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Mayan Cultural Heritage in the Digital Age: Technology, Memory and Decolonial Possibilities

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Abstract
This article examines the use of digital media in disseminating and preserving Mayan cultural heritage through a series of interdisciplinary projects grounded in archaeological research and immersive technologies. Developed by a team of academics and students, these initiatives explore how augmented reality (AR), artificial intelligence (AI) and three-dimensional reconstruction can bring ancient Mayan knowledge systems before the public. The article examines the educational and interpretive possibilities of digital technologies for communicating complex cosmological beliefs, particularly to younger generations. It also addresses the challenges of translating sacred narratives and intricate visual traditions into digital formats without diminishing their cultural significance. It follows a decolonial perspective and argues that digital dissemination can challenge the alienation of cultural heritage and democratise access to historical knowledge.

Keywords: Mayan cultural heritage, digital media, augmented reality, digital art, cultural memory, decolonization, archaeological preservation.

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1. Introduction

The project "Symbolism and Technology: The Transformation of the Mayan Zero into Digital Art", examines a series of digital art produced from 2025 to the present by a team of professors and students. It aimed to disseminate the pre-Hispanic Mayan worldview through contemporary artistic practices, specifically, digital art. Our critical analysis focuses on a trans-historical dialogue with the Mayan past, utilizing immersive experiences within contemporary public spaces, where historical memory seeks to break through the technological alienation characteristic of modernity.

Created with digital tools, the project was presented in the public sphere as part of the exhibition "Symbolism and Technology: The Transformation of the Mayan Zero into Digital Art", held during the 2026 edition of the "Universiada Cervantina" at the University of Guanajuato (Mexico). The exhibition takes the Mayan perspective on physical objects and recontextualizes it for the public sphere, employing technological and performative languages. This process helps to redefine the relationship between historical heritage, the "decolonized citizen" (Dussel, 2022), and the physical urban environment.

It is worth noting that the invention of the Mayan zero marked a major breakthrough in the development of abstract thought, signifying not merely a void but also the concept of the absolute. This concept underpins the exhibition's discourse, translating the abstract complexity of the Mayan worldview into the electronic language of zeros and ones. This manifests in various forms—such as augmented reality, video mapping, animations, and other visual outputs generated through computational processes—including the controversial use of artificial intelligence. Here, contemporary cybernetics converges with abstract Mayan thought, manifesting in interactive works that transform the viewer—accustomed to perceiving archaeological elements as static, solid, and immovable—by presenting them through a different dynamic: digital light projection, which is, at times, both interactive and immersive.

2. Echoes of Future

2.1 Masks as Guardians of the Universe

From the inception of this outreach project, a key consideration was ensuring it was not aimed solely at an adult audience. By educating children from an early age, they will be better equipped to recognize elements of their own culture as adults. Throughout human history, masks have served to conceal not only the face but also the personality of the wearer. Popular culture is replete with such references; for instance, the character of Batman contains an unmistakable allusion to the Mayan god Camazotz. While this specific reference was not included in the exhibition, it is planned for future displays—though the present exhibition does feature other types of masks associated with Mayan deities.

As previously mentioned, the project began in 2025 with research into stucco masks dating from the Pre-Classic to the Classic Mayan periods. This research subsequently enabled their representation through Augmented Reality. For the ancient Maya, these masks represented deities that served as guardians of the universe (Valencia, R.R., 2017). The project and the underlying research were a collaborative effort involving archaeologist Luis Joaquín Venegas de la Torre—

who oversees the Ichkabal archaeological site—and student Carlos Felipe Villafán Parra. The latter assisted in gathering images, drawings, and articles from previous excavations and publications, which later facilitated the modelling of these masks with the aid of AI. The research findings were presented to the public in an exhibition titled " Millennial Masks" or *Mascarones milenarios* (see figure 1), held during the first anniversary of the opening of the archaeological site on January 30, 2026 (the exhibition remained open to the public for several months). The exhibition was presented using Augmented Reality (AR).

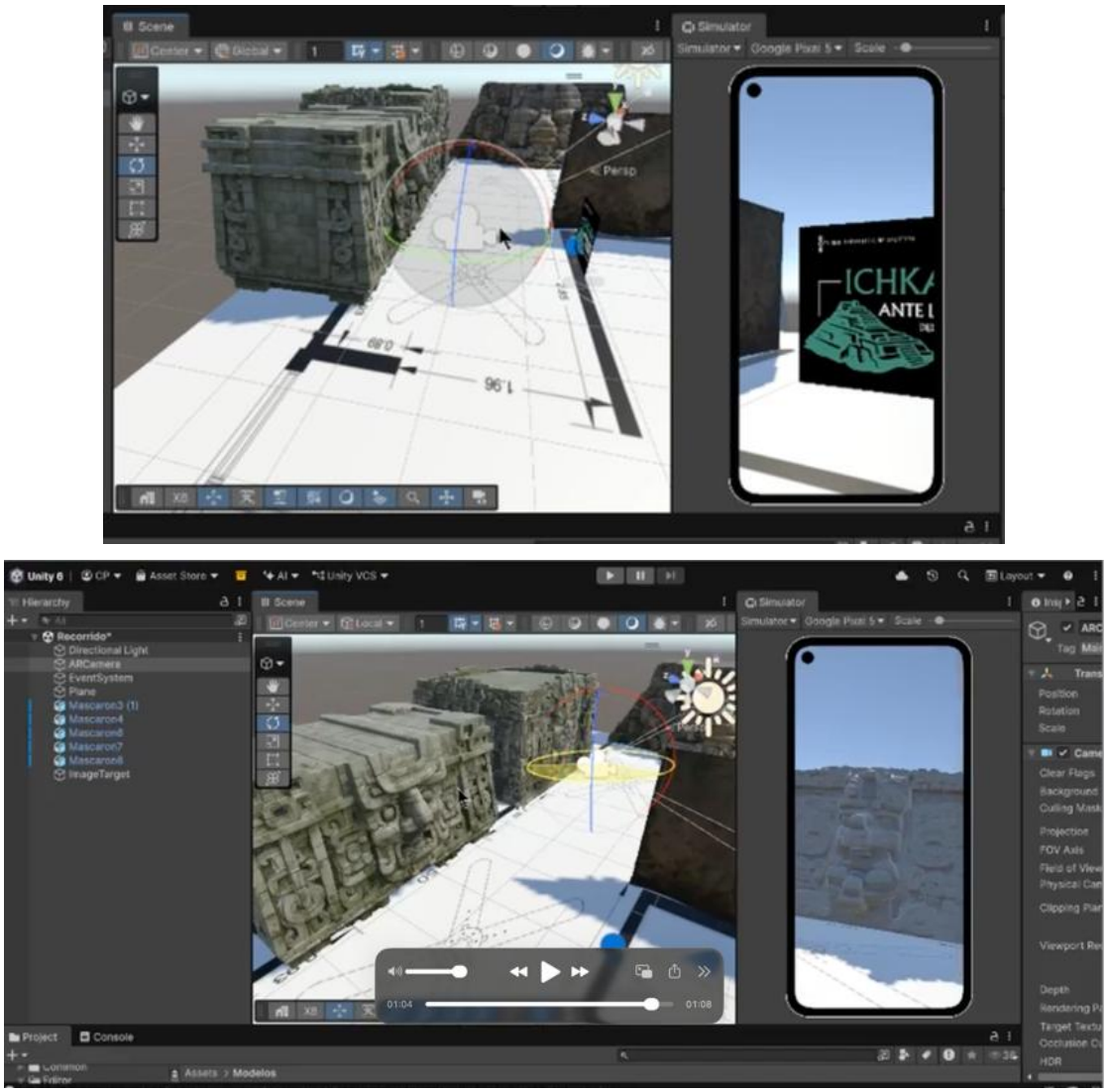


Figure 1. Author: Felipe Villafan. Millennial Mask Project. Preliminary renderings for the exhibition, 2025.

The featured *mascarones* (large, decorative architectural masks), including those from Ichkabal (Nalda et al., 2000), Chakanbakán, and Kohunlich in Quintana Roo; Calakmul in Campeche; and the now-lost *mascarón* from the "Kabul" structure in Izamal, Yucatan (Salazar L.D., 2015), were created with the assistance of AI (see figure 2), which processed prior research and documentation compiled by archaeologists. The work made a very positive impression on visitors; for many, it

was their first opportunity to experience an AR piece, where an alternative reality, viewed through their smartphone screens, was superimposed onto the physical space of the exhibition hall.

Location of the masks in the Yucatan Peninsula (Mexico)

Figure 2: Author: Felipe Villafan and AI Google (Gemini). Millennial Mask Project AR. Rendering of the Ichkabal (Quintana Roo) and Izamal (Yucatan) masks. 2025

2.2 Youthful Adventures

Developed alongside the *mascarones* project was "*A Visit to the Popol Vuh with Hunahpu and Ixbalanque"*, an animation based on the *Popol Vuh,* an anonymous and sacred book of the K'iche' Maya from the highlands of Guatemala (Roldán, B. 2023, 5). This animation was designed specifically for children. Gabriel Barragán van Amerongen created the project based directly on the K'iche' text, transcribed using the Latin alphabet (Soustelle, 2023, 148), which was later translated into Spanish. The *Popol Vuh* recounts the mythic experiences of the divine twins, Hunahpu and Ixbalanque, during their descent into *Xibalba* (the underworld). In this instance, the narrative was transformed into a digital animation, produced using Procreate (via frame-by-frame illustration). The work recounts the story of the twins who played *pok-ta-pok* (a ball game), provoking the wrath of the gods; they undergo various trials in the House of Darkness, the House of Knives, the House of Jaguars, and the House of Bats, yet ultimately emerge victorious, transforming into the sun and the moon.

Figure 3. Author: Gabriel Barragán. *A Visit to the Popol Vuh with Hunahpu and Ixbalanque.* Message from the *Xibalba* (underworld) to the twin brothers, 2025

Over the decades, this rich narrative has transcended the written text to find new forms of expression. Animation, in particular, has proven a powerful, accessible vehicle for conveying the complexity and beauty of this myth to new generations, especially at a time when audiences are often drawn to foreign cultures that lack historical substance and aim primarily for economic gain. Furthermore, in an era where environmental conservation is central to the survival of all life on Earth, it is worth noting that the *Popol Vuh* and Mayan beliefs, in general, did not place human beings at the center of the universe; rather, humanity was merely part of a greater whole (Thompson, J.E.S. 2024, 330).

Adapting the *Popol Vuh* for animation required a process of synthesis; moving beyond mere illustration, the project demanded an exercise in visualizing the mystical and the divine realms difficult to depict, leading to the use of abstraction for certain aspects. At the same time, oversimplifying the original plot risks creating a narrative disconnect from the historical text; thus, the work's merit lies in striking a balance between preserving the essence of the narrative while omitting irrelevant aspects, for instance, highlighting intelligence and the defeat of arrogance, all the while striving to preserve the poetic quality and richness of the story, for both educational and artistic purposes.

2.3 Aluxes: The Mayan Sprites

This project, titled *Alux Etéreo* (Ethereal Alux), features a digital *alux*, a protective mythological entity that serves as an interactive guide at the Museo Regional de la Costa Oriental or MURECO, in Tulum, Quintana Roo. It fuses ancestral storytelling with cutting-edge technology. The value of this tool lies in its ability to break away from traditional museum presentation, offering an immersive experience that creates an emotional connection with the visitor. The *alux* does more than provide historical data about archaeological artefacts; it contextualizes their ritualistic and everyday uses, while revitalizing the Mayan language and local legends. This digital outreach strategy democratizes access to knowledge, fosters cultural ownership, and attracts younger

audiences. The project shows that augmented reality (AR) acts as a vital bridge for preserving living memory, transforming a museum visit into a dynamic dialogue between the pre-Hispanic past and the technological present.

As a mythical figure in Mayan culture, the *alux* is represented in various forms and materials, such as clay, stone, or wax, and appears across much of the region encompassed by Mayan civilization. They serve as protectors of *milpas* (traditional cornfields), *cenotes* (sinkholes), and caves, as well as the broader animal and plant kingdoms, guarding against the exploitation and abuse often inflicted upon them by humans (Gallardo & Lartigue, 2016, p. 174).

According to Mayan tradition, the *alux* is a generous being, yet it also punishes those who commit abuses or farmers who fail to show proper respect by neglecting to leave offerings (Balam & Quintanal, 2016, p. 180). Much like humans, these beings experience sorrow and distress; they communicate with farmers through whistles, signalling that it is time to leave the *milpa* before nightfall, as they consider it a dangerous area after dark. Ultimately, the *alux* is defined by its values, sheds its physical form, and transforms into "wind," living on forever to watch over everything that exists on earth and in the heavens (Balam, P. & Quintanal, E. 2016, 185). As ancestral beings that inhabit both the human and spiritual realms, the *aluxes* engage in a playful connection with the *digital alux* encountered on electronic devices (see figure 4). This digital manifestation acts as an intermediary between the magic of technology and Mayan mysticism, bridging two worlds.

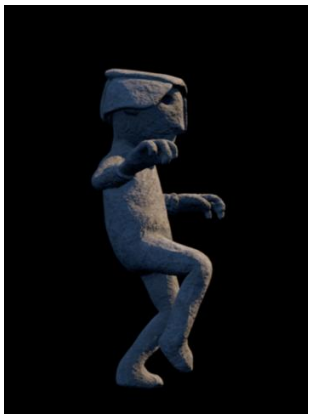
a. b. c. 

Figure 4.
a. *Alux* Mayan original piece. Postclassical period. *Museo Reginal de la Costa Oriental*. INAH. Q.R.
b. *Alux etéro* Authors: Pablo Calvillo, Alix Sandobal, Ameyali Rico, and Mónica Vera.
c. Mapping with the *Alux etéreo* by Israel López
Ethereal Alux. 2026

Within the museum, this serves as a transition between artefacts from a culture whose remnants now rest in display cases, though they were once objects of worship and spiritual reverence. The invisibility of the digital *alux* contrasts with the stone artefacts in the museum, which are themselves protected by enclosures made of the same material—much as hardware protects a digital device. Both exist in the space between the visible and the intangible. Given the technical complexity of the project, it was developed by the following students: Pablo Calvillo, Alix Sandobal, Ameyali Rico, and Mónica Vera.

Before concluding this section, we would like to note that our primary objective is for the exhibition to resonate not only with adult audiences but also to capture the interest of children and young people, the future promoters and ambassadors of the sophisticated, ancestral Mayan culture.

3. Mayan Frescoes: An ancient worldview facing a technological mirror

3.1 The Bonampak of Chan Muwan II

Another project of interest for the dissemination of Mayan culture involved the creation of an animation based on the Bonampak murals, a project that remains unfinished to this day due to its inherent complexity, particularly regarding the central room, which features a dense, intricate scene of warfare. The building housing the murals at Bonampak was dedicated to the ruler Chan Muwan II (De La Fuente, 1998, 8). As a victor in war, the ruler becomes the pillar and axis of the cosmos, gaining the ability to traverse its three levels: the Heavens, the Earth, and the Underworld. The artist who executed these works was named Och, and it is believed they were created around 790 AD. These murals remained hidden until their rediscovery for the Western world in 1946 by Giles Healey (Villagra, C. A. 1949, 7), who was guided to the site by José "Pepe" Chan Bor, a man of Lacandon origin (Miller, M.E., Brittenham C., 2013, 178).

From a contemporary perspective, the mural's structure is profoundly symbolic; it can be seen as comprising three levels, each of which is divided into three rooms, each commemorating a significant event. Numerology plays a central role—not only because the number three holds special significance in the modern Christian tradition, but also because of the Maya practice of celebrating hotunes (five-year periods), which in this instance commemorated the enthronement of Chan Muwan II. In the first room, a seated figure holds a mirror that reflects the men positioned above; the mirror serves as a symbol of royal power and an instrument of divination. In Room 3, the dance scene takes place on the terraces of a red-painted pyramidal structure—representing one of the buildings within the Bonampak acropolis. This demonstrates how the painting corresponds to the actual architectural space, functioning as a stage—a geometric representation of space and volume. The Bonampak frescoes project draws on the extensive research of Mary E. Miller and Claudia Brittenham, as presented in their book "The Spectacle of the Late Maya Court", as well as the work of archaeologists such as Sophia Pincemin and Alejandro Tovalin. The objective is to offer the viewer a sense of immersion and intimacy regarding the depicted events and rituals, inviting them to participate in the experience. To achieve this, it is essential to grasp the sensory complexity of the Maya ceremonies that once took place there. Consequently, our proposal is not a futuristic vision, but rather a necessary extension of established digital conservation efforts. We aim to transform digital records into an interactive experience that protects the original site from the pressures of tourism and environmental factors—addressing the monument's inherent fragility, a persistent challenge that has demanded a multinational and multidisciplinary approach ever since its discovery. The project tackles the complexity of these scenes and their digital reconstruction through augmented reality (AR). This allows us to recontextualise archaeological and epigraphic data, enabling the viewer to experience the immersive depth of the depicted events—ranging from dance rituals, which highlight the significance of ceremonies in social life, to their role in the legitimation of power and, by extension, politics. Furthermore, the scenes reveal

the dynamics of interaction between city-states—through tributes, alliances, the exchange of wealth, and social and economic ties—while also shedding light on warfare practices, such as the capture of prisoners. They also depict victory ceremonies that bear witness to military triumphs and rituals, conveyed through art and the authority of the rulers. The digital project *Bonampak: Otra Realidad… Aumentada* ("Bonampak: Another Reality… Augmented")—which focuses on a masterpiece from the Classic period located in the Lacandon Jungle—was led by Paul Gerardo Mosqueda Montes, with support from Karen Sosa, Gael González, and Josué Hernández. Acting as a kind of hermeneutic microscope, this digital work reconstructs key scenes from the murals in 3D, highlighting iconographic details that remain hidden from the public due to physical degradation and geographical distance (see figure 5).

Figure 5.

Authors: Paul Mosqueda. Collaborators: Karen Sosa, Gael González, and Josué Hernández. *Bonampak. Otra Realidad….Aumentada*

Left. Work in process for the Augmented Reality. Right. Mural Detail. Room 2. VIII Century. Image courtesy of Yale University Art Gallery. Gift of the Bonampak Documentation Project. Illustrated by Heather Hurst, M. Phil 2006, and Leonard Ashby. 2026

3.2 Daily Life in Maya Society

Another notable project involves the murals at Chiik Naab within the Calakmul archaeological site in Campeche. These murals depict scenes of daily life and have been digitally animated using augmented reality (AR) by student Ingrid Ruiz. The original murals focus on the everyday life of the Maya towards the end of the 8th century CE. The project prompted us to reflect on the inherent fragility of elements that might otherwise seem eternal—such as the stone and clay of Calakmul. The murals themselves reveal this vulnerability, which in turn motivates us to share the richness of this monumental artistic heritage. Explorations in this area began in the first half of the 20th century—specifically in April 1932 (Marcus, J. 1987)—and many structures remain unexplored to this day. Nevertheless, archaeologists have uncovered significant cultural treasures, including friezes, large masks, and murals—such as those found at the Chiik Naab acropolis—as well as ceramic ritual objects, burials, funerary masks, and ornaments. In this brief text, we will focus exclusively on the murals of Chiik Naab (650–700 CE) in the city of Oxtetún (Calakmul).

The animation project centers on specific domestic scenes from the murals, aiming to make them accessible to a broader audience (see figure 6).

Figure 6. Author: Ingrid Ruiz. *Chiik Naab*, Calakmul murals. Augmented Reality (Details of different scenes). 2026

While reproductions of these murals can be found at the Calakmul site museum, the Museum of the East Coast (MURECO) in Tulum, Quintana Roo, or the Great Museum of the Maya World in

Mérida, Yucatán, public access to the originals is restricted due to their fragile condition. The proposal presented here could lead to Augmented Reality (AR) applications, given that Virtual Reality (VR) devices have limited accessibility. Furthermore, with AR, the viewer does not lose contact with reality itself, as it remains perceptible in the background; AR is superimposed onto reality, as noted by Nicola Liberati (Thompson, 2025, 78).

The images in this work are based on reproductions from the Regional Museum of the Eastern Coast (MURECO), rather than the originals in the Chiik Naab plaza at Calakmul, which are not physically accessible. The animation can be viewed via an application accessed by scanning a QR code. Once the application is installed, visitors can point their mobile devices at the mural images. The devices can then display audio, text, and interactive content related to the objects—such as information about food, clothing, and the figures depicted—offering an accessible, personalized educational experience. In this way, the project promotes the region's culture by reinterpreting murals that focus on the bustling local market of that era (Valencia R.R., 2023).

The murals depict daily life, commerce, and the diet of the ancient Maya. The scenes show the consumption of items such as *tamales*, *atole*, salt, and tobacco, while also revealing the coexistence of different social strata, as evidenced by the clothing worn by the individuals (García-Barrios et al., 2018).

4. Conclusion

The dissemination of Mayan heritage through digital media marks an essential step in the evolution towards reaching wider audiences without succumbing to the trivialisation of mass culture. Archaeology, frescoes and literature thus become living, interactive and even immersive experiences for new generations. By integrating multimedia technologies, it is possible to democratise knowledge of an ancient, sophisticated and transcendent culture, supporting the development of humanity itself and overcoming geographical and generational barriers. The digitisation of these universal treasures is not merely an archival exercise but a strategy of resistance and cultural dissemination, fusing the mysticism of the past with the interactivity of the present and, through digital resources, guaranteeing that the Mayan legacy continues to inspire amazement, knowledge and identity today and always.

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