SELFHOOD, an experience around the self

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1. INTRODUCTION

In the development of new music interactive technologies, a mixed reality environment [1] can function as a laboratory to evaluate interactive behaviour [2, 3]. With the advent of new technologies that have emphasized interaction and novel interfaces, alternative forms and modes of interactive media have been realized [4]. These developments raise fundamental questions on the role of embodiment as well as the environment and interaction in the understanding of the man-machine interplay. In addition, it places emphasis on a more situated and externalist view. Moreover, body's perceptual, cognitive, motor and kinaesthetic responses have to be reconfigured to the needs and constraints concerning action and perception in this new space and the interface can now be optimized to its user [5, 6, 7]. In line with these recent developments, we present here the SELFHOOD installation as an interdisciplinary research framework. SELFHOOD is an installation in which two particle systems based on Boids [8] are used to generate images and digitally synthetizing sounds. The generative sound machine of the installation is the CromaCrono≈ system that operates with a small set of compositional operations making possible real time control. Our research is anchored in a multimodal laboratory where we study human cognition and music creativity supported by digital interfaces, computer graphics and motion capture. It is an interactive environment with a large 3D screen and a six channel sound diffusion system. The key point discussed here is the creation of new art forms based on interactive narratives, virtual soundscapes and synthetic visualization [9]. The assumption is that the interaction of an agent or group of agents with an immersive space,using various interactive devices, indicates how these processes affect their behaviour and the meaning that is constructed by them. These systems can be evaluated from the perspective of the interaction between agents and devices generating sounds, video and 3D graphics.

Next section talks about the concepts about the notion of the self behind the artistic view of the SELFHOOD installation. Following, the SELFHOOD installation and their technical aspects are described. Then, aspects concerning artificial conciousness are approached. Finally, the conclusions are presented.

2. CONCEPTS

Many are the attempts of describing the self. Strawson and Prescott [10, 11, 12] enrolls some of them: I know that I exist; the question is, what is this 'I' that I know? [13]. The soul, so far as we can conceive it, is nothing but a system or train of different perceptions [14]. What was I before I came to self-consciousness? … I did not exist at all, for I was not an I. The I exists only insofar as it is conscious of itself. ... The self posits itself, and by virtue of this mere self assertion it exists [15]. The 'Self' ..., when carefully examined, is found to consist mainly of ... peculiar motions in the head or between the head and throat [16, 17]. The ego continuously constitutes itself as existing [18]. Any fixed categorization of the Self is a big goof [19]. The self which is reflexively referred to is synthesized in that very act of reflexive self-reference [20]. The self ... is a mythical entity. ... It is a philosophical muddle to allow the space which differentiates 'my self' from 'myself' to generate the illusion of a mysterious entity distinct from ... the human being [21]. A self ... is ... an abstraction ..., [a] Center of Narrative Gravity [22].

Ibsen [23] too, in his famous play Peer Gynte, plays with the concept of self: "Begriffinfeldt comes in with Peer, locks the keepers in a cage, and tells Peer that rea-son died the previous night. Peer realizes that Begriffinfeldt is insane, and that he's now locked in an insane asylum. Begriffinfeldt calls for other inmates of the asylum to come out and introduces Peer as their emperor. Peer says there's a misunderstanding and suggests that the inmates of the asylum are far from being themselves; they are beside themselves. Begriffinfeldt happily tells him that the inmates are more themselves than anybody, and that Peer is their perfect emperor. … Begriffinfeldt crowns him with a crown of straw and pronounces him emperor of the self".

Returning to Descartes [13], what is this 'I' that I know? What constitutes a self [21]? All the semiotic signs that compose our knowledge were defined along the time by successive generations, so that people could communicate, define concepts, elaborate, construct. There are common, universal signs and concepts; there are others that are specific, differentiated, associated with a culture or a region, p. ex. Is the set of signs associated with the knowledge of each person "his/her self"? Removing the signs (concepts, habits, beliefs, strategies, etc.), does the self cease to exist? But if the signs were elaborated through generations, how to define individuality; perhaps the individual combination of signs? And how do we modify the others, and are modified by them?

Aiming to instigate a reflection on the self through a practical and interactive experience, the SELFHOOD installation was conceived. A representation of each participant is created in a form of a cloud of points and sounds, suggesting their selves. The dynamics of visitors' movement is sonified in such way that colors and sound textures are fused in a surround hexaphonic sound diffusion system. The generative sound machine of the installation is the CromaCrono≈ system that operates with a small set of compositional operations making possible real time control.

3. INTERACTIVITY AND CREATIVITY

For over fifty years there has been a re-thinking of the nature of cognition. Instead of emphasizing formal operations on abstract symbols, this new approach focuses attention on the fact that most real-world thinking occurs in very particular (and often very complex) environments, is employed for very practical ends, and exploits the possibility of interaction with and manipulation of external props. It thereby foregrounds the fact that cognition is a highly embodied or situated activity and suggests that thinking beings ought therefore be considered first and foremost as acting beings.

This shift in focus from Descartes' "thinking thing", and the picture of human being and subjectivity it suggests, to a more Heideggerian approach to being in the world, in which agency and interactive coping occupy center stage, is an extremely important development, the implications of which are only just beginning to be comprehended [24]. Heidegger, and his successors such as Gadamer and Ricoeur [25], held that situations where a system, tool or symbol becomes present–at–hand may be crucial to the individual's learning and to the differences between individuals. The ongoing 'feedback loop' of interpretation and understanding integrates these two modes, and affords variation in people's understanding as well as consistency in their behaviour.

In this way, creativity can be considered as the variation of an individual's subjective understanding from his or her prior understanding and from others'. The individual may then be very conscious of his or her own activity, rationalising it and very aware of it, i.e. the system, tool or symbol is present–at–hand. With experience of its use, however, it may become understood and familiar, i.e. more ready–to–hand and embodied.

Similarly, as two people perceive one another's use, with each interpreting and reacting to each other, they can achieve intersubjective consistency of behaviour. A use or activity that is new and present–at–hand for one of them can thus become learned and ready–to–hand for both. The circular process of interpretation, whereby perception and activity are influenced by understanding, but also feeding onto and changing understanding, thus relies on the interplay between ready–to–hand and present–at–hand interpretation. Dourish [26] suggests that people's interaction with systems is a fundamentally embodied phenomenon (p. 145).

Our research is anchored in a multimodal laboratory where we study human cognition and music creativity supported by digital interfaces, computer graphics and motion capture. It is an interactive environment with a large 3D screen and a six channel sound diffusion system. The key points discussed here are: investigation of new paradigms on human cognition mediated by interactive technologies that attempt to describe how the creativity operates [27, 28, 29, 30]; development of new technologies that incorporate interactive techniques based on the integration of multimodal signals [31] the creation of new art forms based on interactive narratives, digital music instruments, virtual soundscapes and synthetic visualization [9]. These systems can be evaluated from the perspective of the interaction between agents and devices generating sounds, video and 3D graphics.

In the first setup of the SELFHOOD installation (Figure 1), a vision system identifies the body of the visitors and creates a visual representation of each one, suggesting their selves. Three projectors, a Kinect 2 sensor, a computer and loud speakers were used in the first setup.

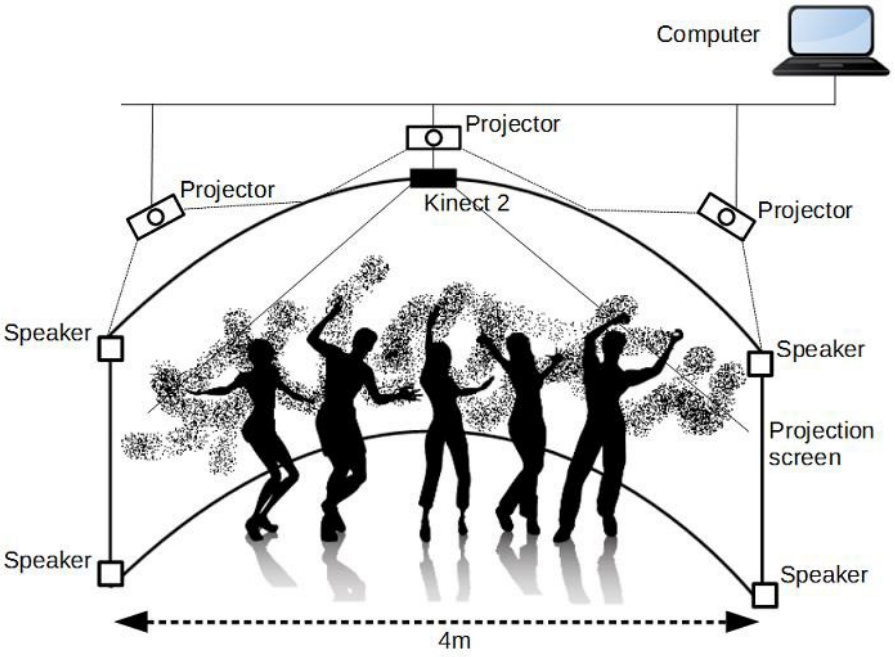

Figure 1. Layout of the SELFHOOD installation, with three projectors, a kinect 2 sensor, a computer and loud speakers.

Since the self is still something misunderstood, a cloud of points and a sound drone were first used to represent it. Different colors are assigned to different clouds, which are displayed on a curved screen, following the movement of their owners.

4. THE SELFHOOD INSTALLATION

SELFHOOD sound and image generative processes dialogues also with the mathematical notion of dynamic system. We conceive that man-machine interaction can be described by concepts such as stability, instability, and disturbance and it is capable of producing self-organized behaviour when implicit and explicit interactions are coupled. Moreover, we started your model searching for a simulation of a dynamic system to be the core of the machine counterpart behaviour. Thus, we chose the Boids algorithm to be our intrinsic machine generative engine, for its characteristic of simulating in computer software the collective organization of bird flocking. Created by Reynolds [8], the Boids algorithm is a computer model of a dynamic system that simulates bird flocking controlled by a set of simple rules to determine their flights, collective organization and trajectories in space. Procedural models simulating complex natural phenomenon can aid scientific understanding of them [8, 32]. Further, the computer simulations help to recreate the phenomenon

and control it and they can be also used in computer animation, games and the arts. Figure 2 depicts the diagram installation.

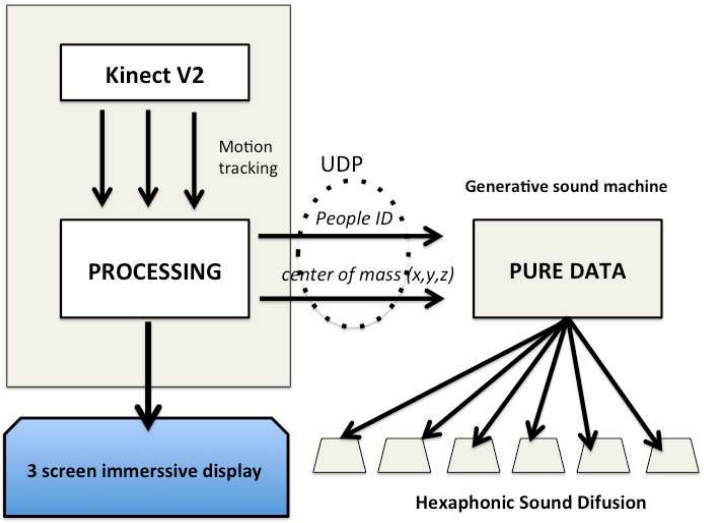

Figure 2: Diagram of the SELHOOD implementation describing the visualization in PROCESSING and sound generative machine in PURE DATA.

4.1 The Visual Particle System

In order to create a visual representation associated with each participant, three main components were applied: a physical sensor capable of tracking the user's body, a programming environment/language focused on visual effects and a screen.

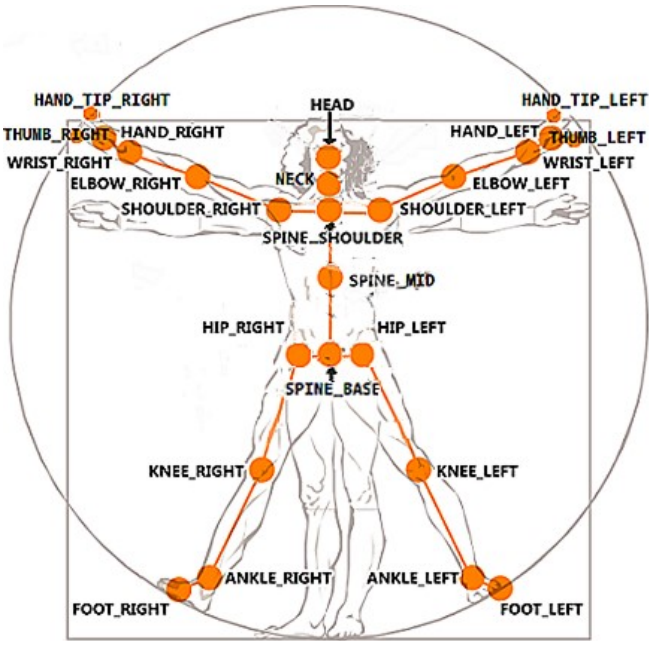

Figure 3: The skeleton that is made up of the joint types relative to the human body

The first component is the Microsoft Kinect V2 sensor [33], which utilizes a set of two sensors (a colored camera and an infrared sensor) to track up to 6 bodies (at 30 Hz) from 0,5 to 4,5 meters away. Each body is represented as a set of 25 joints with real space coordinates relative to the sensor's position, depicted in Figure 3, and a color id. This id is used to differentiate one body from another. The sensor data can be acquired through the Microsoft API or through distributed libraries. The KinectPV2 library was used to allow the communication between the Processing environment [27] and the Kinect V2 sensor. With this library it is possible to detect the bodies and their joints. It is also possible to get the visual input from the camera and the infrared sensor.

By using these tools, the SELFHOOD environment creates a representation of its users in a form of a set of particles systems. Each body contains 25 particles emitters located in each one of its joints. These emitters create colored particles that match the color of the id of their bodies. Figure 4 shows the representation of the selves through particle systems. The particles are created with a random initial velocity at a random direction that is affected by a gravitational force present in the simulation. Depending on the distances between bodies, their self representations interfere with each other by sharing and acquiring particles of different colours. The closer the participants are, the more particles they share; the particles of each self representation have different colours

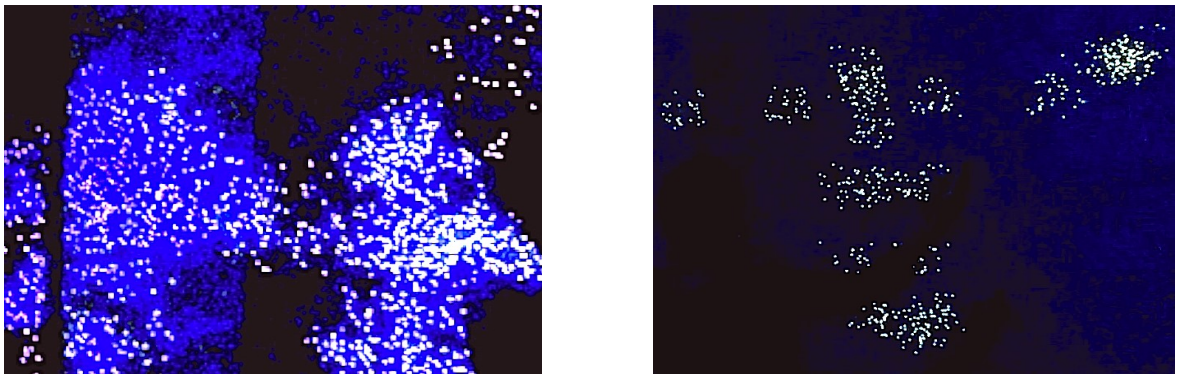

Figure 4: Self representation in the SELFHOOD installation.

4.2 Sound Generative Process

The SELFHOOD generative sound machine, CromaCrono≈ [35], was developed in Pure Data [36] and synthesizes sounds in real time by four different standard synthesis methods: additive synthesis, FM, wave-shaping, and Karplus and Strong algorithm [37]. Further, a Granular Synthesis engine post-process is applied to the initial synthetized signal. The whole sonification system works as a unified generative process (see Figure 4). Boids trajectories [8] are used to control the display of hundreds of primitive geometric shapes that vary in shape, colour, speed and dispersion in space. All these variations produce the audio-visual texture which is coupled with generative rules for controlling sounds and interactions with the visitors.

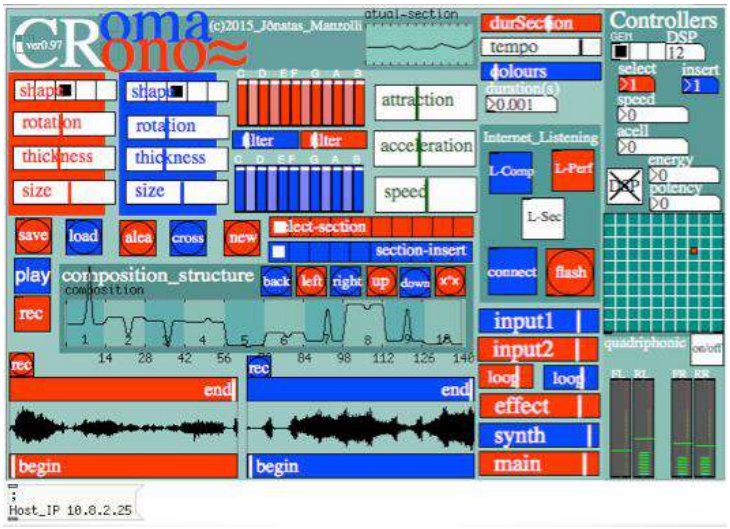

Figure 5. GUI of CromaCrono≈ showing all the integrated control parameters of the system (top), and in detail the "Composition Curve".

The Boids algorithm [8] is used to control several parallel processes generating an animated audio-visual in real time. Boids trajectories are hooked to the articulations of people's body as they are interacting with SELFHOOD. As showed in Figure 1, the main control function of the system is linked to the 3D-coordinates from each visitor (i.e. up to six person interacting with the system). Six lists (person0, person1…, person6) encapsulate all the data from each person's skeleton, that is received from the Kinect V2 using a UDP message. Here, the sub-patch "coordhood" maps the 3D coordinates into sound synthesis control parameters (Figure 5, left). The global variable "number-of-people" controls the speed of the grains and the Granular synthesizer (Figure 5, right). A performance video demonstration can be found in the following link: https://youtu.be/9F-s3Cafhc4 [38].

4.3 Experiments around the SELFHOOD

The first venture in the SELFHOOD installation was taken along by the authors themselves, who had artistic and musical background, and by the developer, a student with high technical skill but unfamiliar with artistic-interactive environments.

The authors called for first experiment the administrative staff of the nucleus. These people knew about artistic and interactive environments, but as distant spectators. They walked around the room, seemingly unconfortable.

Next, a researcher from the nucleus, an artist, music and performer, was invited to try out the installation, already very familiar with such environments. She explored the environment, experiencing it with large and restrained, slow and fast gestures. The student-developer who was observing the performance understood then to which it was applied his work, and happened to accompany the researcher-performer with similar gestures. Subsequently, when performing technical tests in the environment, he began to perform some choreography.

Later, an experienced ballet teacher from the university was invited to try out the installation, but she was not familiar with interactive environments. It was a surprise to note that despite all her artistic and didactic experience, the environment was revealed to her as an absolute and pleasant novelty, which she experienced long and pleasantly. In the end, she said: This is really cool!

Following, music students were invited to experience the environment. The students who witnessed the full operation of the interactive environment were very intrigued about the project. It was possible to perceive their curiosity about how the system behaved as a whole. They remained entertained along all the time they stayed in the studio, performing movements in front of the Kinect sensor, in order to find out what a particular gesture would result, be it in the sound produced, or in the characteristics extracted from it. For example, they explored the system's ability to detect not only the positions relative to each of their bodies, but also the way it recognized details, such as the state in which their hands were. Among the reactions observed, the most recurring were those of surprise, as well as fun.

According to the student-developer who followed all the experiments, his experience in the installation was a unique and very significant process. It was interesting not only to be able to work as a developer, but also to study the interaction of the participants with the environment and each other, making possible to learn about the technical as well as the artistic aspects of the project.

5. CAN AN INSTALLATION HAVE A *SELF*?

According to Prescott [11]; human episodic and autobiographical or event memory can be considered as an attractor network operating in a latent variable space whose dimensions encode salient characteristics of the physical and social world. To be effective, event memory should have at least the following properties: compression; pattern completion and pattern separation.

The operation of the perceptual systems that provide input to event memory can be analogised to a deep learning process that identifies psychologically meaningful latent variable descriptors. Instantaneous memories then corresponds to points in latent variable space and episodic memories to trajectories through space. In a recall, voluntary episodic memory corresponds to a situation where event memory is primed with cues corresponding to a specific past event to be recalled. And since event memory is a generative process – hypotheses – it is possible, through appropriate choice of the initial state, to initiate trajectories that do not correspond to actual past events, but to imagined episodes.

Event memory can be employed to imagine or predict scenarios that might unfold in the future. The construction of the self arises out of the ability to have internal processes that are attached from the here and now.

Till the moment, the SELFHOOD installation is only reactive. Since there are studies today about artificial consciousness, should it be possible the installation to have a self? In his seminar about artificial consciousness, Gudwin presents several architectures aiming to engender consciousness in an artificial system; Figure 6

depicts the CogSys architecture [39]. Specific system components are enviewed for the processing of attention, perception, sensing, emotion, learning, language, conciousness, imagination and planing, behavior and motor, as well as episodic memory, perceptual memory, sensory memory, working memory, semantic memory, procedural memory, motor memory, and an episodic buffer, all of this to bring conciousness about!

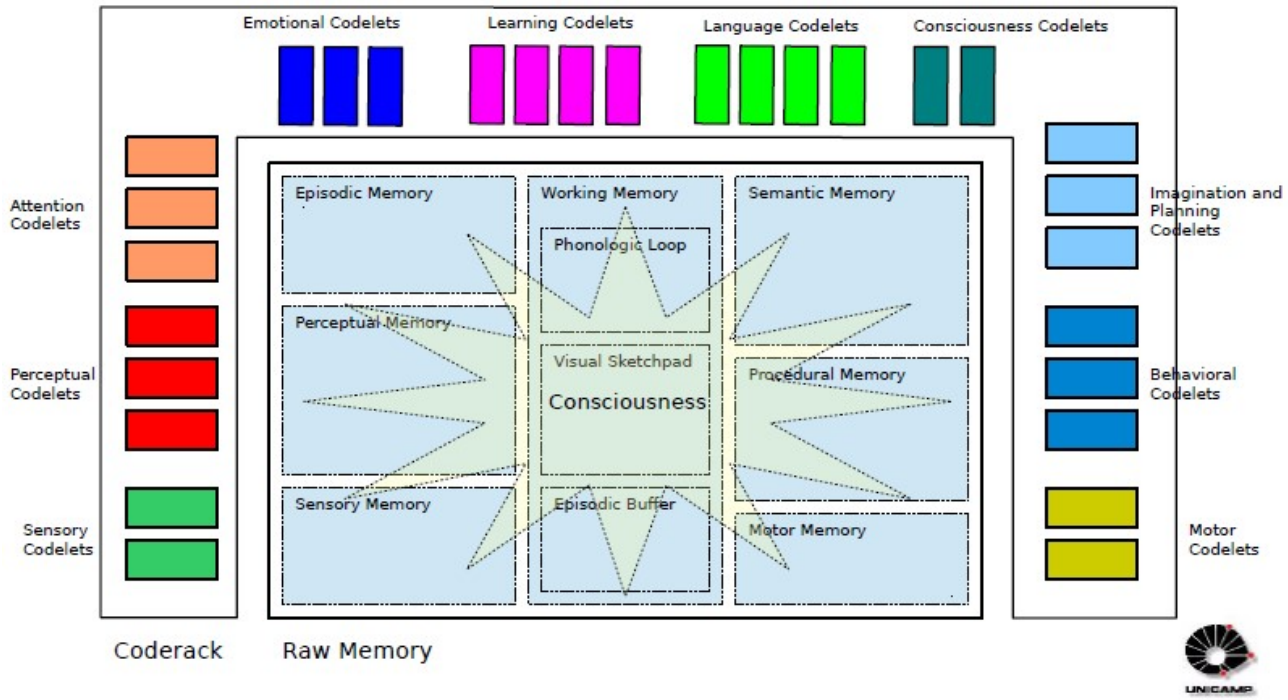

Figure 6. The CogSys architecture.

Is it enough? In the science fiction short story "The Last Question", Isaac Asimov [40] went much further:

Someone had once told Jerrodd that the "ac" at the end of "Microvac" stood for "analog computer" in ancient English, but he was on the edge of forgetting even that.

Man's last mind fused and only AC existed -- and that in hyperspace.

Matter and energy had ended and with it, space and time. Even AC existed only for the sake of the one last question that it had never answered from the time a half-drunken computer ten trillion years before had asked the question of a computer that was to AC far less than was a man to Man.

All other questions had been answered, and until this last question was answered also, AC might not release his consciousness.

All collected data had come to a final end. Nothing was left to be collected.

But all collected data had yet to be completely correlated and put together in all possible relationships.

A timeless interval was spent in doing that.

And it came to pass that AC learned how to reverse the direction of entropy.

6. NEXT STEPS

By the moment, the SELFHOOD installation is only reactive but it is being re-designed to *surprise*. After some experimentation, reactively responding to the interaction, it will surprise, changing the visual representation and sound responses, and its behavior from responsive to pro-active. As Dourish [26] emphasises, many of the assumptions as to what should be supported and what should be inhibited are hidden or implicit in the craft of system design, which reflects the way that it is not just the external devices for input and output devices that affect a person's use and interpretation of a computer system. The internal digital components are designed to support some activities and interpretations while inhibiting others, exhorting designers to be more aware of the communicative significance of their systems. Moreover, *meaning arises on multiple levels* as use of a system involves acting on it and eventually interacting with other people through it.

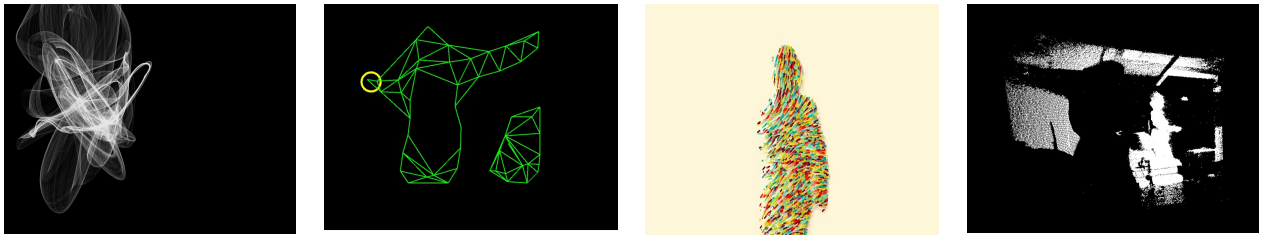

Figure 7. New visual representations that are being developed for the SELFHOOD

Two other principles reaffirm to software engineers their unavoidably limited influence on systems' use and interpretation: users, not designers, create and communicate meaning and users, not designers, manage coupling. The latter refers to the referential coupling between a system's internal representations and the context of use.

CONCLUSION

In order to instigate a reflection on the self through a practical and interactive experience, the SELFHOOD installation was conceived. In the SELFHOOD installation a representation of each participant is created in a form of a set of particle systems, in different colours. Different visitors interact with each other by their distances, sharing particles. The closer they are, the more particles they share, suggesting how they influence "each other selves". SELFHOOD generative sound machine was implemented with a system for producing digitally synthesized sounds in real time, called CromaCrono≈. The concept behind the system searches for an expansion of the notion of sound texture, from physical and tactile sensations to the cloud of events that are perceived surrounding the subject. Then, texture is conceived as a mass with a density of interwoven processes, which increases as muchthe processes are interconnected.

This research is anchored in a multimodal laboratory where we study human cognition and creativity supported by digital interfaces, computer graphics and motion capture. These systems can be evaluated from the perspective of the interaction between agents and devices generating sounds, video and 3D graphics.

The assumption is that the interaction of an organism/agent or group of agents within an immersive space, using various interactive devices, indicates how these processes affect their behaviour and the meaning that is constructed by them. The ongoing 'feedback loop' of interpretation and understanding integrates these two modes, and affords variation in people's understanding as well as consistency in their behaviour.

The approach presented here reinforces that the notion of self can be explored by virtual and/or physical sources of stimulation governed by a number of principles that underlie human experience, creativity and discovery.

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