESCO, 2001), it also includes the phenomena, habits, customs, and traditions that reflect the culture of citizenship and constitute support that builds the idiosyncrasies of peoples and promotes a cultural, historical identity (Núñez & Sánchez, 2011), these traditions are transmitted orally or through gestures and they change over time. The oral tradition has been essential for a culture to remain alive in the towns and whose practice rich in knowledge, history and vocabulary have been shared mainly by the elderly, considered guardians and disseminators of this linguistic wealth, who through their stories are bequeathing to the new generations this cultural expression (Sandoval et al., 2022). One of the ways to keep the cultural heritage of the people alive is the preservation of photographic images of buildings, monuments, works, and other symbols to proceed with their reconstruction in the event of a catastrophe, the photogrammetry techniques promoted by the German architect Meydenbauer consist of the study of the geometric properties of objects and scenes from photographs to collect graphic documentation of heritage for its preservation (Pereira Uzal, 2013).

2.1. Pass of the child King of Kings as intangible heritage in Riobamba

The Convention for the Safeguarding of the Intangible Cultural Heritage developed by the General Conference of UNESCO was approved in 2003, an agreement signed by 158 countries that commit to safeguarding these cultural expressions. (UNESCO, 2003). The customs and traditions that have taken place in Latin America, from pre-Hispanic times until the Spanish arrived, have endured as a heritage over the years. The syncretism of these two cultures spread throughout South America until reaching Ecuador, where they mixed with the indigenous culture of a popular folkloric nature, resulting in mestizo traditions that went to different cities, cantons, and parishes until arriving in the town of Riobamba.

The city preserves some of these, such as the popular and religious festivals that continue to be transmitted between generations. Riobamba has various popular expressions linked to the Catholic religion in the city's beliefs. For example, the King of Kings celebrates the Day of the Epiphany; in this way, the arrival of the wise men at the birth of Jesus is commemorated; this celebration is



religious, but in the celebration of the city, characters from the indigenous culture enter, giving. As a result, a mestizo celebration. The image of the child was carved in wood in 1794 and rescued by the Sánchez Fernández Family from the rubble of Antigua Riobamba after the 1797 earthquake, which was later donated by Mrs. Tomasa Sánchez due to her poor state of health in January 1921 to Messrs. Mendoza (Taípe, 2016). For years the pass of the Child King of Kings has been developed, which begins with the novena in the Franciscan temple "Loma de Quito." It ends on January 6 with the pass in honor of the child, and the presence of the traditional characters are the tin devils, clowns, Sacha runas, dancers, curiquingues, monkeys, and dogs, characterized by their unique clothing and role they play during the festivity (Villacrés et al., 2022). This is reflected in the popular festivals that take place over several months, especially in December and January, where one of the most important local and national celebrations is the feast of the King of Kings. A phenomenon of collective identities results in local cultural value growth (Vicuña Calderón, 2019, pp. 18).

3. Methodology

The research uses two methodologies to fulfill its purpose; the first is ethnographic research or qualitative research, which starts from the descriptive study (graphos) of the culture (ethnos) of a community, which is why it allows studying people in the form of collective to understand social phenomena from the perspective of its members (Guber, 2004) and understand how they carry out their routine activities, their beliefs and customs to comprehend the way of life of a specific social unit (Muecke, 2005). This allows us to find answers as to why devout and non-devotee people actively participate in this festivity and, based on the resulting analysis, create representative characters that will enable us to identify the cultural traits that remain intact for years and enhance the cultural heritage of Riobamba that makes this festivity in a tradition, applying the descriptive design the research group was able to determine the characteristics and properties of all the characters that participate in the child's pass, to be able to decide on the main characters, their symbolism, culture involved in each one and representativeness. The qualitative approach, for its part, analyzes a social phenomenon, and to obtain information, a standardized or statistical system is not used; what is used are oral, written, and visual perspectives (Hernández et al., 2016) of the people who participate or participated in the investigated phenomenon, even the point of view of the research group is taken into account to consider the characteristics of the characters that will be created.

The 3D design does not have a methodology that allows for creating characters on the different tools used to design; for this reason, the research group decided to adopt a software development methodology to make the traditional characters of the festivity, in this case, The selected and the second methodology in this case that allows guiding the modeling process is the XP methodology, considered the best-known agile methodology, it is appropriate to guide small or medium work teams, between 2 to 10 people. Furthermore, it adapts to environments of imprecise or changing requirements (Molina et al., 2018). This characteristic was observed in the present work since it is considered to model the representative characters based on parameters manifested by the population that knows them the most. Another essential feature of XP is that it allows applications to be developed in less time and with the necessary functionalities (Bautista-Villegas, 2022). These aspects will allow the research group to have the characters validated during the academic period and with the students participating in the research. First, the phases that make up the XP methodology are project planning; then, the design is carried out based on the results obtained, the programming is carried out, and finally, the tests are carried out (Ramírez-Bedoya et al., 2019); for its use in the present work, each of these phases has correspondence within the modeling process as shown in Table 1.



Table 1 - Correspondence between phases of the XP methodology and adaptation 3D Modeling

<i>Phase</i>	<i>Metodología XP</i>	<i>Modelado 3D</i>
Phase 1	Project planning	Semiotic analysis of the character
Phase 2	Design	Character design and customization
Phase 3	Programming	Modeling
Phase 4	Tests	Validation

3.1. Phase 1. Semiotic analysis of the character

The objective of this phase is to determine and select the characters who, within the festivity, stand out for their personality, clothing, values, and roles with which the community most identifies. In this phase, the research group participated in the festival through observation (ethnographer), seeing what happens during the development of the different activities, listening to what is said, asking questions, and collecting all kinds of accessible data (Chavarría-Zambrano, 2020) to identify the characteristics to be captured in the traditional characters to be created. The success of this observation does not depend solely on the skills and experience of the researcher but on how accepted it is by the people with whom they will work, which is why it is recommended to carry out several observations with different people to have a broader approach. of reality (Restrepo, 2018). The data collected from the bibliographic review and the analysis carried out on each character to be modeled presented below.

3.1.1. Tin devil

An original character from the parish of Yaruquíes described as a symbol of rebellion against the Spanish (Pala, 2016) during the Spanish conquest, this character represented the Inca Atahualpa, showing resistance against the Spanish (whites). He has a duality due to his functions in the child's passes; it is declared that he drives away evil spirits and takes care of the main character of the festivity, King of Kings. It is maintained that people who dress up as little devils must do so for ten years in a row; otherwise, it is said that the devil makes them dream, or they have nightmares in which the devil takes them.

It is characterized by its red tin mask that has straight shapes, and it also has a black beard and mustache, pointed teeth, and horns that protrude from its forehead. Incorporated into this is her flowered scarf that covers the back of her head, from which a long cabuya braid emerges. At present, they usually add strips of cloth in bright colors to give more dynamism to the moment of their dance. In his clothing, he wears a white shirt, a tie, and a long red and blue nightgown on top, which can be adorned with yellow fabrics or details with a fabric ribbon, black fabric pants, and his black shoes. Although, as an accessory, she uses a tin rattle that she shakes to the rhythm of her characteristic dance, she also usually wears a cowhide whip or "cabresto"; this depends on the dancer (Pala, 2016, p. 43).

3.1.2. Traditional clown

A jocular character who holds in his hand a cloth sausage, one that is stuffed with rags or sawdust, while dancing hits people who are part of the public and recites popular sayings with a mocking voice. He has a one-piece garment, and the colors go according to the tastes of the dancers; they are generally bright colors that contrast strongly, as stated (Pala, 2016, p. 44). "The sleeves and pants are bloomers, gathered at the wrists and ankles. The neck is large and haughty".

He covers his head with a colored scarf, and on top, he places a mask made of paper painted with bright colors. On top, he wears a conical hat lined with paper; and at the tip, he has a ball made with pieces of paper. It is maintained that those who dance while playing this character must do so for at least seven years. It is said that those who do not are punished by the child.



3.1.3. Curiqingue

Mythical character, several beliefs about this bird are familiar to the Ecuadorian peasant. One of them is deeply rooted throughout the inter-Andean alley, including the province of El Oro, and that is that by crossing Phalcoboenus carunculatus with Creole hens (Gallus domesticus, Phasianidae Family), you have offspring whose males later become famous fighting cocks. . According to Inca Garcilaso de la Vega, Curiqinga means "sacred bird of the Inca" (Curi = Gold; Inga = King or Sun God), an interpretation that would be valid for Phalcoboenus carunculatus only after the Inca conquest of the territory of present-day Ecuador, since This species is typical of the high Andes of Ecuador and southern Colombia, and therefore unknown to invaders. Table 2 summarizes the semiotic analysis carried out on the three characters.

Table 2 - Semiotic analysis of the characters

Character	Description	Morphology	Ideology
Tin devil	Rattle devil or tin devil considered an elegant demon capable of enveloping and enchanting with its dance, can scare away evil spirits. It is a character born as a mestizo representation.	The red-painted tin mask stands out, detailing the face of a devil, a black beard and mustache, pointed teeth, and horns protruding from its forehead.	His image represents rebellion and expresses resistance to the symbols imposed on the image of God imposed by the Spanish.
Traditional clown	Traditional Clown is considered to have cheerful and fun personality. However, he dances and recites popular sayings with a mocking voice. He is a character that was born as a mixed-race representation.	The character's physique stands out as he is tall and thin and has a mask, bonnet, suit of various bright colors, and a cloth sausage.	His image represents the guardian of the Child's physical integrity, takes care of its participants, and opens the way to continue with the tour.
Curiqingue	Curiqingue, considered a dancer that resembles how Andean birds dance and represents the divinity of birds in religious acts, is born as a traditional Andean figure.	Its silk clothing stands out, with enormous colored wings and a high bonnet that ends in a small beak.	Its image represents the sacred bird of the Incas that bears the same name. Its dance is performed imitating the movements of the Curiqingue to honor the Sun god.

3.2. Phase 2. Character design and customization

This phase aims to establish the graphic and visual part of each selected character, where the type of illustration is determined to create the concept art of the characters. For this work, the Cartoon type illustration has been chosen, which is a friendly style with great visual appeal, easy to understand and recognize, which allows it to be presented to any public. An illustration must follow specific parameters and have certain characteristics to prove convincing and qualify as an excellent graphic representation. Communication, the relationship between the text and the image, the emotional factor, the aura or its significance level, the relationship with historical and cultural contexts, creativity, continuity, symbolism, composition, and originality are some critical aspects. When developing an illustration (Grove, 2013).



The process followed for the design (concept art) of the characters is as follows:

1. References: create a mood board of inspiration to determine shapes and colors.
2. Type of illustration: select a type of friendly illustration.
3. Design of views: The visual reference design serves as a guide to model the character in 3D, the most important being the front and side views.
4. Poses and gestures are illustrations of the character's actions that help determine her personality and will be reflected in the 3D modeling.
5. Color palette: determine the hexadecimal colors that the character will have and how they will be applied in the modeling tool.
6. Final illustration: the final finish the modeler will have as a guide to create a better model.

Figure 1 shows all the elements considered during the design to illustrate each aspect of the traditional Clown character.

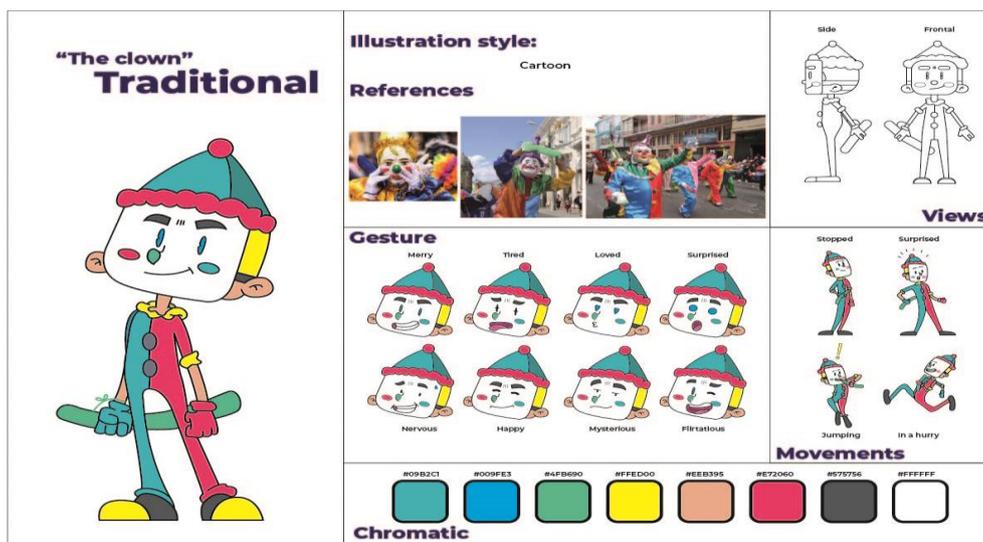


Figure 1 - Design and customization of the character "Traditional Clown"

3.3. Phase 3. Modeling

This phase has as its objective the development of the modeling of each of the characters, equivalent to the programming phase. At this point, the Autodesk Maya software, professional 3D modeling software, is used to create unique characters and effects. From fantastical creatures to incredible landscapes to explosive war sequences, Maya's software toolset is the go-to solution for generating believable characters and the worlds around them. Among Maya's many features is modeling, which allows you to create 3D models using geometry based on vertices, edges, and faces. Table 3 shows the set of related activities that must be followed in a specific order to achieve an objective (Workflow), and the case study details what was done.

Table 3 - Workflow followed to model in Autodesk Maya

Modeling	Lightning	Textured	Render
Four-edge topology based on reference views.	Arnold Application: Light and Skydome Light.	Light Area using materials, Standard Surface.	Configuration of the Hypershade using Arnold
			Export jpg images size 1K_Square.

Polygons consist of geometry based on vertices, edges, and faces that you can use to create three-dimensional models in Maya. Polygons help build many 3D models and are widely used in developing 3D content for animated effects in movies, interactive video games, and the Internet. (Autodesk, 2021). Figure 2 shows the Workflow carried out on the traditional Clown character.

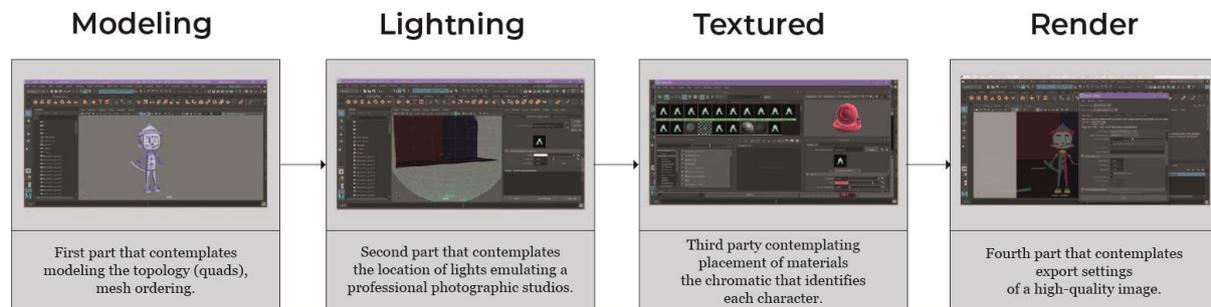


Figure 2 - Workflow followed to model in Autodesk Maya, the character "Traditional Clown.

All the elements that make up a 3D scene are polygons. The hardware must process these to be displayed as we want. It is clear that the greater the number of polygons, the greater the resolution, but also a more excellent calculation process that involves slowdowns in the display of views and even program crashes. On the other hand, with a lower number of polygons, the optimization is faster, but it implies that they will have less detail (Sánchez, 2020). It will then be the final application of the 3D characters that determine the type of modeling to be carried out. Generally, if Objects for video games are modeled, these are simpler than if objects that will be used for film production or animation are modeled, as in the case of this study.

3.4. Phase 4. Validation

Once the entire process of modeling, lighting, application of materials, and the correct configuration of the rendering options is finished to avoid noise or low quality in the final images, the result is images with a .jpg extension of 1k size. Due to their quality, they can be used in other graphic design applications. Based on the models obtained, the next point is to validate if they meet the purpose of the research work, for which a survey is planned for students from the Faculty of Computer Science and Electronics who, due to their knowledge of design, 3D modeling, identity and culture, software development and development methodologies will be able to show if the characters created to meet the acceptance criteria.

3.4.1. Population and sample.

The population is 1,206 students between, men and women of the Faculty of Computer Science and Electronics who study in the careers of Software and Graphic Design. Because a complete population analysis would entail a great effort of time and resources to analyze, a representative sample of students was selected through non-probabilistic sampling, called convenience samples (Cortés-Cortés et al., 2020). who previously studied subjects related to the research topic, and also who belong to courses in which research teachers teach classes to control the participants, verify that they fill out the entire questionnaire, and can respond to possible queries about the quiz questions.

Using the formula that allows determining the size of a sample, we work with a confidence level of 95% and a margin of error of 5%, obtaining. As a result, a sample size of 292 people, of whom the surveys were applied to a total of 287 students, representing 23.79% of the total population, five less than expected, because during the days in which the surveys were carried out, this number of students did not attend classes. The instrument used was a questionnaire comprised of 13 questions to determine the level of similarity and recognition of the 3D modeled characters concerning the real characters by the target audience. The different questions are a basis for the aspects related to the three modeled characters, which is presented in figure 3.

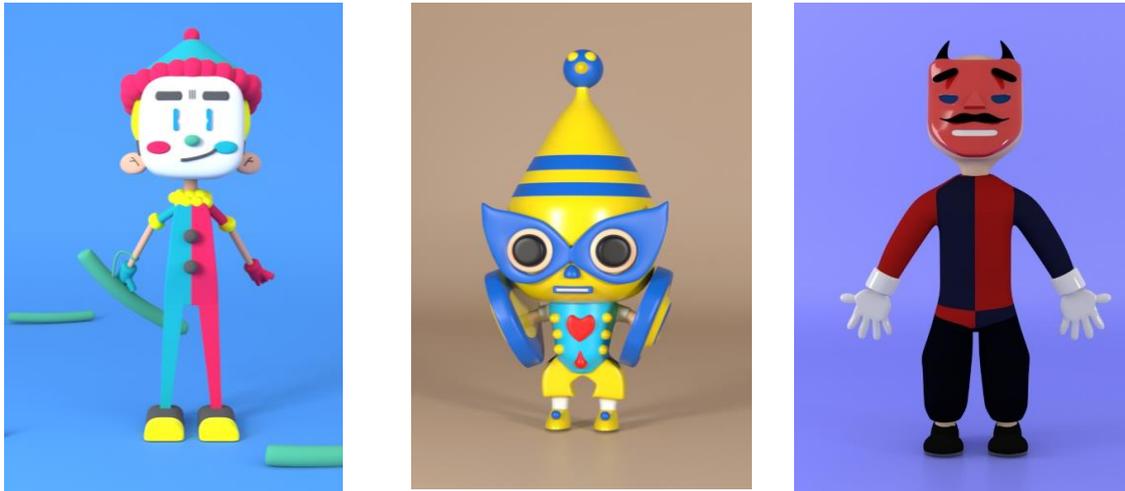


Figure 3(a). - Final image of the character "Traditional Clown". Figure 3(b). - Final image of the character "Curiquingue". Figure 3(c). - Final image of the character "Tin Devil"

The results achieved after analyzing the surveys carried out with the different students are presented below.

The first question was oriented to determine the number of students in each major. Of the 287 students who participated in the survey, 167 men and women, representing 58%, are from the Software major, while 42% are equivalent. One hundred twenty respondents belong to the Graphic Design career. The second question asks about the province in which the students were born. Since they are the modeled characters typical of a traditional festivity in the province of Chimborazo and recognized in the central Sierra region, the objective of this question is to see if the students from other provinces who do not know these characters have problems identifying them. As a result, it is obtained that 39.4% of students surveyed belong to the province of Chimborazo, 14.6% were born in the province of Tungurahua, and 13.9% are from the province of Pichincha. Therefore, they would have no problem identifying and validating the modeled characters based on their experience. In this same question, the remaining 32.1% are made up of students who belong to 19 different provinces.

For the following question in the questionnaire, an image was included with the 3D modeling of the characters, accompanied by a list of some traditional festivities in the country. The objective was to determine if the respondents related each image of the characters with the celebration they represented. The result Pase del Niño Rey de Reyes was the most selected option with 202 respondents, equivalent to 70%, followed by the Diablada Pillareña option, selected by 42 respondents, equivalent to 15%. The Carnival option obtained 11% due to being the option of 31 participants, and the Mama Negra option with 12 votes, equaling 4%. Figure 4 graphically presents the results above.

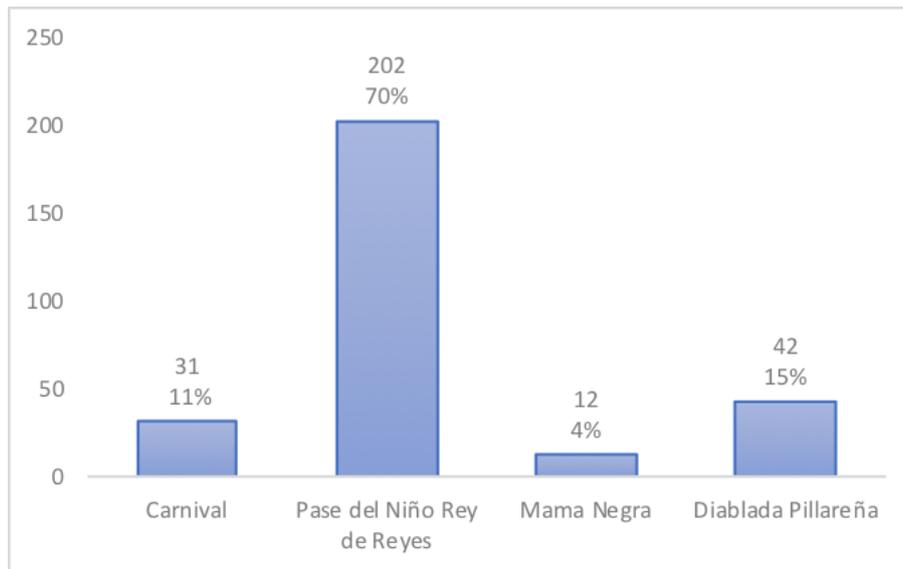


Figure 4: Festival to which the characters belong

As the King of Kings Child Pass option is the most selected, it is evident that most respondents correctly identify the modeled characters, guaranteeing that the answers to the following questions have a high level of certainty. It is essential to indicate that the number of participants who selected the wrong option in this question is similar to the number of students from provinces where this type of character is not popular in the different festivities, it could be a coincidence, or it would be the result of that these students during their stay in the city have not seen these characters because some of the participants are from courses below the fifth semester. Due to the pandemic (COVID-19), it is the first semester that they receive classes in person.

For the following questions, each of the modeled characters was presented individually, and it was asked if the respondents recognized which character it corresponded to. The results indicate that the Clown was identified by 277 people corresponding to 96.51%, and the Curiquingue was recognized by 257 students representing 90% of those surveyed. When the Tin Devil was presented, it was recognized by 278 students representing 96.90%. The Clown and the Tin Devil have higher recognition percentages.

The following questions are asked to measure the similarity between the modeled and actual characters. To fulfill this purpose, the image of the modeled character was presented together with an image of the natural character. For this and the following evaluations, the scale was used Likert test, widely used in social studies because it allows for collecting non-quantitative perceptions regarding a topic (Canto de Gante et al., 2020) and also because it is simple and easy to apply, used mainly in matters of preference or taste (Monteiro et al., 2020). Table 4 shows the ranges considered for the measurement scale, its qualitative score, and the degree of satisfaction based on what is proposed by international standards (ISO/IEC, 1998).

Table 4 - Numerical representation used to analyze the survey

Measurement scale (%)	Punctuation	Satisfaction Degree
75.1% - 100%	Satisfactory compliance	Very satisfying
50.1% - 75%	Acceptable compliance	Satisfying
25.1% - 50%	Medium compliance	Unsatisfying
1.00% - 25%	Little compliance	Unsatisfactory
0%	Unacceptable	

Regarding the Clown modeled character, the following results were obtained: the option with the highest percentage is 75%, equivalent to 108 respondents. The 100% option is equivalent to 92 respondents, the 50% option is equivalent to 47 respondents, the 25% equals 39 respondents, and finally, the option with the lowest result of 0% equals one respondent, as shown in figure 5. In this case, the possibilities of 75% and 100% similarity were selected by 200 respondents, close to 70% of participants. This lets us conclude that the modeling work allowed us to achieve the best results.

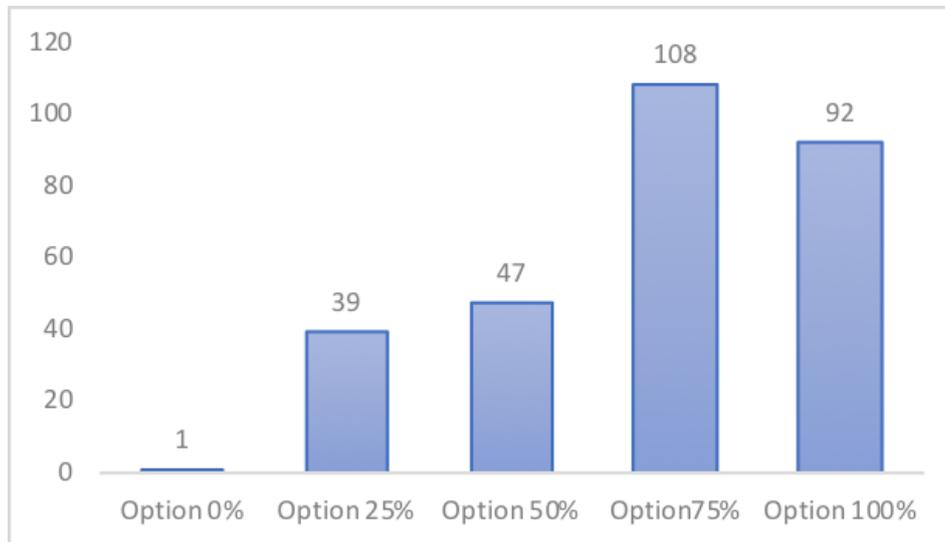


Figure 5: Percentage of similarity between the real character and the 3D model of the Clown

In the case of Curiquingue, the same previous procedure was followed. In this case, the results with the highest percentage were 75%, equivalent to 106 respondents, and the 50% option with 92 respondents, the 100% option had the selection of 42 respondents, the 25% option chose 39 people, and finally, the option eight people selected 0%. The analysis of the results indicates that the 75% and 100% options add only 148 people, almost 52%. According to the respondents, the similarity between the modeled character and the actual character is not high enough. Therefore, you must make improvements to the modeling before its final presentation to achieve satisfactory results.

In the case of validating the similarity of the 3D modeling of the Tin Devil, the following results were achieved, the option with the highest percentage, as in the other characters, is 75% equivalent to 104 respondents, then is the 50% option equals 78 respondents, the 100% option equals 68 respondents, the 25% option equals 34 respondents. Finally, the option with the lowest 0% result equals three respondents. However, as in the case of the Curiquingue, the modeling of the Devil of lata shows that the respondents do not find a 100% similarity between the modeled character and the photograph of the natural character, in this case, too, some changes and improvements must be made to achieve optimal results.

The chromatic variable is intended to determine if the colors used in the 3D modeling of the characters reach a satisfactory level of similarity in comparison with the colors of the natural character's clothing. For this, the same similarity measurement procedure was followed. , that is, to show an image with the final modeling of each character and an image with the colors of the natural character's clothing to determine the level of similarity. The Clown character was presented first, and the results show that 132 respondents selected 100% similarity; the 75% option had 87 preferences, achieving 76% positive responses between the two options. For its part, Curiquingue achieved 86 responses for 75% and 40 answers for 100%, which represents only 44% of positive responses. In the case of Diablo de Lata, 132 participants selected the 100% option, and 87 set the 75% option. %, between the two options, 76% of positive responses are reached. This means that both the Clown and the Tin Devil in the chromatic aspect meet Satisfactorily, while the Curiquingue has medium Compliance. Table 5 shows a summary of the results achieved in each of the characters and for each of the variables used to achieve the objective of the research work.



Table 5 - Summary of results achieved by each character in each measured variable

Character	Punctuation	Satisfaction Degree
Clown		
• Identification	96.5%	Very satisfying
• Similarity	69.7%	Satisfying
• Chromatic	76.3%	Very satisfying
Curiquingue		
• Identification	90.0%	Very satisfying
• Similarity	51.6%	Satisfying
• Chromatic	43.9%	Very satisfying
Tin Devil		
• Identification	96.9%	Very satisfying
• Similarity	59.9%	Satisfying
• Chromatic	76.3%	Very satisfying

Finally, the last question to those surveyed was whether they would be willing to use souvenirs in which the modeled characters are present for academic activities (notebook covers, covers, reports, etc.), for leisure (cell phone backgrounds and cases, PC screens, games, etc.) and clothing (prints on T-shirts, caps, sweaters, etc.) as part of a campaign so that more people can identify the characteristic characters of the King of Kings child festivities and magnify the heritage culture of Riobamba through these traditional characters of the city, and in this way rescue local traditions. After presenting images of some options of the proposed articles, the answers were: No way, two respondents, if mandatory, one respondent, a total of 49 participants would use the pieces sporadically. However, for the option, I would use the articles frequently, 148, equivalent to 51.6%, and selected the choice, I would always use the articles, 87 people representing 30.3%, a total of 81.9% of those surveyed answered affirmatively to this question.

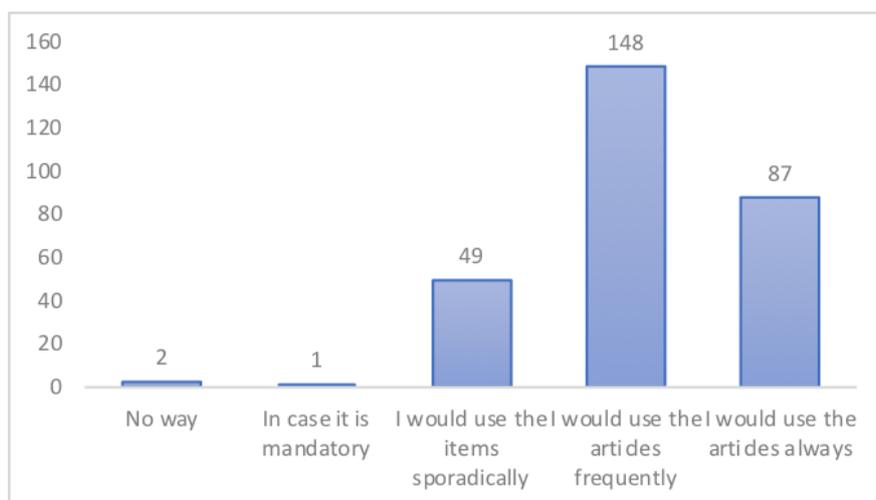


Figure 6 shows the graphical results of the question.

The final result is very satisfactory because most of those surveyed identified the animated characters satisfactorily. However, in comparison with the actual characters, it is necessary to make some adjustments to increase their similarity percentage, which, although not low, could be better. Concerning chromatics, the animated character Curiquingue presents an unsatisfactory degree. In general, the character has the lowest score in all the evaluated points; in this case, more work must be done in the modeling process to achieve better results.



Regarding the last question and its relationship with the enhancement of the cultural heritage of Riobamba, modeling traditional characters was of great help to be able to position them among the target group because, currently, 3D animated characters are present in many digital activities that the young public consumes, in this case, this trend is taken advantage of to introduce the animated characters representative of the festivity of the King of Kings Child in different inputs and materials commonly used for the target group. The results of this work could be implemented in other campaigns that allow the traditions and customs of the city of Riobamba to be kept alive using the modeled characters that are characteristic of the child's pass festivities.

4. Conclusions

The three modeled characters make it possible to rescue the cultural heritage of the city of Riobamba, making use of 3D modeling technology, which is currently a design trend widely used to create content and transmit messages that represent values, customs and traditions to reach a large segment of the population thanks to the good reception of this resource for visual communication.

The characters Traditional Clown and Tin Devil achieved high scores in their assessment and a high degree of satisfaction, with respect to the character Curiquingue it is evident that his assessment is lower than the other characters, a redesign is proposed based on more extensive information that allows identify the main characteristics and those that stand out the most to create again and validate the results.

The presented work becomes a guide for graphic designers, illustrators and 3D modeling professionals to create characters based on concept art to foster culture and strengthen the tradition of an entire community by following only four phases of development and using the modeling software 3D Autodesk Maya that in the present study allowed to create three characteristic characters of the traditional parade of the King of Kings of the city of Riobamba that has a wide wealth of cultural manifestations.

The software that was best adjusted for the development of this research work is Autodesk Maya, which has tools and a friendly and intuitive interface that allows the modeler to properly follow the Workflow for the development of 3D characters, standing out as the most used software in the industry at a professional level for its excellent results.

References

- [1] Autodesk. (2021). *Modelado poligonal*. Obtenido de <https://knowledge.autodesk.com/support/maya/learn/explore/caas/CloudHelp/cloudhelp/2022/ENU/Maya-Modeling/files/GUID-7941F97A-36E8-47FE-95D1-71412A3B3017-htm.html>
- [2] Bautista-Villegas, E. (2022). *Metodologías ágiles XP y Scrum, empleadas para el desarrollo de páginas web, bajo MVC, con lenguaje PHP y framework Laravel*. *Revista Amazonía Digital*, 1(1), e168. <https://doi.org/10.55873/rad.v1i1.168>
- [3] Cabezas Bastidas, J. M., & Ponce Alcívar, J. S. (2018). *Pase del niño como patrimonio cultural inmaterial en el imaginario colectivo de la ciudad de Riobamba, período septiembre 2016-febrero 2017* (Bachelor's thesis, Riobamba, Universidad Nacional de Chimborazo).
- [4] Canto de Gante, Á. G., Sosa González, W. E., Bautista Ortega, J., Escobar Castillo, J., & Santillán Fernández, A. (2020). *Escala de Likert: Una alternativa para elaborar e interpretar un instrumento de percepción social*. *Revista de la alta tecnología y sociedad*, 12(1).
- [5] Caro, J. L. (2012). *Fotogrametría y modelado 3D: un caso práctico para la difusión del patrimonio y su promoción turística*.
- [6] Chavarría-Zambrano, P. I., & Camacho, H. (2020). *Ruta metodológica en la investigación etnográfica*. *Polo del Conocimiento*, 3(12), 449-468.
- [7] Cortés-Cortés, M., Mur-Villar, N., Iglesias-León, M., & Cortés-Iglesias, M. (2020). *Algunas consideraciones para el cálculo del tamaño muestral en investigaciones de las Ciencias Médicas*. *MediSur*, 18(5), 937-942.

- [8] Díaz, M. (2021). Modelado 3D de precisión en procesos de digitalización de escultura construida. *AusArt* 9 (2): 113-125. doi: 10.1387/ausart.23077
- [9] Gómez, F. D., Jiménez, J., Benavent, A. B., Recuenco, B. A., & Juan, J. H. (2015). Modelado 3D para la generación de patrimonio virtual. *Virtual Archaeology Review*, 6(12), 29-37.
- [10] Grove, J. (2013). *Evaluating Illustration Aesthetically*. Obtenido de <http://www.illustratorsillustrated.com/evaluating-illustration-aesthetically/>
- [11] Guber, R. (2004). *El salvaje metropolitano: reconstrucción del conocimiento social en el trabajo de campo* (pp. 323-323). Buenos Aires: Paidós.
- [12] Gutiérrez, J. P. (2021). *Modelado 3D mediante el programa Autodesk Maya para la conservación y difusión del Patrimonio arquitectónico en la ciudad de San Gabriel* (Bachelor's thesis).
- [13] Hernández, R., Fernández, C., & Baptista, P. (2016). *Metodología de la investigación*. 6ta Edición Sampieri. Soriano, RR (1991). *Guía para realizar investigaciones sociales*. Plaza y Valdés.
- [14] ISO/IEC. (1998). *Software product evaluation* 14598 [en línea]. S.l.: s.n. 1998. Disponible en: <https://www.une.org/encuentra-tu-norma/busca-tunorma/norma/?c=N0038073>.
- [15] KEFREN. (2021). *Modelado 3D. características, tipos y más*. Obtenido de <https://grupokefren.com/disenio/modelado-3d/>
- [16] Labschütz, M., Krösl, K., Aquino, M., Grashäftl, F., & Kohl, S. (2011). *Content creation for a 3D game with Maya and Unity 3D*. Institute of Computer Graphics and Algorithms, Vienna University of Technology, 6, 124.
- [17] Molina, B., Vite, H., & Dávila, J. (2018). Metodologías ágiles frente a las tradicionales en el proceso de desarrollo de software. *Espirales revista multidisciplinaria de investigación*, 2(17), 114-121.
- [18] Monteiro, A., Rodrigues, E. F., & Murilo, S. (2020). O uso das escalas Likert nas pesquisas de contabilidade. *Revista Gestão Organizacional*, 13(1), 27-41. <https://doi.org/10.22277/rgo.v13i1.5112>
- [19] Muecke, M. A. (2005). *Sobre la evaluación de las etnografías*. In *Asuntos críticos en los métodos de investigación cualitativa* (p. 243). Servicio de Publicaciones.
- [20] Núñez, D., & Sánchez, M. (2011). *Antecedentes de la cultura popular tradicional o folklore en Venezuela*. *Omnia*, 17(1), 157-170.
- [21] Pala, C. (2016). *Producción de arte popular tangible basado en los códigos gráficos de la vestimenta tradicional, utilizada en los personajes del pase de niño de la ciudad de Riobamba*. Obtenido de <http://dspace.epoch.edu.ec/bitstream/123456789/5750/1/88T00179.pdf>
- [22] Pereira Uzal, J. M. (2013). *Modelado 3D en patrimonio por técnicas de structure from motion*. *ph investigación*, (1).
- [23] Prats, L. (2000). *El concepto de patrimonio cultural*. *Cuadernos de antropología social*, 11.
- [24] Ramírez-Bedoya, D. L., Branch-Bedoya, J. W., & Jiménez-Builes, J. A. (2019). *Metodología de desarrollo de software para plataformas educativas robóticas usando ROS-XP*. *Revista Politécnica*, 15(30), 55-69. <https://doi.org/10.33571/rpolitec.v15n30a6>
- [25] Restrepo, E. (2018). *Etnografía: alcances, técnicas y éticas*. Universidad Nacional Mayor de San Marcos.
- [26] Sánchez Bermejo, P. J. (2020). *Modelado 3D correcto*.
- [27] Sandoval Gallegos, M. G., Villacrés Pumagualle, M. L., Plaza Lucero, J. L., & López Chiriboga, M. A. (2022). *Creencias populares transmitidas en el contexto familiar: Relatos de manifestaciones culturales mágicas y narrativas de Riobamba*. *Revista de Ciencias Humanísticas y Sociales (ReHuSo)*, 7(1), 1-18.
- [28] Santillán-Aguirre, P., Duque-Vaca, M., Lozada-Yáñez, R., & Molina-Granja, F. (2022). *Learning By Doing Through Steam Methodology And The Use Of Educational Software*. *Journal of Positive School Psychology*, 6(9), 1787-1798.
- [29] Taípe León, S. F. (2016). *Historia de las fiestas populares religiosas y su incidencia sociocultural en la vida de los habitantes de Riobamba desde el año 2000 hasta la actualidad* (Bachelor's thesis, Riobamba, UNACH 2016).
- [30] Tian, Y., & Chen, Y. (2022). *Research on Visual Design of Computer 3D Simulation Special Effects Technology in the Shaping of Sci-Fi Animation Characters*. In *2022 IEEE 2nd International Conference on Power, Electronics and Computer Applications (ICPECA)*, 1080-1083. doi: 10.1109/ICPECA53709.2022.9718946.
- [31] UNESCO. (2003). *Qué es el patrimonio inmaterial*. Obtenido de <https://ich.unesco.org/es/que-es-el-patrimonio-inmaterial-00003>
- [32] Vicuña Calderón, J. A. (2019). *Catálogo de ilustración con contenido transmedia para difundir los personajes tradicionales de los pases del niño de Riobamba* (Bachelor's thesis, Riobamba).



- [33] Villacrés Pumagualle, M. L., López Chiriboga, M. A., & Sandoval Gallegos, M. G. (2022). *Festividades del pase del niño “Rey de Reyes” en Riobamba en tiempos de pandemia*. *Conciencia Digital*, 5(1), 153-170. <https://doi.org/10.33262/concienciadigital.v5i1.2064>
- [34] Zamora Acosta, E. (2011). *Sobre patrimonio y desarrollo. Aproximación al concepto de patrimonio cultural y su utilización en procesos de desarrollo territorial*. Vol.9 N° 1 (101-113).
- [35] Zhang, J., Chen, K., & Zheng, J. (2020). *Facial expression retargeting from human to avatar made easy*. *IEEE Transactions on Visualization and Computer Graphics*, 28(2), 1274-1287. doi: 10.1109/TVCG.2020.3013876.