

Developing Cyberspace Design as a Digital Extension to future Interior Spaces [A Genetic Programming (GP) Approach to Cyberspace (Modeling)]

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Abstract.

As architecture enters the new era of digital representation, geometrical theories and processes are being implemented, tested, and pushed to their limits. Recent theories of form in architecture have focused on computational methods of form exploration and expression. From "topological geometry" and hypersurfaces to blobs and folds, there is a clear tendency to seek and explore formal properties as sources of ordering systems. Through computational methods and algorithms, geometry, as we knew it, is being redefined and reconfigured.

Many algorithms have been developed in the past, however recently evolutionary techniques have emerged as an alternative approach to their solution. In this paper, a Genetic Programming (GP) approach, one variation of evolutionary computation, is discussed. A representation of cyberspace interiorities (modeling) problem suitable for genetic programming is presented along with some implementation details and results.

1. Introduction

The Internet, in its diverse manifestations and applications, is showing us daily the traffic of our global consciousness, allowing us to rapidly modify input and output through the formless medium of cyberspace, where time contracts and matter-consciousness is disabled by communications based largely on mind rather than body [1]. That ongoing transition from energy to information helped to discover new space within information, a space free from limitation of the physical world and amenable to explorations of alternate laws .within this space we created new public realm in search of architecture appropriate to its nature. Cyberspace is fast becoming an extension of our physical and temporal existence [2].

For Marcos Novak [3], cyberspace as a whole and networked virtual environment in particular, allows us to construct 'spaces for human inhabitation' in a completely new kind of electronic non-local, public realm and to think in terms of genetic engines of artificial life. Novak is convinced with the idea of the inhabiting in the cyberspace [4].

Cyberspace is more than a breakthrough in electronic media or in computer interface design. With its virtual environments and simulated worlds cyberspace is a metaphysical laboratory, a tool for examining our very sense of reality [5]. The new extensions, of man and the environment they generate are the central manifestations of the evolutionary process [6].The process that extends to form "Evolutionary architecture" which is the

digital embodiment of the dream of an unfettered, creative process. Just as architecture defines people's environments, so too do people define architecture's. There seems no more logical way to achieve harmony than to set the two evolving together [7].

As Karl Chu [8] points out the infinite value of cyberspace in comparison with physical world, he suggests that the actual limits of cyberspace are the limit of computer. By mentioning the infinity of cyberspace, he presents the logical inevitability to use digital based world as a territory for architecture and the computational capability to generate an artificial living form with the ultimate complexity [9]. Genetic algorithms, by specifically addressing the temporal and evolutionary aspects of cyberspace, provide us with the access to new environments and the ability to design complex and meaningful spaces within them [7]. The use of Genetic algorithm model is the evolution of virtual spaces actively engages this abstract notion of accessibility. The algorithm presented here and its use in evolving virtual spaces has tested the feasibility of a paradigm for design with new implications for the theory and practice of architecture [7].

2. Research Problem

One of the central challenges of computer science is to get a computer to do what needs to be done, without telling it how to do it. Genetic programming addresses this challenge by providing a method for automatically creating a working computer program from a high-level problem statement of the problem. Genetic programming achieves this goal of *automatic programming* (also sometimes called *program synthesis* or *program induction*) by genetically breeding a population of computer programs using the principles of Darwinian natural selection and biologically inspired operations. The operations include reproduction, crossover (sexual recombination), mutation, and architecture-altering operations patterned after gene duplication and gene deletion in nature. The genetic programming paradigm represents a leap forward in the ability to optimize computer programs in a wide array of fields. It is a unique departure from the standard genetic algorithm model. In that it circumvents the need for a phenotype which is usually responsible for providing the context for fitness evaluation.

Inside Cyberspace man experiences a new feeling of freedom some thing which looks like a dream in it's purity and transparency, but the true challenge which may face the cyberspace designer, is that he was used to face certain obstacles and barriers in space of reality, which may oblige him to follow some rules concerning Architectural Data, Ergonomics, and many other natural given facts like weather, wind directions, sun rays, law of gravity etc. But now inside such free world known as cyberspace all obstacles and rational facts have been removed to open the horizons of the designer's pure imagination the thing which stimulates debate & questions concerning the relation between inner and outer space, solid & void and the truth about the virtual enclosure of net- architecture. All that may lead the designer to search for some alternative rules & boundaries or let's say some new design strategies & concepts, inspired from his own visualization, memories, culture & background but at the same time must achieve interactivity with the space visitors(participants) whom may accept it not to be reasonable but will never forgive being not comfortable. Moreover producing representations of morphological changes in form and space requires different level of skill than the more basic task of generating so called 'flythrough'. So the question is; should cyberspace designers produce their own algorithmic self-learning tools, such as the work of john Frazer and team (evolutionary architecture), or is it a perfectly reasonable position for the designer to rely on the algorithms that come with the various software packages? [10].

This paper tries to develop algorithms and computational methods that would encapsulate the processes that lead to the generation of alternatives of cyberspace interiorities and that is by the use of Evolutionary design concepts to create design alternatives in a spontaneous way by using GP and this will be applied on a cyberspace project called Peace Shelter [navigable space] (fig 1). The project aims at investing and exploring the structures and processes, of algorithmic design to develop a topological body that inhabits cyberspace and is characterized by its complicated geometrical and mathematical non-Euclidean model using a couple of different softwares. The project "Peace Shelter" is based on the idea of spreading peace among children and teenagers allover the world and achieving interactivity and communication between the children who belong to different cultures and back grounds which may increase awareness of such children and give them strong assets and resistance to face war lies and hatred and let them grow in a better atmosphere and be able to deal with problems, such project will also help to raise a new generation of young people who have better knowledge and able to deal with others and accept different thoughts and points of view.

This project can act like a "Virtual Peace Shelter" which envelop the children and let them navigate through it and be opened to a huge amount of information transmissions and offer them new experiences to enjoy different activities. The project therefore is based on the concept of a (communication chain) working out a global communication concept using each element of the chain as a dynamic vector of diffusion and access to information.

Genetic programming will be used for applications in the field of spatial Composition which could be used to generate spatial forms inside the cyberspace from a set of geometrical structures, deformations and other given cases therefore the process will pass by two main phases:

- learning by case
- predicting new cases

And that takes place by choosing number of cases and features which will be transformed into a mathematical formula (in puts) to facilitate dealing with GP and let it generate new cases (out puts) to facilitate the design process in the future.



fig(1) Peace Shelter, Interior view of the play area.

3. Significance & Future work

The future work involves the identification of a larger number of cases and transforming it into a mathematical formula so it can be manipulated by the GP to help generating new Design alternatives of spatial forms inside cyberspace which represent different generations which will facilitate the design process and help the designer to focus on

innovation rather than wasting a lot of time and effort in dealing with such sophisticated non-Euclidean virtual structures.

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[3] **Marcos Novak**, A pioneer, a traveler through alien architectural terrains. His seminal work has included

many virtual architectures and essays that is crucial to those architects who are interested in the swiftly blossoming architectural cybertheory.

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[6] Mc Luhan Playboy Interview march 1969

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[8] **Karl Chu**, originally from Burma, is an architect working in Los Angeles. He has taught and lectured at various universities and published throughout the world. Currently, he works at the theory and design faculty at the Southern California Institute of Architecture (SCI Arc). He is the founder of X KAVYA, a research and development studio dedicated to the re-conceptualization of architecture through the metaphysics of possible worlds. Presently, he is involved in the development of evolutionary computations for the generative construction of hyperstructures in "Modal Space".

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