Digital artist, model and Double Other, from creation to empowerment of a virtual clone

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Introduction

In the ever-evolving landscape of digital art, the *Kellynoïde project* stands out as an exploration through the creation of a digital double of an existing person and the empowerment within the framework of digital artistic creation. Beyond the "artistic pretension," it is about studying the bond that unites the artist, her model, and her virtual and autonomous digital double. In this article, we will focus on the contributions of different degrees of artificial intelligence to animate an empathetic digital avatar borrowing the appearance, voice, and gestures of the model. Through the prism of the *PGAM model*, our analysis reveals how AI enriches the artistic experience, creating a bridge between the work and the viewer, awakening a real, new, and profound empathy.

1 Technical and Theoretical Framework

1.1 The Kellynoïde Project

The *Kellynoïde project*[1], led by digital artist Cédric Plessiet and model artist Kelly Mézino, aims to create an autonomous digital avatar, the *Kellynoïde*, a double built around the image of Ms. Mézino. This entity serves as a platform for technical research, artistic performances, conferences, and digital artworks. Since 2016, Cédric Plessiet and Kelly Mézino have worked together to bring this virtual double to life. The *Kellynoïde* is designed to interact with the public and virtual environments in an expressive and reactive manner. To this end, Plessiet has established a creation pipeline named *Taupipeline*[2, p.46-50] in a perpetual dialogue between the digital artist and the model artist[3]. The project is distinguished by its interdisciplinary approach, combining Plessiet's skills in programming and digital creation with Mézino's experience in the performing arts. Together, they explore the possibilities offered by motion capture, real-time engines, and virtual reality. Thus, the *Kellynoïde* is a *double-other*. The concept of the *double-other*, which we began to theorize in [4], differs from that of a traditional avatar. While an avatar generally serves as a "vehicle" for a user in a virtual world, the *double-other* is a digital entity built from a real person. This

digital replica is designed to go beyond mere representation ; it is programmed to acquire a form of autonomy. In other words, the *double-other* is endowed with capabilities that allow it to act and react independently in the virtual space, thereby enriching the immersive and interactive experience. This process of empowerment transforms the *double-other* into a "virtual actor" capable of its own initiatives, offering a new dimension to the exploration of identity and presence.

1.2 Collaborative Construction of the *Matrix Sculpture*

The *Kellynoïde*, reconstructed around a "body", a *matrix sculpture*[5, p.83-116], in the likeness of the model, is a decision-making system offering a digital analogy to traditional sculpture. Unlike a real sculpture fixed in a single pose, the *matrix sculpture* is designed to express a multitude of poses, embodying the "possibility of movement". The *matrix sculpture*, at the heart of the *Kellynoïde project*, is the result of a complex creation pipeline that begins with the meticulous fusion of artist Kelly Mézino's scanned face with a base body carefully modeled from a basic mesh. This initial step is crucial as it establishes the foundations of the digital entity. Subsequently, a creative dialogue is establi-

FIGURE 1 – Model/Artist Dialogue Sheet

shed between the artist and the model through annotated sheets that the model comments on (figure 1), allowing for collaborative "resculpting" that refines and personalizes the avatar. This process is punctuated by a series of automated steps, ensuring coherence and fluidity in the transformation of the basic sculpture into an expressive and autonomous *double-other*. Thus, the *matrix sculpture* becomes a unique digital incarnation, ready to be animated and interact in its virtual environment. It even becomes a figure of experimentation for the model, who does not hesitate to try out new possibilities on this virtual double (haircut, outfit...).

1.3 Le modèle PGAM

Nous utiliserons le modéle *PGAM*[6] comme grille de lecture pour analyser les degrés d'interactivité de la *Kellynoïde*. Cette classification offre un cadre pour comprendre les différentes formes d'entités virtuelles et leurs potentiels dans

l'art numérique, en mettant l'accent sur l'interaction, l'autonomie et la capacité de mouvement[7, p.98-99,161-162]. Elle repose sur deux critères : l'origine du mouvement et la décision qui le guide(figure 2). Quatre types d'entités virtuelles

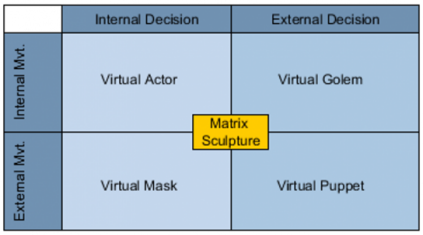


FIGURE 2 – le modèle PGAM[6]

émergent de cette classification :

- La *marionnette virtuelle* est une entité qui requiert un manipulateur pour son mouvement et ses décisions. Sans marionnettiste, elle reste inerte, soulignant la relation symbiotique entre la marionnette et son manipulateur.
- Le *golem virtuel*, quant à lui, peut initier son propre mouvement mais pas ses décisions. Capable d'exécuter des ordres précis, il peut néanmoins présenter des comportements émergents comme dans pour le jeu de la vie.
- L'*acteur virtuel* représente un niveau supérieur d'autonomie, capable de prendre des décisions et d'initier des mouvements basés sur ses observations et interactions avec son environnement. Cette entité nécessite des mécanismes d'apprentissage, tels que les réseaux de neurones ou les algorithmes génétiques, pour développer son autonomie.
- Enfin, le *masque virtuel* est une entité dont les décisions sont internes mais qui manque de capacité de mouvement propre. Il n'est pas nécessairement issu d'une *sculpture-matrice*.

2 Contextualizing the *Kellynoïde* as a Virtual Puppet

2.1 Virtual Puppet and Live Performance

Work on the *Kellynoïde* began in 2016, initially as part of Mr. Gagneré's courses in the theatre department at the University of Paris 8 (France), and later as part of the creation of the *Avatar Staging* platform[8] which was subsequently used in a number of projects combining live performance and digital art. A real actor equipped with a motion capture suit (referred to as a *mocaptor*) took control of a virtual character modeled after Kelly Mézino (figure 3). Thus, the virtual entity does not originate its own movement since it is controlled by an external manipulator (the *mocaptor*). This leads to deliberate manipulation in a mimetic transfer of movement, with the virtual puppet replicating the movements of the manipulator.

FIGURE 3 – The virtual puppet of Kelly Mezino on the right controlled by a *mocaptor*[6](2016)

2.2 Interactive Portraits

As an illustration of the concept of virtual puppet and *double-other*, Cédric Plessiet has undertaken work around his series of interactive portraits. Digital tools transform the art of portraiture by not only capturing form, pose, and light but also by integrating interaction with the artwork into the heart of the artistic process. The resulting creations are based on a *double-other*, an interactive representation of the model, activated by simple devices such as an Arduino setup or a microphone. The focus is not on technical complexity but on how technology re-questions artistic expression, making the portrait a living and reactive work[2, P.30-46].

As a concrete example, let's mention the portrait *Ça bug dans les rotations* (figure 4a), inspired by a collaboration with Georges Gagneré. This interactive portrait uses a potentiometer to adjust the rotation angle of the neck of a *virtual puppet*, reflecting a real bug encountered during the development of a motion retargeting system. The reaction of the "virtual Georges" to the angle adjustment creates a playful and engaging experience, illustrating the importance of interaction in the narration and personalization of digital art. This work highlights the complicity between the artist and his model and foreshadows a future collaboration to enrich the interactions of Gagneré's *double-other*.

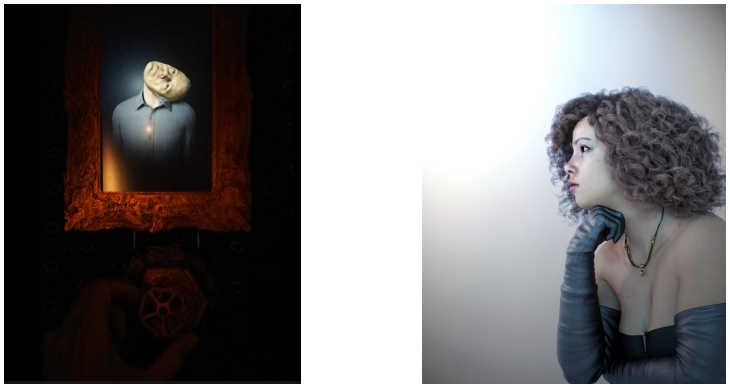
We define three main categories of manipulation :

- *Voluntary manipulation* refers to manipulation by a person fully aware of their role as an animator and the consequences of their actions on a *virtual puppet*. As an informed user, the manipulator uses the puppet as a tool, anticipating responses to their actions.
- Conversely, an *involuntary manipulator* is not aware of their influence on the puppet and therefore cannot predict the puppet's reactions. To maintain this ignorance, the capture devices must be discreet but can give the illusion of an autonomous entity. However, if the spectator discovers the mechanism, the illusion of autonomy dissipates.
- Sometimes, even an informed manipulator can find themselves in a gray area between control and surprise, gradually learning to navigate between the two states through their interactions with the puppet, thus creating

a *tamed manipulation.*

2.3 Chut !

Thus, the work *Chut !*(2017) [1] reflects how Cédric Plessiet perceived Kelly Mézino at the time. Through this creation, another dimension of her personality is revealed : her depth, symbolized by a silent gesture requesting silence. When the ambient noise reaches a certain level, detected by a standard microphone, the portrait of Kelly Mézino reacts by placing a finger on her lips and emitting a sound "Shush," inviting the viewer to share a moment of tranquility. In this case, we are indeed in the presence of an *involuntary manipulation* by the audience, unaware of their influence on the work, until the call for silence.



(a) *Ça bug dans les rotations*(2016) (b) *Chut !*(2018)

FIGURE 4 – Two Interactive Portraits

This simple yet powerful interaction offers a direct and intuitive experience of digital art, where technology serves as a bridge between the artist, their model, and the audience. The mechanism behind *Chut !* is deliberately elementary, using accessible technology to create a moment of personal and sensitive connection.

3 Contextualizing the *Kellynoïde* as a Virtual Golem

3.1 *Lucky 2.0* : The First Work Based on a Virtual Golem

The work *Lucky 2.0*, created by Cédric Plessiet in 2012, is his first piece based on a *virtual golem.* The installation is an immersive experience inspired by Samuel Beckett's play *Waiting for Godot* (1948), where the user assumes the role of Pozzo, controlling his slave Lucky through voice commands and a virtual rope (figure 5). This interaction symbolizes the author's relationship with technology, where Lucky is a *virtual golem*, programmed to carry out specific actions without initiative. Capable of understanding about twenty instructions in English and

1. formerly named *Reverie*

French, Lucky is an entity that mindlessly obeys orders such as *"move"* or *"interact with objects"*, illustrating the computer's ability to respond to human commands.

FIGURE 5 – Virtual reality view of the golem Lucky

The system of the installation is based on a haptic device, a microphone to capture the user's voice, a VR headset, and initially a Kinect (figure 6), later replaced by a Leap Motion. The setup is built around tools developed as part of a previous project called *outilnum*[9].

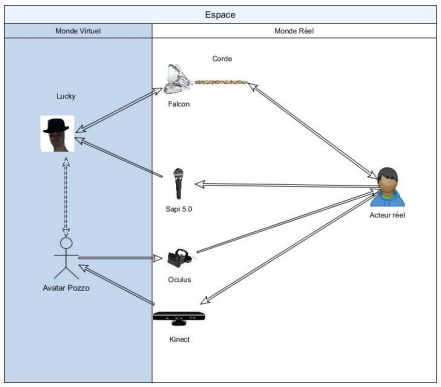


FIGURE 6 – Architecture of the golem Lucky

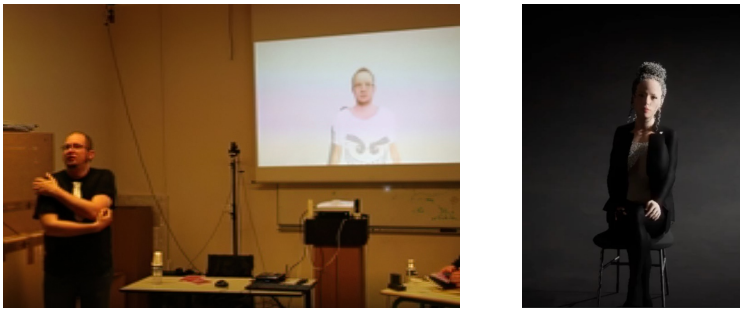
3.2 *Cou2Jarnac*(2016), First Conference-Performance

This modular development enabled the setup of the first conference-performance named *Cou2Jarnac*(2016). In this interactive experience, a *virtual puppet* resembling Cédric Plessiet, as part of the *Labex Art H2H Augmented Stage*(2015-2017), controlled by a Kinect2 and a state machine, reacted to the unconscious gestures of the presenter, such as scratching his head or placing his hands on his hips. During a conference, this digital double unexpectedly interrupted the speaker to start a conversation (figure 7a), creating an uncertain and playful dynamic where gestural control was not always predictable. This interaction revealed the complexity of scripting required for such performances and prompted reflection on the relationship between the manipulator and the *virtual puppet*,

inviting exploration of the idea of role reversal where the *virtual puppet*, although devoid of any decision-making mechanism, could influence the manipulator[5, P.186-187]. It was also the basis for reflections on what we called a *Man In The Middle Interaction(MITMI)*[10].

3.3 Kelly the Speaker

During a conference held in Belgrade in 2018 for the International Federation for Theatre Research (IFTR) congress, we improved the setup by using the *matrix sculpture* built around the image of Kelly Mézino to create a *virtual golem* equipped with the gesture recognition mechanisms present in *Cou2Jarnac*, to which voice recognition mechanisms and narrative tools were added to follow the evolution of the conference...



(a) Cédric Plessiet interacting with his virtual double in Cou2Jarnac(2016)

(b) *Kelly the Speaker* for the safra'numériques conference

FIGURE 7 – conference-performance with virtual entities

Having successfully utilized the initial version, we began transforming the *Kellynoïde* into a conference platform named *Kelly the Speaker*. We enhanced its response capability by adding vocabulary and gestures that could be recognized by the virtual entity, as well as phrases and movements it could perform. To achieve this, we organized sessions for recording gestures and texts, as well as scriptwriting sessions to create more complex and dynamic conferences. As a result, we were able to animate the colloquium "Values of the Imprint" in 2023 with the participation of a *Kellynoïde*, presenting the conference "from the imprint of the real body to the virtual 'double-other'" and during the safra'numériques of 2024 as part of a round table discussion.We are currently contemplating equipping *Kelly the Speaker* with enhanced response capabilities by utilizing the LLM LLAMA2 engine.

4 Contextualizing the *Kellynoïde* as a Virtual Actor

4.1 *Line*(2023)

The work *Line*(2023) marks a development in the *Kellynoïde project*. *Line* is a virtual reality installation designed by Kelly Mézino and Cédric Plessiet, mar-

king their first artistic collaboration[2]. This immersive experience plunges the viewer into darkness where they can interact with the *Kellynoïde*, an enigmatic digital double, through beams of light (figure 8a). The *Kellynoïde* engages the viewer (figure 8a) in a game of discovery and revelation, establishing an intimate connection through the control of light beams. This interaction raises questions about perception and the reciprocity of the gaze, while evoking deep emotions and exploring the dynamics between the artist and their model.

(a) VR viewpoint of a spectator (b) A spectator immersed

FIGURE 8 – *Line*(2022)

The development of *Line* was a meticulous process that contributed to the creation of innovative tools for digitizing bodily and sensory elements. The installation represents a significant step in the quest for creating digital virtual doubles. Presented at the Laval Virtual festival in 2023, *Line* embodies a reflection on our relationship with the body, beauty, and otherness, and the intimate bond between the model and the artist. The spectator communicates with the *Kellynoïde* through voice and lines of light projected by their hands... This leads to a mutual taming where the *Kellynoïde* learns how the spectator looks at her, and at the same time, the spectator learns to look at the *Kellynoïde*. The work is intended as a metaphor for the intimate work that Cédric Plessiet and Kelly Mézino had to undertake.

4.2 Description of the Kellynoïde's Decision-Making Process

The *Kellynoïde* from *Line* is a virtual actress as previously described. She is equipped with learning systems that will evolve her behavior through interactions with the audience. Indeed, it was important for us that a connection could be established between the virtual entity and the spectator. The work *la funambule* (2000)[11] by Michel Bret and Marie Hélène Tramus, featuring a virtual tightrope walker controlled by an artificial neural network, and Alain Berthoz's analysis[12] of the empathy mechanisms employed during interaction

2. In previous projects, Kelly Mézino had an artistic role downstream of the work's realization, whereas in *Line* all artistic and technical choices are the result of their collective decision

with an audience, confirmed that this could be a good approach to create such a connection.

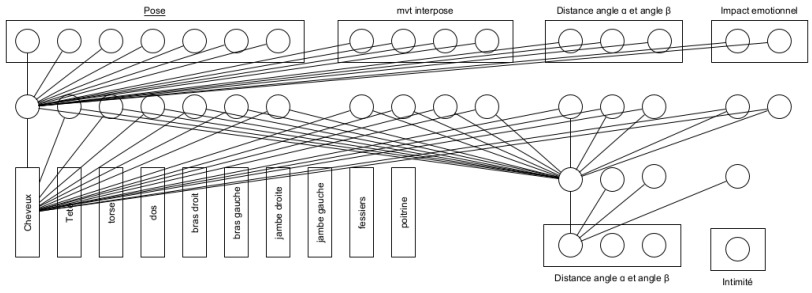


FIGURE 9 – The artificial neural network of the *Kellynoïde* from *Line*

Thus, we developed a multilayer perceptron[13, p.23-29] as shown in figure 9. This network can be decomposed into four areas : first, groups of neurons called *Pack* (figure 10) that capture information about the parts of the body being observed (there are ten different zones) ; then, groups of neurons responsible for transcribing the emotional state of the *Kellynoïde* ; followed by hidden neurons and output neurons that indicate the gesture the *Kellynoïde* must perform ; and finally, the position she must take and whether or not she liked the interaction with the spectator. While the basic learning was done through intensive interaction sessions between the digital artist and the *Kellynoïde*, it continued throughout her presentation to the public during the recto-verso festival 2023 and 2024 [3].

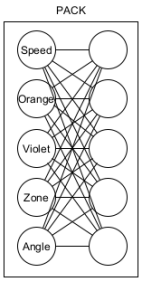


FIGURE 10 – The pack capturing the speed of light, the color of light, the body area observed, and the angle of the light beam

4.3 Reflections on Audience Reception

Feedback from spectators during presentations has confirmed several things... As interactions with the public progressed, the Kellynoïde "gained confidence" in its interactions with the audience. Initially, it kept a distance from people other than the digital artist with whom it had trained. Its behavior evolved, for

3. in the 2024 version we added the voice recognition module developed for *Kelly the Speaker*

example, when faced with major cultural differences [4] led to significant defiance in its behavior. Yet, as interactions with the public continued, the *Kellynoïde* adopted a more sensitive behavior, increasingly entering the personal proxemic space of the spectator, and eventually settling there when the interactor managed to establish a strong bond. This learning mechanism confirms the creation of an empathic link between the virtual entity and the spectator[14, p.142-143]. Moreover, according to experience feedback, it has been confirmed that recreating a *Kellynoïde* with the appearance of a realistic and plausible person strengthens this empathic link, echoing Joseph Weizenbaum's approach in creating his famous chatbot Eliza, inspired by Eliza Doolittle[15].

4.4 *The Jail* and STRIPS

The Jail is an innovative project that explores the creation of a *virtual actor*, an entity endowed with its own decision-making and motor processes, capable of learning and evolving. Despite the potential for unforeseen behaviors, this initiative aims to maintain a "Plausibility Bubble" within the entity's autonomy. The installation represents a virtual reality self-portrait, where the artist's *double-other* is confined in a square room filled with decorative elements. This Double Other, faced with contradictory impulses, can manipulate its environment to access various objects, thus illustrating the challenges and possibilities of autonomy in a closed virtual space (figure 11).

FIGURE 11 – *The Jail*

To maintain a balance between autonomy and control in his creations, Cédric Plessiet uses two complementary algorithms : a customized version of STRIPS to build a knowledge base and plan action sequences, and a multilayer perceptron (figure 12), a type of neural network, to learn from the results of STRIPS[16]. This combination ensures both the autonomy of the virtual entity and the coherence of the "Plausibility Bubble". Although the artificial intelligence and graphic elements are in place, there is still a need to develop the software and hardware mechanisms to enable interaction with the spectator.

4. one of the interactors of Asian origin addressing respectful bows to the *Kellynoïde*

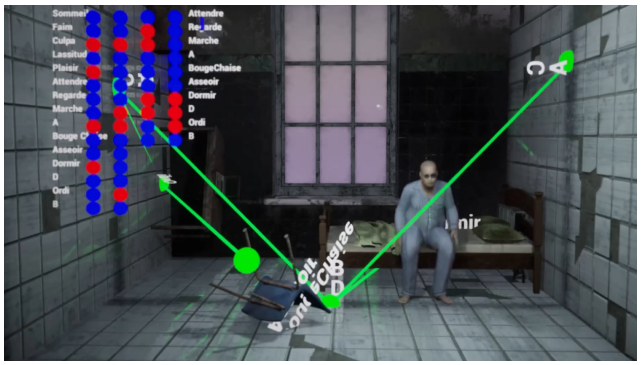


FIGURE 12 – The neural network on the left and the connections made via the STRIPS algorithm in green[17]

Kellynoïde We are currently considering how to adapt these techniques to the Kellynoïde in the context of future works in preparation. This would increase the potential for interactions of the *Kellynoïde* depending on its situation, to make it an "actress adaptable to the role we want to give her" and thus explore the possibilities offered by this model in digital arts.

Conclusion

From these experiences with the *Kellynoïde* and the *PGAM* model, we sketch out a tremendous field of artistic exploration around the *Kellynoïde* entity, which is a creative playground. The bond that unites the model artist, the digital artist, and this "double-other" deserves as much in-depth study as the technical and artistic issues. While the limited interactions of the *Kellynoïde* virtual puppet in *Chut !* allow only limited interactions, the golem of *Kelly the Speaker* has become a partner in conferences, and the virtual actress of *Line*, capable of learning, has become a vector of empathy between the interactor and the virtual entity. The future technical experiments by Cédric Plessiet aimed at improving the learning capabilities of the *Kellynoïde* will make it a true partner in a new artistic creative triangle.

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