ABSTRACT
In this article we argue that digital simulations promote and explore complex relations between the player and the machine’s cybernetic system with which it relates through gameplay, that is, the real application of tactics and strategies used by participants as they play the game. We plan to show that the realism of simulation, together with the merger of artificial objects with the real world, can generate interactive empathy between players and their avatars. In this text, we intend to explore augmented reality as a means to visualise interactive communication projects. With ARToolkit, Virtools and 3ds Max applications, we aim to show how to create a portable interactive platform that resorts to the environment and markers for constructing the game’s scenario.

Many of the conventional functions of the human eye are being replaced by techniques where images do not position themselves in the traditional manner that we observe (Crary, 1998), or in the way we perceive the real world. The digitalization of the real world to a new informational layer over objects, people or environments, needs to be processed and mediated by tools that amplify the natural human senses.

Keywords
Design, augmented reality, motion capture, 3d animation, building blocks, gameplay, simulation, performance, Story Representation.

1. INTRODUCTION
When we are in fiction mode, in a game for multiple participants like Second Life, we are not confused in a sensorial sense; we do not feel the sand of the beach or the wind. Our body is “on this side” of the window, suffering back pain and retinal persistence from moving images. Regular players may suffer from tendinitis, muscle and skin problems (Gunther, 2005). To say we are “on the other side of the mirror” is to deny the importance of the player’s bodily experience and to assume that the avatar’s experience is the most important factor to consider. We disagree with some enthusiastic readings of contemporary cyberculture that defend the possibility of discarding the body in disembodied and “fleshless” experiences. For some authors, the real/virtual ratio in digital games is a ratio of immersion and loss of references (Ryan, 2001; Castronova, 2005; Meadows, 2008), for others, this immersion is quite inefficient to explain the relationship players have with the fiction they confront (Galloway, 2006; Juul, 2005; Salen & Zimmerman, 2004; Grodal, 2003) through gameplay. The immersive experience is a cinematic experience that has little to do with movement inherent to action and reaction found in digital games.

If the realism of Jan Van Eyck’s paintings was achieved with the help of a dark chamber, at present the realism of movements represented in video animation projects is obtained through rotoscopy or motion capture (mocap) techniques. We are able to expand our senses through a cooperative work with the machine, as in the example of a mocap system resource, “we can see” up to 470 frames per second. Thus, the new tools enhance human senses and can project the interaction space onto a new plane. Like an architect who imagines a dwelling on a sheet of paper, virtualising the spaces to be built using drawing techniques, the “new architect” can enter the drawing through a virtual reality system, and using sensorially more sophisticated media, he/she can interact with digital objects that virtualise real objects. However, the human-machine interaction in a VR system is still not very transparent, which makes it difficult to feel one’s presence in the digital space. Curiously, in Ivan Sutherland’s Ultimate Display project, this author called his helmet “Democles sword”, since it seemed like the user’s decapitation was imminent. If on one hand, the possibility of interacting and moving in space caused feelings of immersion, on the other, this helmet’s excess hardware and complex connections caused great opacity in this human-machine relationship that intended to be as transparent as possible.

In the film, Strange Days (Kathryn Bigelow, 1995), the users of Wire used a much more ergonomic helmet than current ones; however, it is Cronenberg, (eXistenZ, 1999) who gives us an indication of an organic connection to a new world that is indistinguishable from the original. In Strange Days, Lanny Nero, the actor Ralph Finnes, is a dream salesman. Through virtual reality (VR) technology, his clientes could feel sensations of other people through a virtual helmet that connected them to the network (wire). Subjective planes introduce the spectator to the VR simulation proposed by the film. On the other hand, Cronenberg distances himself from this thriller (or science fiction
film) and proposes a much more interesting problem: «Are we still in the game?»

VR is an interface that tries to connect all human senses to a single totally transparent media where elimination of the mediation is understood, that is, the contradiction Bolter and Gruisin defined as the Double Logic of Remediation (Bolter & Gruisin, 2000). On our work it’s not a goal to follow in conducting a historical study since Ultimate Display, or Morton Heilig’s Sensorama (1962) to the modern caves, but rather to reinforce the idea of the computer’s dominating power. Experiences in the act of playing help to understand this strong attraction that computers possess. While traditional television "offers content", digital games provide a space to interact and modify. There is a type of "transformation" in the fact we emerge in the space and develop images, stories and understanding that "from behind" the screen, in small interactive worlds through a reflex: - the avatar. On avatars, we see ourselves mirrored in unexpected or desired actions. We visualize our actions through cameras in the first or third person, which generates a greater or lesser approximation to the space. In order for us to better visualize what is about to happen in a certain game, we switch to the aerial camera (God View), thus expanding our view of space. The chosen point of view can determine the feeling of presence in space, action (event) or story being told.

2. REALISM AND SIMULATION IN DIGITAL GAMES

The realism in the game is related to the capacity the mechanism has to respond to actions the player processes on the digital board. Thus, it is considered that only one analysis that takes into account the player’s bodily and spatial experience in the game system can be efficient in interpreting analogue simulations and experiences. The human-machine relationship involves the construction of schematic and simplified representations of our bodies (avatars), but has yet to offer us passage to other dimensions. Gameplay fiction does not allow us to escape “flesh and blood” reality. In this context, it is argued that simulation is a representation of a source system through a less complex system that sets the format of the player’s understanding about the source system in a subjective manner. For that reason “exploring the manifestation of game rules in player experience is perhaps the most important type of work game criticism can do ... simulation escapes the ideological context, and the synthetic form (synthesis) it presents is immersed by the experience’s subjectivity. Video games require a critical interpretation that moderates our simulation experience and the set of consistent and expressive values, answers or understandings that constitute the effects of the work (Bogost, 2006: 131).

No simulation escapes the ideological context, and the synthetic form (synthesis) it presents is immersed by the experience’s subjectivity. Video games require a critical interpretation that moderates our simulation experience and the set of consistent and expressive values, answers or understandings that constitute the effects of the work (Bogost, 2006). The mechanism of the game\(^1\) (simulation) maps the player, acts and reacts according to his/her inputs; rewards one’s attention with its own attention. Action and reaction. The simulation replicates the player’s experience and amplifies it through mechanisms inspired by human body biology, although far from it since it deals with the machine’s digital body, Boolean sequences and software strips. The online game offers us a social simulation: “The game’s realism is about the extension of each person's social life” (Galloway, 2006: 78). Players play knowing well they are participating in a simulation and that life is not as convincingly organised as the narrative’s principles. However, only the real is open to true possibilities for action and can address our senses (Atkins, 2003). It is the player’s experience on the game board that defines the true extent of realism and this takes us to how the received work is understood by the participant in the simulation system.

There are no cultures exterior to the realistic attitude and every commentary is full of formal ideas about the world. Realism is always more a quality of representation than precisely what is not real. Symbolic representation and the manipulation of abstract forms are only possible in types of games that appeal to configuration and to reflexive action. However, realism in the game does not assume an instrumental cause and effect relationship between the actions of players on the console’s handles and buttons and their consequences in the real world. This argument would take us back to Columbine, whose theory is quite well-known: the murderers were playing electronic games, thus, as a result, violence was generated. It is argued that the Columbine theory defends the opposite, that is, that the games can generate realistic effects. However, the fact the player improves shooting and game skills through the device does not prove that this practice is used as a source of criminal inspiration.

It is necessary to have congruence and loyalty to the context, which is transferred through the senses of the player’s social reality to the game environment. Normally, after the game the player return to reality without any confusion. The congruence between the social reality experienced in the game and the social reality experienced in real life by the player is fundamental. In this sense, a realistic game must be so in terms of action and not so much in terms of representation. Action game players at times reduce the detail of representation to increase response speed. Loyalty to the context is the key to understanding realism in video games because they offer the third moment of realism, that is, realism of action.

The realism present in video games is sensorial. Players remain in the game world because unreality is attractive and fills their imagination. The suburban homes of the Sims are immune to racism, sexism and religious intolerance. They undergo a simplification, abbreviation and reduction of the world in which everything is generalisation. The Sims nation is modelled on the world in which we live, but capitalism is the only model we can play (Atkins, 2003: 129-33). Consumer society also reigns in Second Life through a matrix that essentially favours the acquisition of material goods. The virtual has become part of our real experience incorporating computer game landscapes and remixing them in the manner we synthesise our life. The Sims have not replaced our life but rather have changed it. We live in a

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\(^1\) Game mechanism or engine relates to the exchange of sequences between the device and the player. Millions of lines of code that structure and control the game world where the rules are the algorithms that create dynamic movement and not the rules of gameplay.
world that we mental create and the real world is also an imaginary environment. For every real object there is an imaginary one inside us, either schematic or complicated.

3. **POV IN CINEMA AND GAMES**

In cinematic experience, the spectator’s body is never reflected on the screen. The avatar functions like an “I” and an “other”, symbol and index. As “I” the behaviour of this avatar is associated with the interface (keyboard, mouse, and joystick) and relates to the player’s actual movement, but also to the triumphs and defeats in figurative terms that result from the player’s action. As the “other” because the avatar’s behaviour is a supernatural intermediation delegated by the “I”, for which it is the ambassador and representative. The avatars are different from the human “I” because of its capacity to live, die and live again, in a symbolic rebirth. If we consider that the avatar is a reflection of the player, this reflection corresponds to body reality, in a mapping that is not only appearance but also control. We can find the same type of situation in surveillance cameras where the body sees its gestures reflected through a real time device in a reflective environment. The avatar articulates an obedient representation of the corporeal being on the screen by manipulating the interface. The concepts of avatar and interface connect through the game (Rehak, 2003: 111). According to Rehak:

“The game apparatus – a software engine that renders three-dimensional spaces from an embodied perspective, directed in real time by players through a physical interface – achieves what a cinematic apparatus cannot: a sense of literal presence, and a newly participatory role, for the viewer” (Rehak, 2003: 121).

In cinema as well as in digital games, the point of view is the user’s main connection to the space being represented. The manner in which we perceive this space is a limited way to better understand it. Several perspectives permit the multi-angle perception of space, which means that general planes reveal more information, whereas tighter planes can provide greater detail of part of this information. Thus, the chosen point of view is both limiting and broadening at the same time, to the point where programmers, or designers, define the angle of view to cause greater levels of immersion for users. In order to generate greater spectacle while enjoying a narrative or game, the point of view is radically altered so the objects represented can be better transmitted. In *Grand Theft Auto*, as we drive a car at great speed over a ramp, the point of view changes to a cinematographic representation of the leap moment and the image is shown in slow motion. This cinematic effect has the player pull away from the space, by the subjective plane or in the third person of the car being driven, and substituted by another of contemplation, a general plane.

According to King & Krzywinska: “The resonances of framing in “stand alone” first-person perspective is a rarity in film in other than brief sequences (the major exception being film noir *The Lady in the Lake*) (…)” and we can consider that “time in games may be spent exploring (…) or interacting with objects that do not have any significant bearing on the main tasks” (King & Krzywinska, 2002: 13-14). Games are closer to real time than cinema and they use “dead time” as a way to create engagement and presence.

![Figure 1. Camera angles and different senses of presence](image)

4. **FICTION AND EMBODIMENT**

Fiction in the game is ambiguous, optional and imagined by the player in an uncontrollable and unpredictable manner. The emphasis on fiction worlds may be one of the strongest innovations of videogames. Fiction helps the player understand the rules of the game. The rules separate the game from the rest of the world by building an area where they are applied; fiction projects a different world from the real one. The game’s space is part of the world in which it is played, but the space of fiction is outside the world in which it is created (Juul, 2005). The fictional world present in the game depends strongly on the real world to exist and helps the player make assumptions on the real world in which this game is played.

Total involvement of the perceptive body reminds players, through pain, that they are participating with their whole body in the device. Thus, one player says: “I like combat games because of the stress they contain, your fingers glued to the handle… pure reflexes, not a moment to think” (Loic, 27, cited by Clais & Roustan, 2003: 41-42). Countless parasite movements, that is, uncontrolled movements that do nothing to optimise game actions, confirm the total involvement of the player’s body. There is a breaking away (“décrochage”) of this body in relation to
conscious desire and some players have actually declared they have fallen asleep while playing. The eyes are stimulated, but they raise a resistance to the images through countless mechanisms of retinal persistence, for example. Headaches, backaches, and eye problems can emerge as a direct consequence of a game session. Players are stimulated in their attention as well as their perceptions not to mention their emotional investment. Some players complain of emotional fatigue: “there is truly a moment in which I reach a maximum level of excitement and where I feel that after that I'm going to feel anguish, so that if I continue I won't feel good...” (Alexandre, 23, cited by Clais & Roustan, 2003: 38).

During the act of playing, there is a numbing of the body’s conscious attention: “observations with players in action show that from a certain level of game experience, there is a reduction in reflexive consciousness, the hands are mechanically activated beyond all deliberate control” (Clais & Roustan, 2003: 41). Technical mastery of the game can be considered a process of incorporation similar to what happens in car drivers; motor stereotypes or simply motor algorithms are acquired that result in an economy of energy enabling the body to resist longer without fatigue, where:

“The perceptive body is at the centre of this appropriation mechanism. It resembles a “rubber band” in the action, and even more so in the repetition of the action. It is no longer limited to the boundaries of the flesh and is accompanied by a capacity of extension to the surrounding objects and with which the player got used to developing automatisms in order to know all of the characteristics and physical reactions. Thus, in order to play well and access the pleasures of the technical domain implies “forgetting” the body in action to the point where the body plays more, as I play less.

The player's habits and routines must be analysed in terms of action, reaction, adjustment and repetition. After Warner makes the object part of the body, he incorporated it into his “dynamic”, “as a prosthesis in motor conduction (...). Now it is necessary to understand the meaning of “incorporating” the dynamic of the videogame” (Clais & Roustan: 2003: 42-43).

There is a continuum between the player and the game world: “We see “through eyes of the monitor” what our body is supposed to feel and register. (...) as a sort of imaginary prosthesis, it links the player’s body into fictional world, again emphasizing a continuum between the player's world and that of the game” (Lahti, 2003: 161). The stories present in videogames are stories for the eyes, the ears and the muscles. These stories have the capacity to adjust our experience, organising perceptions, emotions, thoughts, and motor actions (pécma). In this context, they cannot be understood through the French structuralist models that dominated narrative theory because they are not concerned with the implementation of the narrative in the brain and do not take into account the internal relationship involving perception, emotion and action in narrative structures (Grodal, 2003).

5. PROPRIOCEPTIVE EXPERIENCES AND GAMEPLAY

The proprioceptive experience, a sensorial-emotional-motor experience, enables players to go from the passive to the active position in relation to others and this characterises us as human beings. The quality of the first interactions between the baby and its environment feed a general impression that confirms the idea of a consistent universe similar to what is felt in kinaesthetic terms. In this context, a bodily experience is what confirms the connection of the being to the world. This experience is facilitated by proprioception, which enables the acquisition of certainty that we are the authors of our own acts and that, through our hands, as natural extensions of our desire, we perform our movements. The “sensorial narration” reminds us of the stories or recitals the human being tells itself according to the life situations it faces. In these situations, the need for consistency is vital and at each moment we have the need for a beginning, a middle and an end where repetition, this “acting again”, provides an experience of trial and error that enables the construction of a consistent world” (Stora, 2003: 53-66).

Proprioceptive coherence, a term used by phenomenology that refers to how the frontier of our body is combined with feedback loops and habitual uses, is what enables tennis players, for example, to feel the racket as an extension of their own body, it is the feeling that tells us where this frontier lies. In this context, videogame players feel a relationship of continuity with the keyboard and with the screen surface as a space in which subjectivity can flow (Hayles, 2001). The enormous difference between how proprioceptive coherence works on the computer screen when compared to the printed page is one of the reasons why spatiality is so important in the topographic writing found in electronic fiction. Bodily and psychological integration is evident in every human being as stated by António Damásio:

“The brain and the body are integrated by biochemical and neural circuits reciprocally directed from one to the other. (...) the blood stream; it transports chemical signals, like hormones, neurotransmitters and neuromodulators. (...) the brain can act, through nerves, on every part of the body” (Damásio, 1994: 97).

The real involves sharing and a feeling of repetition in which the “word “represents”, however, does not cover the exact meaning of the act, at least not in its looser, modern connotation; for there “representation” is really identification, the mystic repetition or re-representation of the event. The real re-presents and encompasses something shared. The terms repetition, share, proximity, ineffability are recurring thoughts and words in digital narratives. In order to check if something is real, we hope to be able to experience the occurrence again. Repetition is what constitutes the regularity that allows us to identify something as real and through it find others, the community. The fictions do not become confused with the real, but rather free the human from real constraints: “The
normal man, like the comedian, does not view imaginary situations as real, but rather, on the contrary, frees himself from the real body and its vital situation in order to breathe, speak and smell in the imaginary” (Merleau-Ponty, 1945: 121-122).

6. CONCRETE AND ABSTRACT MOVEMENT IN SPACIAL EXISTENCE

Spatial existence is a primordial condition for all living perception, and kinetics initiation is an original way for the subject to relate to the object. There is a difference between abstract movement and concrete movement where perception and movement form a system that changes as a whole and the notion of real is intimately connected to incorporation, a body that assimilates reality's data through movements in space. Whereas concrete movement is tactile, abstract movement is visual, and depends on the power of representation (Merleau-Ponty, 1945). The notion of real is also associated with the idea of repetition since it is through this regularity that we appropriate the existence of things. The body performs the movement, copying it through a possible representation which is, later, returned through a formula for automatic movement. Consciousness operates the synthesis of the countless relationships that are implicit in our body.

The real implies a presence and there are limits to what can be simulated in the computer. Using a specific set of algorithms and a computational system designed to deal with a type of spatial organisation (a grid of columns, for example) we may not be able to simulate another type of spatial representation (i.e., running in the mountains). It is considered that the number of points and corners in an object and their locations in space change according to how we choose to look at this object (Coyne, 2001: 75). For a normal person, playing implies the capacity to place oneself in an imaginary situation during a specific moment; it implies changing one's position. For a sick person this fictitious situation is not possible because this person converts it into something real. Our inhabits space and time and motricity is the primary sphere that engenders the feeling of all the meanings in the realm of space represented.

We assume that it is not possible to express spatial experience through the mathematical description of coordinates, since for phenomenology, the representation stems from the spatial experience. We cannot understand how organisms work simply by looking at chemistry. Laying out the DNA code of an organism will not itself tell us how the organism functions in its environment. We do not access the design of things from geographical coordinates. From a phenomenology point-of-view information cannot dominate if we want to understand space from the concept of spatiality, because understanding begins with unreflected involvement. Understanding is praxis and that is the point that clearly distinguishes phenomenology from structuralist theories (Coyne, 2001: 152-54).

If we consider that the key to space resides in its mathematical description, then we can consider that virtual reality and cyberspace contain, reproduce and re-present it. Virtual reality and cyberspace do not challenge our concept of reality, but rather introduce new means and practices, disconnecting from older and more common practices and means. If, on the contrary, we believe that computers give us access to new subjective spatial experiences, then we should distinguish between space and place in a geographical sense. Space can be reduced and it can be described mathematically in drawings, plans and maps, whereas the place is qualified memory imbued with value.

Experience does not relate to an imitative repetition, but rather to preparatory efforts in which habits and automatisms are acquired. Subjects who learn to play integrate the keyboard and the mouse to his corporal space and the habit does not reside in thought or in the objective body but rather in the body as a mediator of a world. During the repetition, there is an emotional appraisal caused by gestures of acclaim that highlight the expressive side of the game. The habit is nothing more than a fundamental means in which the body allows itself to be penetrated by a new meaning. Our own body’s experience teaches us to root space in existence, and that the perception of space and the perception of things (spatiality) are not distinct acts.

The body functions as a system and in accordance with the theory of complexity and chaos, certain systems can reach a state where small changes in a given variable (a small part of the system) can produce extraordinary changes on the whole. Systems can be unpredictable, yet standardised. The only way to make predictions and plans on what may happen is by using a program that generates the event. On the one hand, the adaptive and gameplay significant factors tell us that it is the repetition of the experience of the sensorial world that provides the basis for understanding. On the other hand, the repetitions that occur at the learning level cease when the stimulus involved is learned. This factor does not occur in the game. In the space of gameplay, experience, repetitions continue due to the pleasure of excitement associated with the development of events on the board and normally do not disappear with habit. Repetition is everything and the space where it occurs provides a good test to examine the relationship between computers and reality.

Performing phrases and sequential actions cannot all be formatted by positivism, but rather appeal to the interpretation and the statements of creation and imagination. Positivism established the thought of many founders of artificial intelligence, cognitive sciences and the theory of systems. The Turing intelligence test, or the “game of imitation”, starts from the assumption that there is an empirical way of checking whether the machine is intelligent. The intelligent gameplay art systems that we propose have no intention of convincing the player that the machine is intelligent and thinks à la Turing (Seaman, 1999). First they try to translate intelligent processes that, according to the responses and behaviors in interaction with the computer, are expressed in artifacts that generate consequential contexts. The uncanny feeling is inherent to the concept of repetition and reminds us of our compulsion to repeat as children. What arouses so many suspicions in us in relation to the computer is precisely this automatic movement that forces us to repeat actions and makes us mechanical automatons.
7. **UNCANNY VALLEY**

The uncanny feeling, strengthened by repetition, is also accompanied, in experiences involving the emotional measurement of human beings in relation to robots, by a certain aversion to the total similarity of the latter with humans. These experiences are nicknamed the **Uncanny Valley** and were introduced by robotic scientist, Masahiro Mori. It seems that humans react well to dolls that are similar to them, but do not react well when the similarity is too close. The realism of the figurative representation is accentuated by a paradoxical relationship in digital culture. Since digital culture has the possibility to work without any reference to reality, contrary to cinema and photography, it is obsessed with reproduction of data from the physical world. Analogical simulation, where we situate motion capture (mocap), attempts to capture the mathematical coordinates of the physical body in movement. We can include in analogical simulation flight simulators and game engines that replicate real world data. In the case of generative processes or experience-based simulation, an attempt is made to capture the biological process inherent to the production of a certain effect, such as how a digital creature interacts with the environment in which it is inserted. Both these strategies are often adjusted and worked on simultaneously.

“Avatars will become more realistic”, says Mark Stephen Meadows, “as noted, people instinctively want their avatars to became real. And the developers, designers, and builders of avatar systems are trying to render reality as fiction” (Meadows, 2008: 112). Next we will see some experiments in real time measurement of movement and perception applied to digital “living” creatures. Movement evaluation, appearance and perceiving will explain why these anthropomorphic characters are so horrible when represented in a realistic manner. This is the target of some studies in the representation analysis area that focus on the conviction that avatars are today becoming much closer to humans.

The notion of realism resides in the game’s tactility and the player’s real bodily experience. This realism is not understood in the sense of the representation’s resemblance on the screen, but rather the technological capacity of the device to create real pleasures in the participant’s physical body (Lahti, 2003). Thus, the player surrenders to technology, the machine, which in exchange, frees the player's body of the constraints of movement in real life. The body occupies another skin and it is aesthetised as a variety of itself, a toy with which we can play. Digital games force a mechanization of the body on their players and seduce us to take pleasure in a sort of mechanisation process (Taylorisation) of the body which becomes a gratifying experience. The game requires a bodily discipline that is real, where the body adapts to the machine through the automatisms it imposes.

Acquiring the tactile experience inherent to the relationship with the interactive image is nothing more than accepting the interaction with the object. Acting changes the existing situation between the object and the “I” although in this impulse there is no separation between the information’s theoretical result and the practical behaviour on which it is based. This aspect, contrary to what happens in the case of vision, shows well the difference between our feelings and the way this difference is reflected in our actions. The distinction between our hearing and our eyesight tells us that, while in the second there is a distance between perception of image (simultaneityness in the presentation of a variety, neutralization of the cause of the sense’s state and distance in the spatial and spiritual sense), in the first, the duration of the sound we hear is equal to the duration of hearing (Jonas; 2004: 161). Likewise, touch, as well as hearing, implies the occurrence of successive perception, but like eyesight, it imposes a synthesis of data in the static presence of the object. With touch, the subject and the object act on each other. In the case of eyesight, I see without having to do anything and without the object having to move for me to see it. In this context, although eyesight is the freest of all senses, because it imposes perceptive distance, it is also the least “realistic”. Touch is the feeling where the original encounter with reality as reality occurs. Touching brings with it the reality of the object within the sensorial experience. The experience of eyesight or optical perspective depends on locomotion, and self-movement is a principle of the organisation of senses, but also the means to synthesise all of them into a common objectivity.

8. **REALISM OF THE APPLICATION**

The objective of this application is to demonstrate the potential use of AR for visualising human movement. The project consists of the digital representation of a track and field track and a 3D character (graphic simulation of an athlete). We intend to project the movements of an athlete set to begin a 400m race over real space using AR techniques. Thus, we determined the need to capture the movements of a professional athlete over motion capture, apply the movements to an avatar using 3D animation applications (3ds Max version 9), integrate the objects in real time (we used Virtuools Dev 3.0) and integrate the graphic processing to real video (ARToolKit).

We sought the realism of the simulation by capturing athlete movements at the Digital Animation and Biomechanics Laboratory for human movement (movlab) at the Laslofoña University, and for avatar displacement we sought a formula to make the representation of the animations random. At movlab, we used 8 infrared cameras that capture up to 470 frames per second with a resolution of 1.3 mpixels (black and white images up to 1280x960). We used 14mm reflection markers (tied to a training suit and directly on the athlete’s skin) and we captured the following movements: - 10 walking movements, 10 running, 10 of the walking-running transition, 10 of the running-stopping transition, 10 jumps over a 55cm high obstacle and 10 poses at rest (standing).

In the Vicon system, we used the Vicon IQ software to filter the information, and with 3ds Max software, we created 4 footsteps cycles because due to the limitations of graphic processing in real time, in general, animations are shortened, so that, in cycles, they simulate displacement with greater visual realism and less computer processing.
As we know, a person does not always move the same way. Depending on the surface friction, inclination or each person’s physical state, we adapt our daily displacements to the environment. The perception of the surrounding environment results in individual interpretations of each person’s experience with the stimulations provided by the environment. Thus, a place is defined by possible interaction and also by the capacity it has to transform us into an inhabitant of this space: - the world as a series of interconnected objects and individuals (Hall, 1997; Ryan, 2001). We do not intend to explore the differences between space and place here, but we accept the study by Yi-Fu Tuan (Tuan, 1976) or the definition that space is the place of action, that is, the experience of the place offers the consistency of the world (McCullough, 2004). Thus, if in the interaction of an avatar with the environment, we recognize daily tasks, the realism of movement is absorbed by the spectators. From this idea, we understand that the cyclical movement of an avatar is not natural and in order to hide the nature of the programming we try to mix the greatest number of possible movements to camouflage this technical requirement.

This is a concern in digital games, so that through artificial intelligence, they can prepare the agents for the interactions that will occur in the digital space. The interactivity that occurs between agents results from the analysis we make of the real world, thus, the relation avatars have with the environment is of utmost importance to perceptively understand human movement (Lee et al, 2002). Therefore, we add objects that can present themselves as obstacles for the characters’ movement. The captures were edited using Vicon IQ, trying to eliminate all capture noise, and using Character Studio from 3ds Max software, we created the different cycles. For example, for walking, the capture presented a 10 footsteps movement. We selected a 4 footsteps cycle where it was necessary to correct the initial and final position of the hands and head so the cycle would not be perceived during repetition.

We validated the animations generated by showing them to a group of twenty-five students from Cinema and Multimedia course (Lusófona University) who were between 21 and 25 years of age. They were told the walking movement had been captured in mocap studio, at movlab, by an athlete that runs over 16 footsteps. What really happened was a capture of only 4 footsteps, and later, it was multiplied on 3ds max (motion mixer) to produce a single animation of 16 footsteps.

When the students were interacting with the system, all of them accept the animation as a cycle of 16 footsteps, which legitimizes the realism of the real cycle being used (only 4 footsteps). The motion capture systems allow us to capture real movements, so we can see in this application a avatar running like us. The avatar is not absorbed as real, cause is a simple graphic project on a laptop monitor, but graphics are not important for a application looks real, what matter is if the action of user is real. If the user moves the markers and the avatar follow the user instruction without delays, the agency of the application will be very strong (Murray, 1997). The notion of realism resides in application’s tactility and the player’s experience. The realism of the application is not understood in the sense of the graphical representation on screen, but rather on pleasure of the user participation.

This is an important characterization on video games – the realism of action. First was the realism in literature (narratives), after on produced images (Mirrors, paintings, photography and movies), now we live the third order of realism – the realism of action (Galloway, 2006). So, to achieve a nice gameplay in this application, it was developed a basic avatar with a simple texture, but we oriented our efforts on animation post production (looking for real cycle movements), interface user friendly (markers with instructions) and flow interaction (at least 70 frames per second). We were very concerned if the interaction with markers could be similar to a interaction with real objects. The main goal was to guarantee realism in interaction with a avatar like we play with a ant, trying to block her to follow is path. Every time the user put an obstacle in front of the avatar it should stop and try to contour the obstruction.
9. DEVELOPMENT OF THE APPLICATION

The application aims to contextualise a space for interaction between people and artificial beings that cohabitate the same place. As we mentioned earlier, we sought a level of realism in the movements of a 3D character so that, through the similarity of the movements, some level of empathy/charm could be generated by interacting with a being that is somehow similar.

We used Virtools Dev 3.0 software to integrate the 3D character (modelled and animated with 3ds Max) and to program its movements. Through ARToolKit Plus plug-in libraries, developed by Graz University of Technology (Austria) and the use of a Microsoft XBox 360 Live webcam, we created the application based on augmented reality.

This library (ARToolkitPlus) is an extension of the ARToolkit library, originally developed by Hirokazu Kato (Hiroshima City University) and continued by Human Interface Technology Laboratory (HIT LAB), at the University of Washington. ARToolkit uses C and C++ languages to permit the detection of markers (patterns) and the identification of their position, angle or direction, through video. The captured data are later transferred in 3D spatial references, where tracking between the real and the digital worlds is possible. For such to happen, this library resorts to graphic computation algorithms to calculate the position and direction of the real camera in relation to the marker. In the next phase, it is possible to generate graphs on the marker’s position and direction.

In the application developed, the computation process follows these steps:

1. Video captured by a webcam is analyzed in real time.
2. The software seeks patterns, that is, the identification of markers, frame by frame.
3. When the previous point has been validated, a trajectory is drawn (track and field track) over markers 1-4. For this to happen, it was necessary to develop the individual detection of each marker. When validated, a curve is created comprised of four points, which correspond to each of the four markers.

Tracking of the real perspective with the digital is the biggest problem in combining the two contents in an AR system (Behringer, Klinker and Mizell, 1999). Alignment of the artificial camera must be fully synchronized to the movements of the real camera, and in order to solve this we used the curve markers for the respective tracking. Due to image processing and the respective precise values, the decimal values (float) for the position and direction are alternatively unstable and regularly conflict with the curve. In order to solve this problem, a Building Block (AR Filter) was created in VSL language to be used as a filter with the position and direction values to make them stable.

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**Figure 4. Path defining markers**

**Figure 5. Virtools Building Blocks created with Virtools Script Language (VSL)**

The filter detects the variation of input values, and if it detects a transformation (translation, rotation and scale) greater than what we consider noise, it is altered: - new values (output) are used, making it possible to alter the design of the trajectory when we move the markers. An occlusion function was also created in the filter in order to maintain the current positions whenever a marker is no longer visible. This is an essential function for transparency in system mediation because whenever we move markers or block the view of the camera by moving our hands, the system remains calibrated thus avoiding delays in graphic processing or trajectory deconstruction.

4. When the curve was created, consonant with the position of the markers, we programmed such that the character followed the direction of the curve. Thus, the 3D character is placed on marker 1 (processed in render) and the randomly scheduled pose animations immediately begin.

**Figure 6. Assign Character movement to curve 2D**
A function was also created that generates the average of the direction angles for the diverse markers. This average is associated with the character’s direction in order to obtain a more precise direction over the space.

5. When we add markers 5 and 6, images of obstacles are processed graphically.

Figure 7. Defining collisions between 3D character and digital objects

6. If markers 5 and 6 are placed over the alignments for the trajectory markers, collisions will be processed between the character and the obstacles. The obstacles are divided into two types: those that cannot be hurdled (muppi) and those that can (placard). With the obstacle that can be hurdled, the avatar will jump and hurdle without any difficulty, however, since the muppi cannot be hurdled, the avatar will need to look for the closest path to the trajectory’s next marker.

This small example of artificial intelligence is initially processed by video analysis as a sensorial component, such as proximity sensors used in robots. In this function, the origin of the “sensorial axis” is defined as well as its direction in relation to the pivot of the character. The sensorial ray (depth) dimension is also defined as well as the group that contains all of the detectable objects. When there is an object (detectable) that is closer than the ray, the function returns the identification of this object. The conditions that activate the actions the 3D character should take are then processed from this output.

10. CONCLUSION

We can conclude that realism in gameplay mainly relates to the bodily experience inherent to repetitive action, and that image realism is a less important factor than realistic movement. The gaming device forces the player’s body to acquire automatism, and the fictional experience on the board, which is the game, is essentially an incorporated experience. The design of human-computer interface should incorporate open fictions in order to let the player build is own meaning and bodily incorporated experiences. Design platforms can stimulate collaborative networks where players enact as actors in a digital drama.

The presentation of this project always generates a special empathy in the audience due to the strangeness of interacting with 3D entities in real time and through simple movements of our hands over the project markers. By interacting with the 3D character that runs from marker to marker, positioning the obstacles in front of it, we play and observe its reactions. When the same students who validated the animations generated by the motion-capture system in the initial phase of this project saw the final application, most of them asked (78%) to interact with the character.

The enchantment that these beings evoke in people place these types of applications in more organic spaces and modes of human-machine interaction, elevating the level of presence in mixed reality spaces. In a perceptual point a view, borders between real and artificial could be dissolved with the advent of artificial intelligence, graphic processing and the reduction of the processor sizes.

The future becomes progressively more hybrid, where digital artefacts will be mixed into real world, allowing us to communicate in broad band. In order to explain to an animation film student how human movement happens in everyday life, we think this application provides a glimpse at the possibility of realistically showing movements of different characters captured through mocap that interpret and react to the surrounding environment. By developing the databases for this application, we came up with a fun application that is pedagogical at the same time.

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12. REFERENCES


