

Setting up of a self-organised multi-agent system for the creation of sound and visual virtual environments within the framework of a collective interactivity.

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Abstract

The interactive installation *Quorum Sensing* will be presented as an example of the development of this type of system. This device is designed to metaphorically reconstitute an ecosystem by means of synthesised sounds and images. The future of the micro-organisms of this virtual universe evolves in accordance with its own particular rhythms but also in accordance with the movements of the public, which also plays a part in the destiny of the work. We will try to elucidate the rich potential of these models in terms of artistic expression, and will also explain the principal difficulties associated with this research, which impose epistemological reflection concerning the concept of its evolution.

1 Introduction

This interactive tool makes use of a multi-agent system composed of an environment generated by synthesised sounds and images and containing a number of objects that may be perceived, created, destroyed and modified by the agents. The agents are original self-organised entities, virtual beings represented by their 3D image graphs and their voices. They possess their own resources and develop active autonomous patterns of behaviour (Varela, Bourguin, 1992).

The environment conditions the relations that unite the objects and the entities; the organisation of this multi-agent system takes place through the intermediary of operations enabling the agents to perceive, produce, consume, transform and manipulate the objects. The space given to the auto-organisational process, which attempts to move towards the emergence of stable (Baas, 1994), homogeneous relational forms, is linked to an aesthetic choice, since this facilitates the generation of continually renewable, rich, unexpected effects.

Firstly, we will explain the functionality of the system, secondly, we will examine the various interactive possibilities, and then we will consider the

possibilities and future implications of this experiment.

2 *Quorum Sensing*

The Quorum Sensing installation is based on the mutual awareness of all spectators' needs. The number of visitors is the trigger of this installation. Its interactivity lies in the individual location of the participants and their collective move which enables them to discover a virtual microcosmos.

Quorum Sensing is a term of bacteriology. It describes a communication mechanism between similar or different species of bacteria through the release and detection of hormone-like molecules called autoinducers that accumulate in the environment as the bacterial cell density increases.

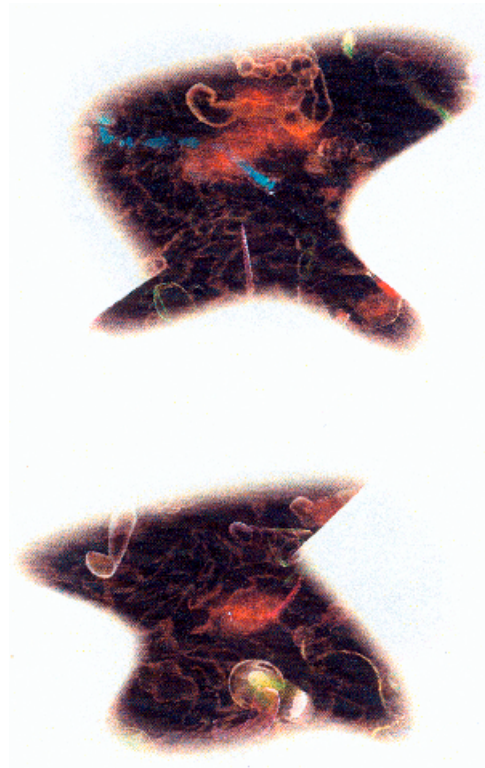
When the detected concentration crosses some threshold, sequences of genes are activated. They induce a change in the behaviour of the bacteria that is reflected on the whole colony. Quorum sensing enables bacteria to co-ordinate their behaviour, to act like multicellular organisms, and to acquire the benefits of co-operative activity (Ward, 2000).

2.1 Principles of the installation

The installation is composed of a by-standers location capture device, and a video projector that screens a computer graphics movie. The installation is placed into a room. The capture device and the video projector are attached on the ceiling so that the movie is screened on the floor.

A base of polygons transforms itself, the capture device gets the number and the position of the visitors. With these input data, a software computes a base of polygons. Indeed, starting from this set of points in the space and depending how they are linked together, one can trace multiple shape of polygons. And by the co-operation of the spectators, when by-standers are motionless, input data are constant. The program generates the morphing sequence between the different polygonal shapes. On the other hand, if visitors move or if their number

changes, input data vary. The software recomputes the new base of polygons and resumes its morphing sequence using the newly generated shapes. Interactions with the spectators including capture and movie animation are carried out in real time (Thompson A. 2002).



Picture A : Generation of the virtual vital space by spectators

2.2 Generation of sound and image

The computer graphics pictures of the movie were created using a set of co-operative and competitive programs. Creatures are generated from a genetic description of their characteristics. These genes describe their morphology, their rendering attributes and their possible moves. Each genome also includes genes for particular vital capabilities and different time thresholds that govern their artificial life cycle (Sims, 1994).

The projected images originate from a first research module called "Biosphere"; in this case virtual creatures were generated in a virtual Petri dish. This artificial life was born of the creation of cellular automata in order to obtain an active environment, the morphogenesis of self-generating creatures through genetic algorithms (Bourez, Cosnard, 1995).

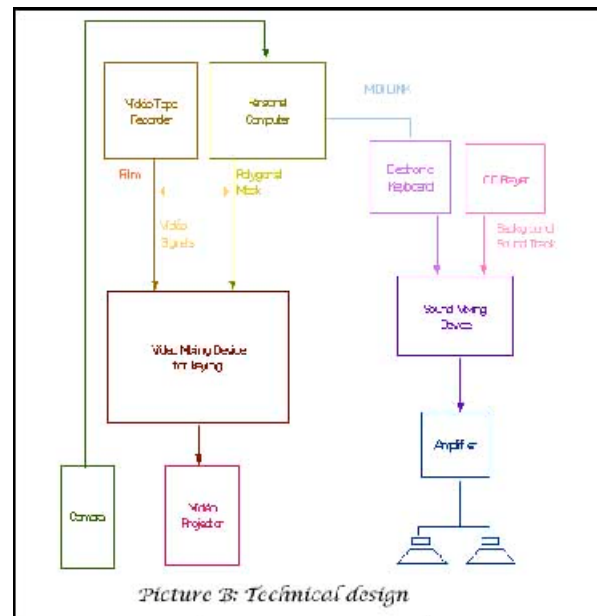
Based on the principles of cellular automata and genetic algorithms, those creatures can breed. They have self-organization and auto-adaptation capabilities. All this creates a complex system that continuously evolves and is never the same (Boden M.A. 2001).

It must be noted that the initial conditions, such as the number of creatures, the space, etc., are extremely important for the future of the system.

To make emerge a world full with life, with artificial life, Animated polygons forms the mask for video keying over a pre-calculated computer graphics movie. The areas of the pictures inside the polygon are visible, while external parts are masked.

With voices which break the silence, a sound track sets the atmosphere of the place where waves of matters coming from the virtual creatures life cycle blend. Voices and cries of strange animals spring up when visitors get closer. The location and the moves of the by-standers trigger different voices. The whole set of spectators creates a polyphony that cuts the peace of the place.

The voices of the creatures are created through the intermediary of a traditional system of synthesised sound generation, and are determined by physical aspects, whether the creature is gelatinous or aqueous, or by aspects of its behaviour, whether it appears fearful or experiences pleasure, for example. This process of sound creation can therefore be seen as a system of amplification of the sentiments conveyed.



Picture B: Technical design

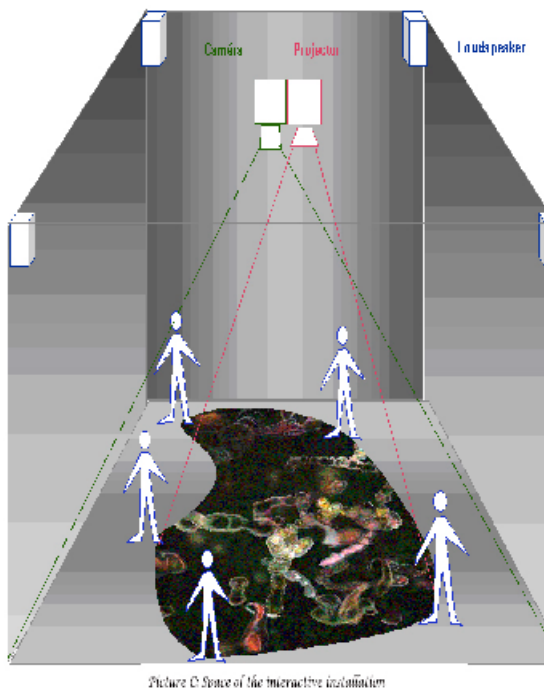
Of an empty place, free and sensorial, this installation creates a free and sensory space where new technologies are hidden on purpose. By-standers are not compelled to wear sensors or press buttons. They are there, quite naturally, together, and can only develop human relationship (Levy, 1992). That enables them to discover a world inhabited by small virtual creatures. The life of these creatures is so active and so short. Each of them blindly moves towards a single goal: to survive and to live in symbiosis with its environment, even if they are not aware of death. Through this feeling of fleeting life, this empty place incites to meditation upon death and birth alternation (Bentley, 2002).

3 Interactivity

3.1 from a small number of participants

When the first by-stander enters the installation, he is an isolated point in space. The picture is composed of a single point. If a new visitor occurs, a line appears. Both spectators will watch a segment of line whose ends correspond to their respective position.

When there are three people, a first emergence happens when a third person enters the installation. The polygon becomes a triangle, and the content of the picture appears. According to their respective moves, those three people will see some part of the movie, but never totally.



Picture © Space of the interactive installation

3.2 From four persons

A second emergence occurs when a fourth witness arrives. If the visitors remain motionless, the picture mask warps by morphing to parse (show) all the possible polygonal patterns. If they walk, the mask shape follows their movements. Depending on the number and the position of the by-standers, the conformations of the mask become more complex to give notched structures that show for a few people, some details of the film that are unseen by others.

However, in order to offer the greatest screening surface, polygons with line intersections are considered as invalid and discarded by the morphing sequence.

3.3 When the number of spectators changes

This process is repeated indefinitely with addition or removal of vertex of the mask in case of the entry or the exit of spectators. When somebody penetrates the

installation, a new vertex is created. The screened picture moves towards him, to welcome him within the community of spectators. When someone leaves the installation, his associated vertex is deleted. The mask is immediately reconfigured, leading to a sudden withdrawal of the pictures towards the remaining people. These phenomena of discontinuities are symbolically similar to the birth and the death of individuals, within a bacterial colony.

4 Perspectives

The aesthetic direction developed by the adoption of a self-organised multi-agent system leads to rich variation and creates a sensation of direct interaction with the image and the sound, implying the possibility of direct dialogue between the creatures and the exterior world, what Michel Bret describes as, "exogenous interactivity" (Bret, 2000).

These real-time systems depend upon to the capacity of the machines to which they are linked, but if these constraints did not exist one could imagine a greater degree of interaction between the different elements, and in particular one could envisage a more evolved system of form recognition for the creatures.

5 Acknowledgments

Thanks to Ms Monique Nahas, M. Hervé Huitric, Ms Marie-Hélène Tramus, and M. Michel Bret, Professors of the University Paris 8 (France) of the department Arts and technologies of Image, for their support, their encouragement and their advice.

We would like to thank also M. Henri Chapier and M. Jean-luc Soret of the European House of Photography.

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