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MovieScape: Audiovisual Landscapes for Silent Movie

Enactive Experience in a Multimodal Installation

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ABSTRACT

The multimodal installation MovieScape articulates sound, image, and movement with the poetics of silent film. It is an immersive mixed-reality environment in which the boundaries between the real and the virtual are imprecise and ambiguous. In MovieScape, audiovisuals generated in real time induce the emergence of recurring motor patterns performed by the visitor. An audiovisual-scape is selected with an imaginary steering wheel that is activated when the visitor closes both fists. After this initial gesture, a sphere covered with images of the silent movie is modified with rotations and displacements that alter the sequence of scenes, music track and the sound landscape. The interaction between perception, action and movement articulates with the concept of Embodied Cognition, bringing about an enactive experience in which the participant immerses in the possibilities of the silent movie. The basic setup of the installation is presented, as well as technical aspects concerning the network communication, motion capture, sonification and visualization. A participative methodology, which is (itself) a factor of knowledge construction and artistic expression, supports the creative process of MovieScape.

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CCS CONCEPTS

•Information systems/Multimedia information systems • Human-centered computing • Applied computing/Arts and humanities

KEYWORDS

Interactive Systems for Artistic Applications; Multimodal Installation; Silent Movies; Enactive Experience.

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1 Introduction

The interaction between several digital representations that permeate our collective imaginary, and its possible embodiment, led us to the poetic proposal of MovieScape. Our starting point was to articulate the three modalities of sound, visual and movement in their respective fields of perception, to invite the visitor to an enactive experience within a multimodal installation. MovieScape integrates these three modalities to create an overlap of patterns from the individual's actions. We thus infer that the meaning built through MovieScape emerges from the exploration of the dispositional states of the installation by the person. The contexts articulated in MovieScape are the interaction between action and movement, as well as cognition.

In this sense, we approach the works by Caruana & Borghi [11], Varela et al. [39], as well as the silent films, in texts by Abel &

Altman [2], Altman [3], Marks [29], Gorbman [18], Anderson & Bowser [4], Barton & Trezise [6], Gunning [19][20]. We also approach the interactive art works by Weibel & Shaw [40][36][37] as a poetical reference to the installation.

The interactions between musical themes for scenes and the sound landscape generated in real time, each selected by the visitor, comprise the immersive scenario of MovieScape.

The second aspect to be highlighted is that MovieScape was created from the perspective of a participatory methodology. Through this, we envision the interaction of ideas and processes in the attainment of an artistic representation. In other words, the method is (itself) a factor of knowledge construction and artistic expression. Previous experiences and studies [21][24][27][28][32] guided us in designing the installation.

2 Conceptual Fields

The first interactive environments [14][23][36] emerged in the 1980s. A denominator of such media art is the intention to engage the body of the viewers, to affirm their bodily presence in the mediated space, and conjoin them in an exteroceptive, proprioceptive and kinesthetic relationship with the artwork. Because the technological imaginary is a domain of digital immateriality, embodiment is necessary as a cultural prosthesis in which we can critically register and enact our presence. The core challenge is to articulate and give meaning to these new modalities of *being* in this world [37].

2.1 Cognition, Embodiment, and Enaction

Although the Embodied Cognition paradigm embraces several models and theories, the central concept is that most cognitive processes take place through the body's control systems, especially through the interaction between higher cognitive functions and the sensorimotor system [11]. Enactivism, in turn, attributes a crucial role to perception as a particular type of exploratory activity mediated further by the knowledge of sensorimotor contingencies [30]. According to the enactive approach of Varela, Thompson & Rosch [39], an autonomous system (agent) has continuous interactions with its environment so that this process influences the configuration of the sensorimotor system [13]. Thereby, within the aforementioned paradigm of Embodied Cognition (that includes Enaction theory), adaptations occur both from the agent and from the environment.

Considering these concepts, we propose that MovieScape bring the subject to an adaptive process using their body movement. This adaptation is the result of the exploration of possible combinations of material available in the installation: musical motifs, soundscapes, and silent film scenes. The embodiment of these relationships triggers new patterns of action or performance from the visitor. That is, there are disposition states awaiting activation.

By *embodiment*, we refer to the multimodal, experiential, motor and pragmatic component of Embodied Cognition [5]. This embodiment in our installation allows for a continuous behavioral adaptation acting on the codetermination between agent and environment. This moves beyond the typical interaction that occurs during a performance with a DMI[1]. The visitor's movement, through cognition, is the coordinator of the process and its codetermination.

Furthermore, instead of focusing on the concept of metaphor, we focus on the notion of affordance (especially virtual affordance) in order to interpret the interaction between agent and environment.

2.1.1. Creative Empowerment. In the enactive perspective, the interactivity in particular situations is not arbitrary [39]. It depends on the classification of concrete objects with respect to the properties pertaining to information, biology, culture, cognitive knowledge, etc. [39]. It is therefore in this context of classification that the objects deriving from perception-driven exploration offer *affordances*, as stated by Gibson [17], of basic and virtual levels through the concept of *Multiple Trajectories* [32].

In the MovieScape installation, the notion of the movement of a steering wheel offers an *affordance* to the visitor that practices it. This in turn depends on the motor skills and *know-how* acquired by the experience, while new *virtual affordances* will be established through the concepts of *Multiple Trajectories* and *Sensorimotor Maps* [33]. The process will allow the visitor's experience to reflect *Creative Empowerment*, in which the visitor reaches a state of creative fluidity and interactive dialogue [32][33]. Moreover, this is a consequence of the embodiment of multimodal interaction and of the codetermination process between agent and environment.

In other words, the interaction between the visitor and the dispositional states of the installation is characterized as an "enactive continuum", a cycle of codetermination, as previously explained by the authors Partesotti et al. [32]: *"This is why the type of gestures involved, and the gestural acquisition per se, are paramount for the kind of feedback (i.e., the sound parameter) that technology provides for users."* [32] p.400. Consequently, these parameters are crucial for the multimodal enactive interaction, applied to visual and sound manipulation of silent film scenes.

2.2 Silent Film

In its origins, around 1895, cinema was something between technological novelty and magic. Shown in cafés, amusement parks, fairs, cinema was just small moving picture scenes, lasting few seconds, that could share the stage with dance, illusionism, animal or song acts in the form of a variety theater or vaudeville. Initially, it had a *discontinuous aesthetics* [19], i.e. a cinema cinema made to astonish with a series of unreal situations, without a necessity to construct a continuity narrative. It was, according to Tom Cunning, the *Cinema of Attractions* [20].

It is no coincidence that during this period we saw the Hale's Tour, a 1906 installation using film and real-world effects to create a virtual experience by the individual. It consisted of a theater car with passengers/spectators. "The moving pictures that showed out the front end of the car offered a filmed point of view from the front or rear of a moving train. The goal was to create the sensory illusion of movement into or away from a scene, accentuated by mechanical apparatuses and levers that simultaneously vibrated, rocked, and

[1]DMI is a Digital Musical Instrument that can either take the shape of traditional instruments, or something entirely different [32]

tilted the car" [1] p. 421.

Around 1910, the films began to gain autonomy and to have longer duration, finally incorporating their narrative aspect. Music, while initially not the only form of accompaniment for movies, eventually established itself as the standard [2] [4][29]. This choice was primarily determined by the ability of music to create a psychological immersion, or a *Bath of Affection* as Gorbman called it [18]. Soon, specific manuals and scores were created to standardize music to the movies, but the main aspect of the accompaniment of the films was the adaptation – in relation to the film, the public reaction, the score and often the improvisation.

This double strand (the cinema of attractions and adaptive music) served as the poetic inspiration for MovieScape, an environment reminiscent of Hale's Tour that became interactive – now directed by the visitor who chooses their own path editing fragmentary or narrative scenes in a musical immersion.

3 MovieScape: Multimodal Installation

The MovieScape installation aspires to: 1. create a unified experience where data and **users** are merged in space in true mixed reality experience; 2. evolve the narrative progression in time; 3. explore and exploit both implicit and explicit cues from **users** in their individual and collective interaction with the system; 4. use novel multimodal sensing and effector systems to boost interactivity 5. understand the dataflow generated during human-machine interplay [27]. With the intention to describe potentialized aspects through the creation of multimodal installations, we discuss next how MovieScape is inserted into this context.

3.1 Multimodality

Multimodal installations are described as immersive and interactive infrastructures in which it is possible to generate, interact, analyze, and store multimodal information (audio, video, images, human movement, and bio-signals) by Moroni & Manzolli [28] and Manzolli [27].

Multimodality refers to the integration of analytical results from different media streams, while intermodality refers to the application of the same algorithm to different modalities [10]. Multimodal processing handles multiple data streams, which are often associated with different sources. Several approaches to synchronizing different flows involving different synchronisms have been developed in the literature, including the case where the clocks differ from each other even at the conceptual level [8][9].

3.2 Lab infrastructure

The ImCognita Lab used to develop MovieScape is a multi-user mixed reality environment covering 7m x 7m, equipped with a set of sensors such as a system for capturing human motion (the KinectV2) and effectors such as sound monitors and video projectors to generate visual and sound stimuli. A microphone and video camera can also be used as an audiovisual sensor and for recording and collecting data. In short, the ImCognita Lab provides physical space and audiovisual resources to experiment with sonification and visualization, and interact with generative processes via computer support, such as soundscapes, interactive video, animation and 3D graphics.

3.3 Interaction

Recent literature presents specific and elaborate concepts for the term interaction, such as dialogue, transmission, optimal behavior, incorporation and the use of tools [22]. Further, these concepts are associated with different contexts and ways of constructing causal human-machine relationships – emphasizing the need to improve scope and specificity to better clarify the agency and the effects that computers have on the interaction.

In MovieScape, interaction happens through an abstraction of an imaginary steering wheel, which activates when the visitor closes both fists. After this initial gesture, it is possible to modify the visuals and soundscape using intuitive gestures such as rotations and hand displacements to alter the narrative progression in time. Figure 1 shows the basic setup of MovieScape with the projection screen, projector, motion sensor, sound monitors, and the visitor manipulating a virtual steering wheel. See the coordinates (X, Y, Z) for movement in space: the value (0,0,0) is in the center of the installation.

4 Methodology

MovieScape was created through a collaborative process supported by a computer network and motion capture technology. We emphasize that "*the tendency towards a collaborative/participatory practice is undeniably one of the main characteristics of contemporary art*" [24] p. 67. Network architecture enables circular causality, which is generated with kinetic quality data, derived from (visitor) movements tracked with Kinect V2 or Leap Motion interfaces [24], p. 70.

MovieScape was designed primarily to afford synergy of ideas and processes. The images present in the installation were elaborated from the perspective of flow and emergency concepts (see section 2.1). When a flow disruption happens in the narrative, represented by the real-time montage of silent cinema scenes and the sonification, it might induce the possibility of self-organization [25]. From the visual (silent film scenes) and the sound (musical themes and the granular soundscape) new correlations are generated between their dependence and independence parameters. Thus, interactions could be related to the intrinsic and extrinsic behavior of the visitor, their movement dynamics or associations. When an exposed material is transformed by the individual, the actions (that change it) also influence the material itself and the way it changes.

For example, the visitor's movement acceleration may carry information about his/her intention to select a particular visual or sound of MovieScape. Therefore, there is a hypothesis that the use of movements can be implicitly explored in cognitive fields. This idea is important because, according to Clarke, one can create a fictional environment from simulations of invariant properties [12] p. 89. In an artistic context, interaction with the system invariants creates dialogues with the subject's perceptive apparatus, which in our case is the installation.

MovieScape emulates invariant properties such as the geometric perspective, and the phenomenon that the sphere grows as the visitor approaches it. Correspondingly, the sound intensity increases with this approximation. The audiovisual transformations generated by the installation using the visitor's position in the room and his/her movements might create a credible fictional environment. Thus, our approach is to seek for an

integration of the Sensorimotor Maps and proprioception of the visitor in order to provide an enactive character to the installation.

In the next sections, we will discuss how the dispositional states of MovieScape set up a pattern generation and recursion process during the tests. We first describe the communication between devices, followed by motion capture, the visualization process, and finally sonification.

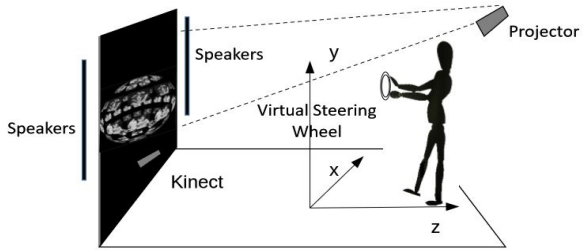


Figure 1: The MovieScape Installation.

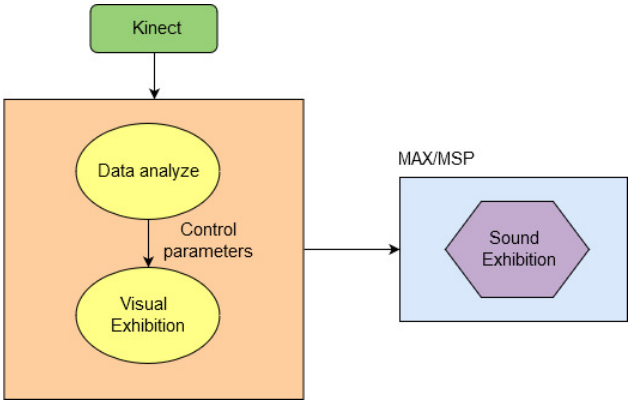


Figure 2: System communication.

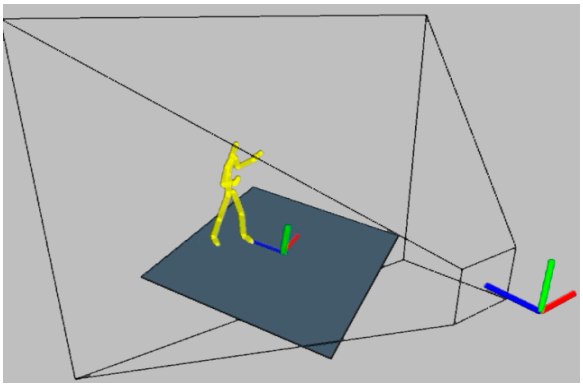


Figure 3 Kinect V2 environment.

4.1 Network Communication

The sphere with the frames/icons.

Figure 4: The sphere with the frames/icons.

The computer network developed to create MovieScape consists of data exchange between the following elements: 1) a motion capture sensor (Kinect), 2) a MAX/MSP developed patch for sonification, and 3) a sketch in the Processing programming language to provide computer graphic visualization. The communication method chosen was the Open Sound Control (OSC)[2] messages through the UDP transmission protocol. The motion sensor sends the visitor's body coordinates to Processing, which in turn performs preprocessing and sends the wireless control parameters to the audiovisual playback units, as shown in Figure 2.

Movement	Control
Left-Right (Relative X Position)	Grain Delay
	Grain Rarefaction
Near-Distance from screen (Relative Z Position)	Drone Volume
	Granulation Volume
	Grain Size
	Sphere Zoom
Steering Wheel Height (Y position)	Rotation of Sphere around the X axis
Yaw of Steering Wheel (Rotation around Y axis)	Rotation of Sphere around the Y axis

Table 1: Mapping of motion and control parameters.

[2]Open Sound Control is a protocol for communication between computers, sound synthesizers, and other multimedia devices optimized for modern networking technology.

4.2 Motion Capture

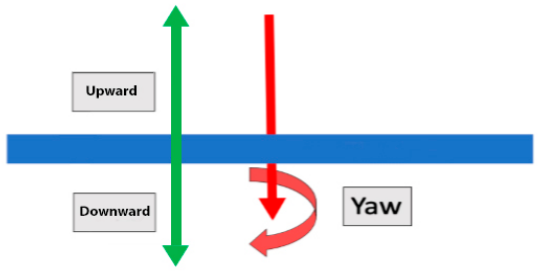


Figure 5: We chose the Yaw axis to rotate the Y axis of the sphere.

Motion capture was performed with the Microsoft Kinect V2 sensor, which identifies the positions of the **visitor's** skeleton joints [16]. The library developed by the group preprocesses the motion data, filtering out noise and calibrating the position of the sensor in relation to the installation room. After this phase, it is possible to extract motion characteristics, such as positions, velocity, accelerations, and orientations of the 25 body joints. **Erro! A origem da referência não foi encontrada.** shows the Kinect V2 data processing environment. The coordinate system indicates the directions of the X (red), Y (green) and Z (blue) axes. After calibration of the motion sensor (Kinect V2), the coordinates (X, Y, Z) are normalized in the range [0..1].To provide human interaction with MovieScape, an abstraction of an imaginary steering wheel was implemented using a program developed in the Processing environment. The movement identification is activated when the visitor closes both fists. After this initial sign, the individual is able to control an orbit around a sphere using rotation and translation movements: the distance of the silent film scene sphere is associated with the height of the virtual steering wheel, while rotation around the sphere is controlled by Yaw[3] steering wheel. Table 1 presents the relationship between movement, the sphere, and sound control parameters.

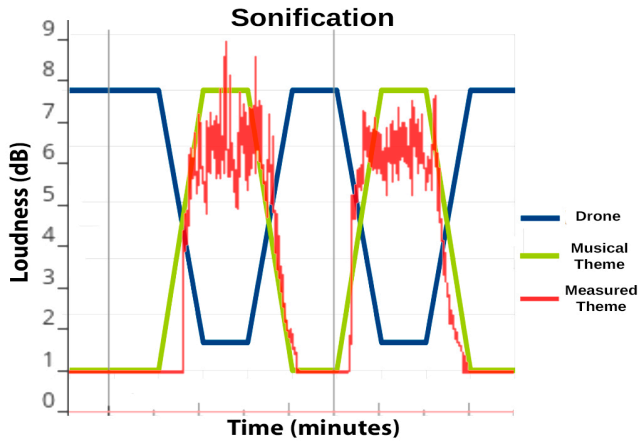


Figure 6: Mixing curve.

4.3 Visualization

The MovieScape visuals, developed in the Processing environment, consist of a moving sphere, based on Ponce [38], in which the visitor moves as if in an orbit in space, reinforcing the sensation of immersion. The surface of the sphere is covered by frames extracted from a given silent movie. The frames of the movie are organized randomly, creating unique environments at each startup of the installation.

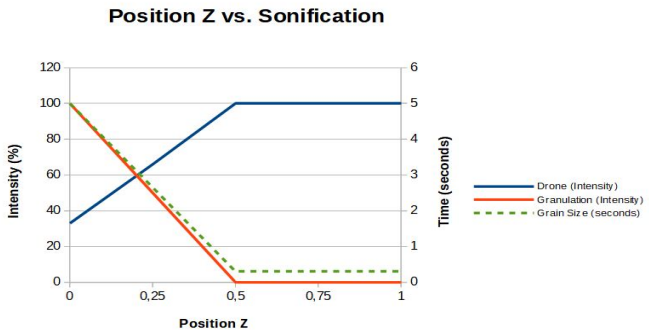
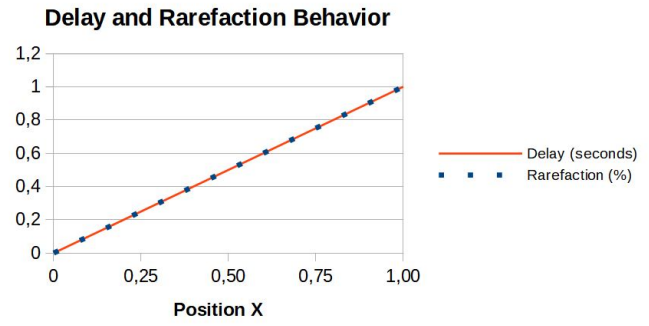


Figure 7: Relation between drone, granular synthesis and grain size.

After initialization and calibration of system coordinates, the people can walk around the room and explore the soundscape. At any moment the visitor closes her fists to control the imaginary steering wheel, starting to spin the sphere. This is where her discovers that the frames are scene icons in the same movie. By placing a frame in the center of the screen at the nearest point, playback of the scene begins, along with the corresponding music theme, creating the silent movie scene. If the visitor moves away from the screen the process is paused, and at any moment the visitor can open the fists to cease control over the sphere, stabilizing it in the desired position. The visitor may also change the scene, deciding whether to do a live film montage or any kind of exploration of the environment.

The Yaw-axis of the visitor's movement is associated with the rotation of the Y-axis of the sphere (see Figure 5). This way, the individual's movement in the physical space of the installation is projected onto the sphere. An algorithm represents the visitor's movements controlling the sphere that results in a rotating kaleidoscope of scenes.

Figure 8: Delay



Movement mechanics concepts represent the visitor's actions. The basic principle is to control the speed of the rotation and the

[3]Yaw is a motion control axis, associated in the literature with aircraft control. It is project from top to bottom, perpendicular to the other two axes (pitch and roll), and parallel to the aircraft fuselage.

yaw of the visitor's imaginary steering wheel, the rotation of the sphere and, thus, allow the visitor to choose a scene. MovieScape can be contextualized as a mixed reality installation as in Papachristodoulou et. al. [31], since it integrates movement, visualization, and sonification, allowing for interaction between the virtual and physical world.

4.4 Sonification

The sonic environment created to MovieScape has three layers. The first is that of musical themes, drawn from photoplay or mood music from silent films[4] [7][35][41][43]; chosen according to the taxonomy of the collections, the themes were adapted and recorded in small tapes played in a loop. The second layer, called drone, was created with granular synthesis techniques, such as a continuous ambient sound of a movie theater. Finally, the third layer, called noise, consists of the discontinuous sounds of the movie theater, such as the noise of the projector, door and chair creaks, audience comments and laughter. The sonic environment is immersive and has the potential to use up to eight speakers around the visitor. For this, we use the HOA library of MAX/MSP software[5], which enables ambisonic spatialization aligned with the granular synthesis.

In our sound design, the visitor's proximity to the projection screen is used as the main factor of sound interaction. The closer to the screen, the larger the sphere and the more present the drone sound; and, at the closest point, the public can finally select one of the scenes and then, hear the associated music theme automatically.

When a scene is selected, the drone remains in a background sound to highlight the music theme associated with the scene. Thus, the visitor would be completely immersed in the narrative proposed by the virtual montage, within Gorbman's Bath of Affection [18]. Otherwise, when the guest removes the highlight of the departing scene, the musical theme disappears. Figure 6 shows the mixing curve of the musical theme, along with the proposed sonification curves. The sphere shrinks and the drone's sound is progressively replaced by the noises: as if the visitor were leaving the 'movie' and entering the 'movie theater'. In green and blue, the linearized loudness curve expected before the tests; in red, the curve recorded during the test. The horizontal axis of the graph (time) is measured in minutes. The vertical axis is the loudness measured in decibels.

Figure 7 shows the sound intensity control between drone, granular synthesis, and grain size without selecting a scene. The horizontal axis of the graph (Z coordinate) describes the proximity or distance of the screen.

Two properties of the *real world* were implemented in the software to create the sonification: 1) the relationship between the proximity of the object and the sensation of loudness; 2) the memory of the acoustic environment present during projection using projection room noises. Figure 8 shows the delay and the rarefaction relationship as a function of the visitor's position in the width of the room. The horizontal axis of the graph (x-coordinate) maps the left-to-right position in the room. Finally, the video of the MovieScape interaction can be accessed in [26].

5 Discussion

In our work, the representation of embodiment comes from the interaction between the visitor and the three modalities of the installation: *visual*, *sound*, and *movement*. Tracing a parallel with the film world, in MovieScape, the visitor adapts to the environment. She/he recognizes its *Multiple Trajectories*, interacts with its *affordances* and becomes a scene editor - eventually searching a way to rebuild the original narrative or to invent a new one.

We also consider that MovieScape provides an immersive environment of mixed reality. Within MovieScape, the boundaries between real and virtual are imprecise and ambiguous, since the generation of sounds and images, related with the detection of movement and spatial position of the visitor, produces a feedback process. Moreover, in the exploration of the dispositional states of the installation, this feedback enhances the emergence of recurring motor patterns. These, in turn, lead to sound invariances overlapped with the musical themes from the silent film, with the drone and the granular sonorities.

The possibility of the dispositional states to induce variety comes from the fact that the installation was designed to emulate *invariant properties* of the "real world" in its *fictional environment*, as described in the context of Clarke's Ecological Perception [12]. The *invariant properties* are the information of a stimulus and not the consequences of the interaction between the stimulus and the perception of the subject [12] p. 34. That is, they isolate the physical characteristics of an object from its psycho-physiological reception.

Finally, MovieScape can be considered as an adaptive performance environment within a self-organizing process [25], where the visitor, together with the environment, make the meaning emerge – a meaning many times unexpected, as probably used to happen in the small halls of silent films.

6 Conclusion

In this article, we presented an investigation about the construction of an expressive multimodal installation. The interaction between perception, action and movement was articulated with the concept of Embodied Cognition. It also discussed the enactive experience between the **subject** and the installation, and the poetic context of silent film. It further emphasized the collaborative character of this research, both in the construction of MovieScape as well as in the reflection about it. Hence, the creation of MovieScape reveals in theory and practice its multidisciplinary nature, the confluence of concepts, the development of technological support and, finally, the artistic experience which is the essence of the work.

The work is situated in a contemporary reappearance of experimentation in the field of silent film, presented in recent studies [6, 15], as well as in artistic multimodal productions involving cinema and improvisation. Among these, we highlight the "Improvising a Live Score to an Interactive Brain-Controlled Film" [34]; there, the visitor used controls to ensemble a film, and the musicians had to improvise the sounds.

However, it is convenient to point out that MovieScape is not a

4 Photoplay or mood music was a form of musical publication that presented lists of musical themes to be used to the various types of movie scenes.

5 cycling74.com/tools/hoalibrary-v2-2, accessed in 06/2019

"revisited cinema". Here, cinema is a poetical input, an intuition and a suggestion - a virtual environment to place our view of ecological perception, and to foster a dialogue with similar installations.

Finally, an enactive experience considers embodiment, sonification and visualization, beyond the interaction that takes place between the installation and the visitor. MovieScape integrates with the individual's cognitive process. Thus, the concept of interaction is surpassed in favour of a process of "enactive embodied immersion". The enactive installation we are proposing leans on the Sensorimotor Contingency Theory [30]. In fact, in MovieScape, "the common denominator is the role played by the body in experiencing and perceiving both the inner and the exterior world in an enactive continuum" [32], p. 412.

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