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TRANSCULTURAL LANGUAGE, NATIVE CHILEAN PEOPLES AND A NEW AI-BASED ARTISTIC-CULTURAL EXPRESSION

Creating a new expression driven by intelligent technologies

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KEYWORDS

Digital Humanities
ICH
AI Technologies
Colourisation
Facial Landmarks
Additive Manufacturing

ABSTRACT

This work aims to rescue, transcribe and create new artistic and cultural expressions through the use of native peoples' historical visual recordings, integrating intelligent technologies. For this purpose, a Chilean native peoples' digital repository is collected, in order to apply a Digital Humanities-based methodology. From the chosen material, portraits are selected, recoloured through a AI-based model; the facial mesh is constructed using a facial landmark detector; the points of the mesh are reconstructed by a Delaunay triangulation; to finally apply an additive manufacturing process. Thus, these physical pieces allow to compare the native people's own physiognomies, creating new cultural expressions.

PALABRAS CLAVE

Humanidades Digitales
PCI
Tecnologías IA
Colorización
Landmarks Faciales
Fabricación Aditiva

RESUMEN

Este trabajo procura rescatar, transcribir y crear nuevas expresiones artísticas y culturales, usando registros visuales históricos de los pueblos originarios, integrando tecnologías inteligentes. Para ello, se recopila un repositorio digital de pueblos originarios chilenos, para aplicar una metodología basada en Humanidades Digitales. A partir del material escogido, se seleccionan retratos; recoloreados a través de un modelo IA; se construye la malla facial mediante un detector de landmarks faciales; se reconstruyen los puntos mediante una triangulación delaunay; para finalmente aplicar un proceso de fabricación aditiva. Así, estas piezas físicas permiten comparar las fisionomías propias de los nativos, creando nuevas expresiones culturales.

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1. Introduction

This work presents a connection between three relevant aspects for the generation of new cultural expressions triggered by Intangible Cultural Heritage. The first of these corresponds to the photographic record made by the ethnographer Martin Gusinde, who travelled to Tierra del Fuego for seeing, knowing and portraying the habitants of this difficult territory Gusinde (2020). The second aspect corresponds to the new technologies for the rescue and safeguarding of the ICH, here we refer mainly to the recovery from photographic images of record, models that allow us to improve the quality of the images Wang (2018) as well as to colourise black and white images Antic (2019). The third aspect considered in this work is the exhibition and assembly of a visual story about this material, which is developed by the students Camila Pardo and Sofia Castillo from the Catholic University of Temuco, under the collaboration of both authors.

The leading theme of this work is relevant, in which the initial recording is carried out in image format, capturing the frame of the image selected by Gusinde on photosensitive rolls. In them, a scheme of representation of the portrait subjects is proposed, where they are exposed for the first time to a photographic frame, with the series of technical characteristics of the care of this material in the face of the inclemency of the weather, as well as the uncertainty of the register until the enlargement of the captures. This is how the captured image takes on a preponderant value in the preservation of heritage, as a technical element of temporary registration, which in a certain way allows us to return in time to refresh that emotionality, giving context to the instant of registration, recreating a sensitive atmosphere capable of being restored through photography.

Thus, the present work acquires meaning in this sensitive area of the use of technique, which today advances with the use of technical elements based on expert AI models, allowing to touch the frontiers of design and art.

2. State-of-the-Art

2.1. Digital Repositories

Unesco's 2003 Convention for the Safeguarding of the Intangible Cultural Heritage was a global milestone that mobilised different governments to take action to promote the safeguarding of ICH at the local level. Thus, since 2003, the Chilean government has launched initiatives for the research, promotion and visibility of the cultural heritage of the native peoples of the current Chilean territory. Some of these initiatives are listed below:

The National Centre for Conservation and Restoration; The Documentation Centre for Heritage Assets; The Information System for the Management of Intangible Cultural Heritage; The National Cultural Heritage Service; and finally the IDE Patrimonio. Some of these organisations are also adopting the dissemination of ICH through the digitisation of these elements, making them available to the public through the global communication network, which opens up immense possibilities for the study and speculation of these elements in new iterative proposals that evolve with new software developments.

The Chilean Museum of Pre-Columbian Art has a marvellous exhibition that originally corresponds to the collection of Sergio Larraín García-Moreno, who around 1970 decided that the safekeeping and care of his collection must necessarily be assumed by a state institution, and thus began conversations with the mayor of the city of Santiago at the time, who immediately began the search for a building that could house the exhibition. This is how the Larraín Echenique Family Foundation was created and donated the collection to the illustrious municipality of Santiago, thus creating the current Chilean Museum of Pre-Columbian Art, located at 361 Bandera Street in Santiago, which has a virtual collection or photographic and musical repository of pre-Columbian native peoples.

The National Library of Chile is the main institution for the collection and safeguarding of Chile's bibliographic heritage, founded in 19813 and offers visitors a large amount of recorded material. Its mission is to preserve, conserve and disseminate this content. It is located at Libertador Bernardo O'Higgins 651, Santiago, Chile.

2.2. ICH for chilean native communities

Considering the millenary transcendence of Mapuche culture, it is surprising to discover that there is currently no active research work using intelligent technologies to rescue the culture tradition. Precisely, Aguilar (2021)

> presents a critical review of the current state of natural language processing in Chile and Mexico... Subsequently, the remaining problems and challenges are addressed... (1) the lack of a strategic policy that helps to establish stronger links between academia and industry and (2) the lack of a technological inclusion of the indigenous languages. (Aguilar, 2021)

Similarly, if we now turn to the recovery of historical visual records, there are technically no references to computer vision applications in the digital preservation of Mapuche culture or in the search for associated patterns. Therefore, we must look to other countries and continents to find relevant work. For example, there is a speciality dedicated to the study of 3D reconstruction methods for digital preservation Andrade (2009), Andrade

(2012), Gomes (2015). This paucity of proposals for the digital preservation gives us the opportunity to innovate, as we will see in this paper.

3. A proposal for the generation of new artistic and cultural expressions

In this section, a systematic review and proposal is made of the different verticals that configure the generative proposal of new artistic and cultural expressions.

3.1. Martin Gusinde and the native peoples of southern Chile

Among the pre-Hispanic native peoples who inhabited the extreme south of Chile in Tierra del Fuego were the Yaganes, Onas, Kaweskar, Alacalufes and Selk'nam. All of them had a close relationship with the territory they inhabited, rivers, seas, maritime and continental fauna which provided them with shelter and food. These peoples were the reflection of the first inhabitants of the southern hemisphere, and according to Gusinde, representatives of the first inhabitants of our human race on the globe, responsible for preserving, until the last century prior to their extermination, primitive customs that were verified in their relationship with the environment and their way of inhabiting Gusinde (1951), Gusinde (2020).

In this context, ethnographers such as Martin Gusinde, Anne Chapman (2002), Robert Lehmann-Nitsche (2019) and even Salesian missionaries Misioneros Salesianos (Chile) (1915) among others, made incursions into geography to record the social and cultural aspects of these people. Specifically, the territory of Isla Grande in Tierra del Fuego was inhabited by the Onas, Yaganes and Alacalufes, and by the 20th century there were one hundred Onas, one old Haush woman, fifty Yaganes and one hundred and fifty Alacalufes Oyarzun (1941), Gusinde (1951). And how did they disappear? Well, because of contact with the European invaders, contracting vices and diseases and the hunters of native men, who acted as bounty hunters exterminating entire families for the sole reason of avoiding cattle rustling, we can mention here Julio Popper, Mc Lenan and Sam Ishlop Gusinde (1951).

Photographic discourse is considered as an narrative of physical reality which allows us to revisit and rewrite the evolutionary record of humanity in a timeless way. Gusinde's portraits are a fundamental part of the cultural history of humanity that we must not forget.

After two and a half years in Tierra del Fuego, Martin Gusinde recorded, portrayed and composed part of the visual memory of the inhabitants of Tierra del Fuego.

3.2. New technologies and the ICH

AI models for the recovery of photographic images and determination of facial meshes together with digital fabrication are a viable tool for the reconstruction of symbolic scenarios, for the restoration and enhancement of the photographic/ethnographic record of the first inhabitants of our human race who, unfortunately, were extinguished by the vortex of the scenarios proposed by European domination and progress based on consumption, responsible for the profound change in the natural development of the various native peoples, who, slowly but consciously, governed an extreme geography and even stimulated the human conditions for an alternative and specific development in full contact with the surrounding nature. Thus, these communities merge with nature in aspects that are still in the process of being understood today, always under this analytical colonial gaze.

Art and Design share methodologies of development and problem solving, however they solve problems with a different origin between them, while the arts solve rather internal problems of the being, design is dedicated to the resolution of external problems of the being and how it relates to the environment Jacobs (2018). Meanwhile, programming in the creative areas of arts and design provides us with a set of creative and productive digital tools where the speed of calculation opens up a range of forms, analysis and transformation of the original elements. However, in the face of all the benefits we can access through programming algorithms, we are always faced with a learning curve that is not minor, a product of the analogous technical tradition in these creative disciplines.

For some years now, digital platforms and their developers have taken these difficulties and solved this quantum leap through new graphical interfaces Grasshopper (2022), enabling users without programming knowledge the possibility of creating and composing algorithms graphically, these interfaces are already becoming common in various design software allowing and integrating genetic algorithms of one and two variables, fuzzy logic that to this day are commonly used in industry, swarm logic, finite element analysis, fluid dynamics calculation, among others. Likewise, collaborative software development platforms have integrated programming assistants that facilitate the use of these, for example GitHub Copilot (2022) offers a virtual assistant powered by the AI that identifies the language of writing the code and collaborates in writing the programming in various languages, while Bisong (2019) provides the public with a platform to perform more complex calculations for the use of AI expert models, facilitating access to GPUs to perform these tasks with the integration of complex libraries.

The global communication network also opened up an interesting field of development and data exchange between software, as software was originally developed under the wing of companies and institutions that had development groups to make versions and updates, but the current model is based on collaborative development and open source, where a diverse community spread around the globe collaborates on new versions of free

software. The cloud also allows the exchange of documents created between different platforms, an example of this can be found in Ladybugtools, a platform that allows the exchange of documentation between platforms such as Openfoam, Radiance, Rhinoceros and others enabling the environmental study of architectural design or also the use of standard formats such as Json, Xml and others, formats that allow to exchange information between platforms.

3.3. Design and assembly of cultural-artistic storytelling

It is essential in the academic context to create a sensitivity towards the symbolic territorial aspects of the native peoples, where the understanding of the environment makes possible, in a certain way, a delicate human aspect, a horizontal sphere of development together with the elements that compose and define our environment, the human world is deeply interrelated to the natural world and certainly, the current human crisis comes from the distancing of the human world from the natural world(200). Here, the development of the human world without the considerations of the natural world, advancing at a self-imposed speed, with dimensions supported by consumption and the market, is leading us at breakneck speed to the extinction of the human world.

Under these general aspects of a global and contemporary view, but no less relevant, the dynamics of the Innovation and Territory Laboratory of the Department of Design of the Catholic University of Temuco arises, which adopts the methodology of digital humanities with the first and not least purpose of giving value to the elements of the peoples who originally and primitively coexisted in a symbiotic way in this territory. For this, in the laboratory we propose this approach through new technologies, taking advantage of these new programming interfaces and the use of standard exchange formats that enable non-programmers to use generative programming tools and AI models for the methodological crossover between art and design, solving both internal and external problems in an amalgam proposed by the students of the workshop and that arises after the observation of the elements of the PCI.

After studying these elements found in various repositories, which make available material from the registry, validated by various cultural organisations, we generated cross-references with current technological techniques and practices that allow us, in the first instance, to recompose these elements of the ICH. Thus, for this particular case, the students Camila Pardo and Sofia Castillo create a story based on the Yagana woman and the last native woman to speak the Yagán language, Cristina Calderón The Guardian (2022), who died at the age of 98, taking with her a cultural legacy that forms part of the heritage of humanity. As a proposal, the students orient a series of symbolic aspects in the reconstruction of a moving audiovisual atmosphere capable of integrating the visitor into a time bubble.

We firmly believe that this work under the proposed methodology configures a practice of resistance to the imposed and globalised economic model to which we simply belong, without necessarily freely choosing to belong to it, and we propose an integrated cultural survival between history, culture and technology with an ethical perspective without falling into cultural appropriation, but rather in revitalising the PCI.

4. AI-based methodological framework

This section deals with the proposed framework for the generation of new cultural expressions, based on Artificial Intelligence.

4.1. Digital Humanities

As defined in Unesco (2003),

> safeguarding means measures aimed at ensuring the viability of intangible cultural heritage, including identification, documentation, research, preservation, protection, promotion, enhancement, transmission, in particular through formal and non-formal education, as well as the revitalisation of the various aspects of such heritage. (UNESCO, 2003)

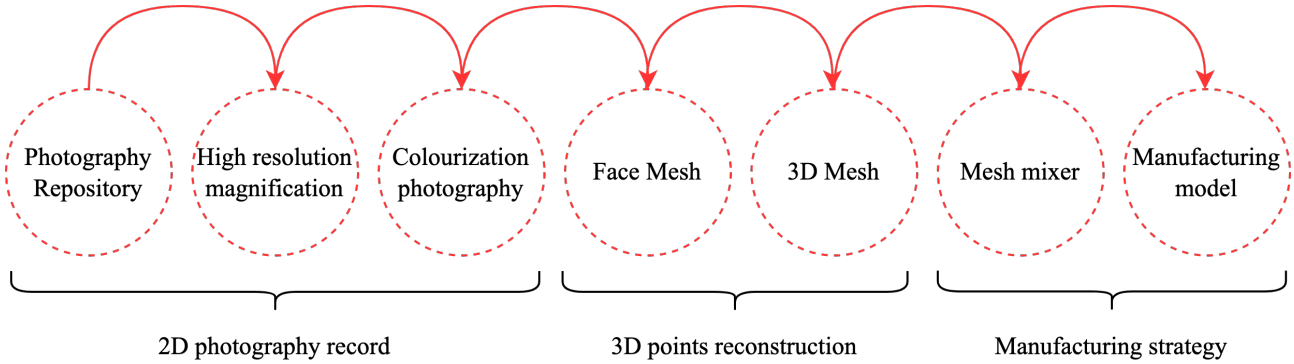
The preservation of cultural heritage requires a panoramic view of various cultural, political and territorial aspects, which necessarily interact with each other in an active way. Similarly, digital preservation models that emerge from cultural heritage information are a real support for the development and preservation of indigenous peoples. This preservation supports a variety of cultural preservation initiatives such as education, research, tourism and others. Thus, we are able to connect different places and times through models that interpret or revive elements of the past and that correspond to an earlier technological era.

Consequently, the definition of a pipeline that correctly addresses the process of historical, patrimonial and intangible cultural recovery of Chilean native communities represents a problem of great complexity and dimension that involves the integration of scientific and anthropological knowledge. Based on the above, it is natural to propose cutting-edge technologies and expert systems based on Artificial Intelligence, given the incredible results that these techniques provide.

However, it is necessary to emphasise that not every problem needs to be approached from this perspective: many traditional methods adequately solve the different formulations developed. Precisely for this problem, the precariousness of historical audiovisual records, together with their historical scarcity, promote the adoption of architectures that integrate Neural Networks (NN), Convolutional Neural Networks (CNN), Generative Adversarial Networks (GAN), among others, to recover a national intangible heritage of global impact.

Based on the digital photographic repository, the present work proposes the application of 3 Artificial Intelligence methods: super-resolution of precarious historical visual records, colourisation, and three-dimensional reconstruction of faces. For this, generative programming and additive manufacturing coexist, which allow to obtain the results reported in the following section.

Figure 1. Methodological pipeline for the application of Digital Humanities in Martin Gusinde's repository of Chilean native peoples.



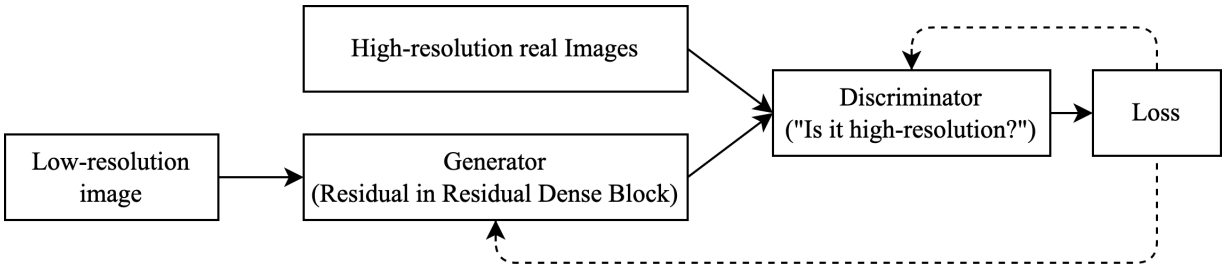
Source(s): Garcia-Lara, 2022.

4.1. Hyperresolution of historical images

One of the critical points of visual historical records is their precariousness, which transfers this problem to the different existing methods, limiting the spectrum of possible applications and requiring the designed models to be robust. A novel and state-of-the-art work is Wang (2018), which relies on Super Resolution Generative Adversarial Networks (SR-GAN) to generate realistic textures during the super-resolution of a single image.

To further improve the visual quality, the authors Wang (2018) propose new contributions in network architecture, adversarial loss and perceptual loss, resulting in an improved SRGAN (ESRGAN). In particular, it is sought that the network discriminator predicts the relative reality instead of the absolute value. Thanks to these improvements, ESRGAN achieves a consistently better visual quality with more realistic and natural textures.

Figure 2. ESRGAN super-resolution architecture used to increase the quality of visual recordings



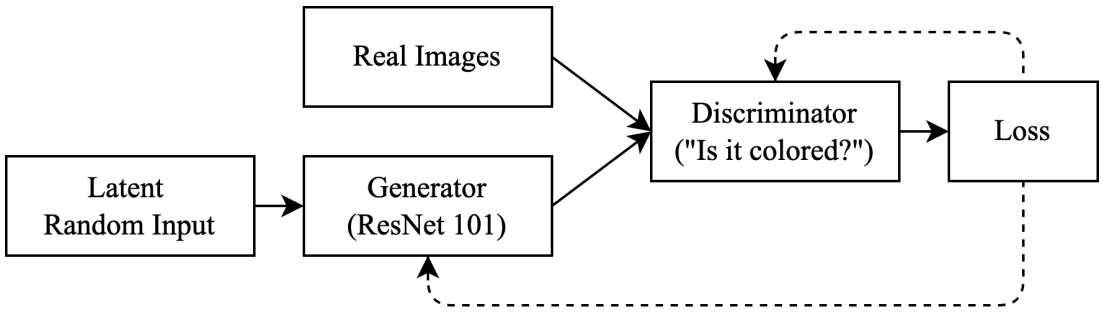
Source(s): Garcia-Lara, 2022; Wang, 2018.

4.2. Colourisation of historical visual records

One of the scientific problems with the greatest societal impact is the colouring of historical images. Not only does it face a reliable reconstruction of poor quality and precarious visual records, but it also implies a strategic adoption to solve the lack of comparative labels to act as a reference in the training phase of advanced reconstruction systems.

Our work is based on the proposed system for the restoration of old images and film material by Antic (2019), adopting the architecture shown in Fig. 1 as a reference.

Figure 3. DeOldify colouring architecture used for colour restoration in visual records.



Source(s): Garcia-Lara, 2022; Antic, 2019.

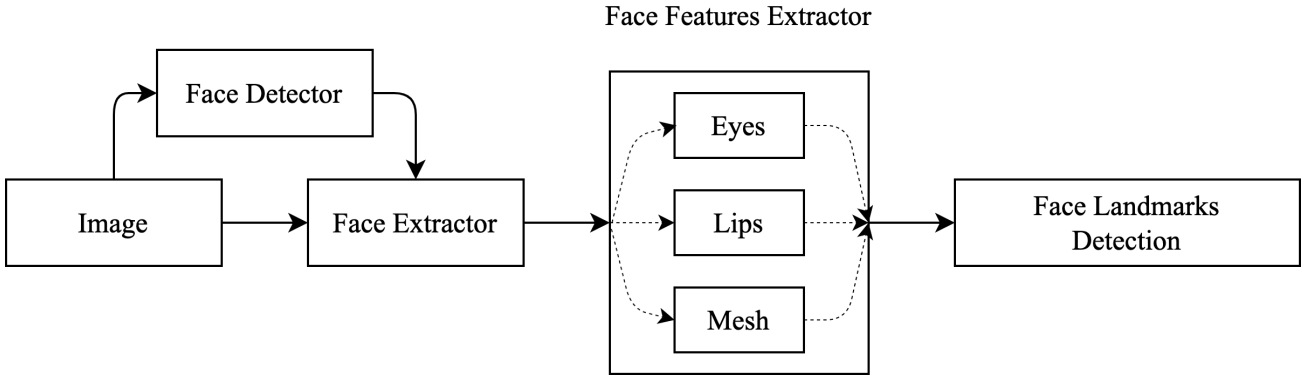
The DeOldify model Antic (2019) uses as architecture a NoGAN, an approach that allows obtaining the training advantages of a GAN, devoting the least time to the direct training of the GAN itself by pre-training the generator and the discriminator. As a result, the discriminator gap is considerably reduced, resulting in a more realistic, faster and more reliable restoration of the available visual recordings, along with a decrease in training complexity. For a more stable model, the authors use a ResNet-101 as the backbone of the generator to have a more consistent and accurate object detection system, resulting in a restoration with more excellent uniformity.

4.3. Face mesh: producing spatial points from portrait photographs

An innate challenge of digital preservation is the search for and detection of hidden patterns in the cultural heritage of indigenous peoples. Considering that visual content is one of the most massive historical records, it is possible to extract relevant information that faithfully recreates the characteristics of these communities. In this sense, a third application is Face Mesh: obtaining three-dimensional spatial points from portrait photographs.

For this purpose, the image to be processed is selected from the audiovisual resources retrieved from the previously listed digital bank, and a face detector is used to determine the bounding boxes associated with the faces of each agent in the image. Once the corresponding faces have been detected, three key features are extracted to build the topology of the three-dimensional mesh: the eyes, the lips and the global mesh. It is feasible to use hybrid Convolutional Neural Networks and Transfer Learning models that detect the above features. Hybrid Convolutional Neural Network (CNN) or Transfer Learning models that detect the above features are used for this purpose. Finally, the landmarks of each participant's face are detected and represented three-dimensionally for coherence and spatial description.

Figure 4. Facial landmark detector architecture.



Source(s): Garcia-Lara, 2022; Grishchenko, 2020.

5. Results

This section reports the results obtained after the application of the Digital Humanities-based methodological pipeline.

5.1. Colourisation of historical visual records

The systematic application of AI-based super-resolution and colourisation methods on the digital repository of the native peoples of Chile allows the pictures in Figure 5 to be generated.

Figure 5. Super-resolution and colourisation of historical visual records of native peoples in the extreme south of Chile.

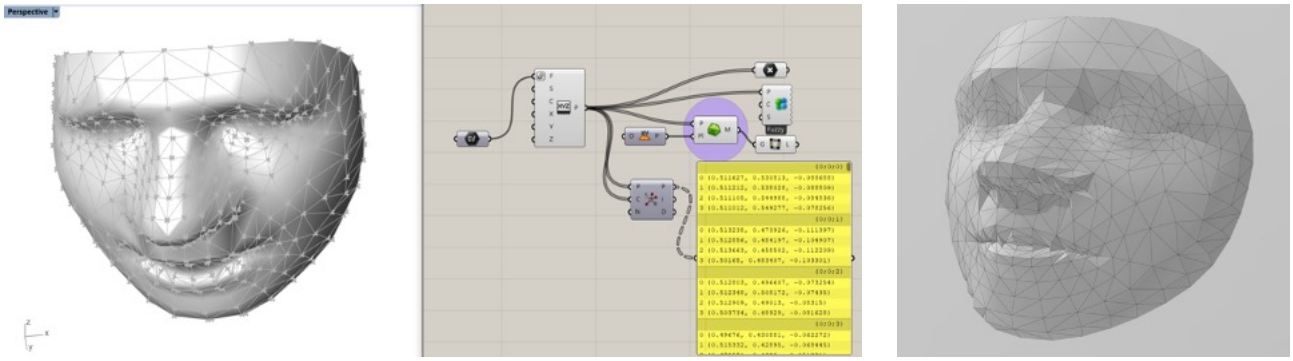
Source(s): Garcia-Lara, 2022. Gusinde, 1951.

Visually, we can see how these methods improve the quality of the image in terms of resolution, and attempt to faithfully recreate the characteristic colours of both the native community and its ornamentation and environment.

5.2. Face mesh: producing spatial points from portrait photographs

Once the images selected from the digital repository are processed, enhanced and restored, we proceed to apply the facial landmark detector in Figure 4, which allows to produce a 3D mesh associated with the portrait photography. The mesh points are reconstructed with a Delaunay triangulation, and then a generative programming is carried out to achieve the results shown in Figure 6.

Figure 6. Three-dimensional facial mesh generation, based on facial landmark detection, Delaunay triangulation, and generative programming.

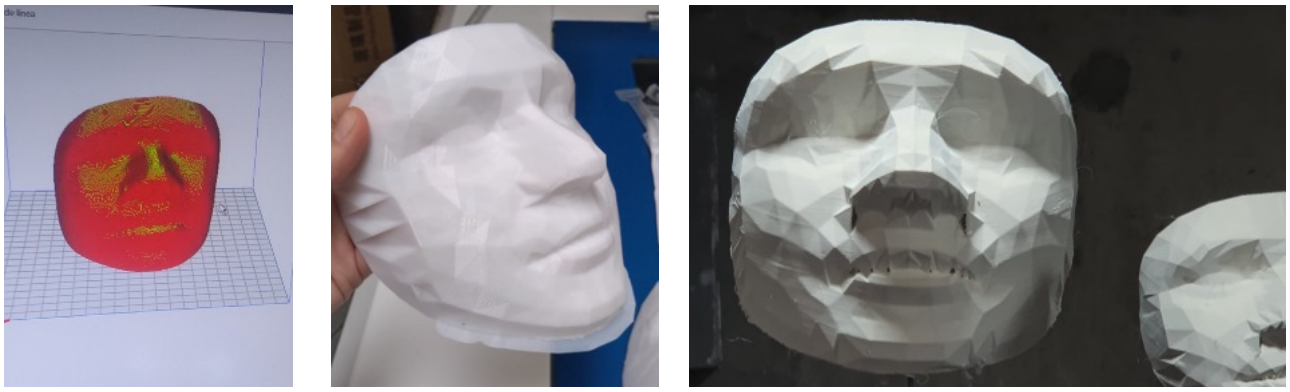


Source(s): Garcia-Lara, 2022.

5.3. Additive manufacturing process

The rendering of the three-dimensional mesh allows to dream and go one step further: through additive manufacturing, it is possible to transfer intangible cultural heritage from digital to physical space, recreating the morphology associated with the photographic portraits of native communities. Thus, in Figure 7, visual records associated with the process of additive manufacturing of faces are reported.

Figure 7. Additive manufacturing process visual records of Chilean native communities' face morphology.

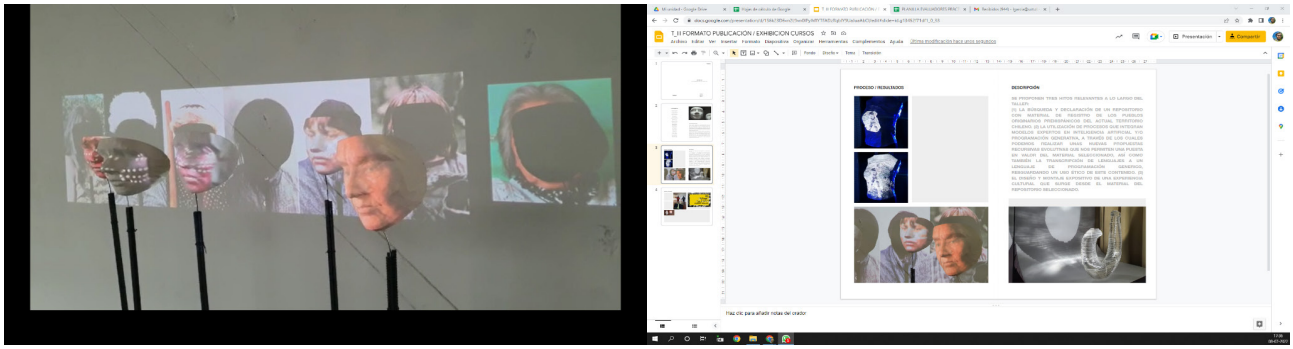


Source(s): Garcia-Lara, 2022.

5.4. Assembly and exhibition

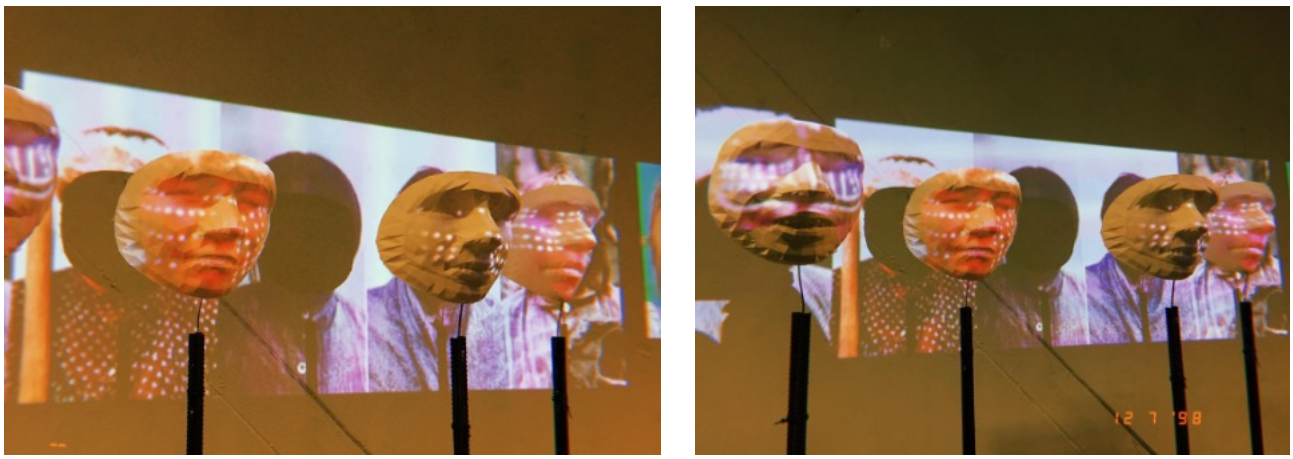
Finally, a coherent proposal is constructed, in which the physical sculptures (elaborated from the facial features of the native communities' photographic portraits) are physically arranged and superimposed on the original visual record. As a result, Figure 8 and Figure 9 show the assembly and exhibition of the elaborated proposal, bringing back to life an extinct native community, transcending through the preservation of the intangible cultural heritage.

Figure 8. Artistic and cultural expressions exhibition, in the immaterial cultural preservation of chilean native communities. Visual record captured from a left lateral perspective.



Source(s): Garcia-Lara, 2022.

Figure 9. Artistic and cultural expressions exhibition, in the immaterial cultural preservation of chilean native communities. Visual record captured from a left lateral perspective.



Source(s): Garcia-Lara, 2022. Aguirre, 2022.

6. Discussion

We propose an ethical use of technologies in this transcultural weaving of material from PCI repositories and the technology that collaborates in the enhancement of humanity's heritage. In this work specifically, the journey begins with the photographic image captured by Gusinde almost a century ago, a cutting-edge technology for the time and still in use today, where the image continues to play a preponderant role as a technological element that allows the study of the physical world, enabling programmes to be trained to solve complex tasks of segmentation, identification and other tasks that require computer calculations from the pixels of the image. Both elements added to the use of contemporary computerised manufacturing technologies construct a coherent narrative for the enhancement of the intangible cultural heritage of the pre-Columbian native peoples of South America.

Our methodological narrative is transportable to other native peoples, where we faithfully believe, as a research group, we have a pending task of valuing the native, the primitive, the pre-existent as a task of resistance from our academic work.

7. Conclusions

This research work, which is part of a larger scope in terms of the observation of the recording material of the pre-Columbian native peoples of South America and their intangible cultural heritage with a direct descent to the undergraduate level, is proposed as a fundamental element in the generation of not only cultural awareness, but also fundamental ecological awareness.

Here, deeply human knowledge and wisdom intersect, creations of human consciousness exposed to a wild and unknown context where that first reflection, those primitive decisions of survival, those basic practices of spirituality make complete sense in this connection between the human world and the natural world. Therefore, this work develops transdisciplinarily in terms of the authors and horizontally with respect to the students in a proposal based on trial and error, on sowing the uncertainty that raises the yearning for knowledge and the revaluation of the existing.

In this area, we continue to address future work in this complex warp of ancestral knowledge and technology. Consequently, the work presented lays the foundation for research that integrates Digital Heritage, Native Communities and Smart Technologies in applications for the preservation of Intangible Cultural Heritage.

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