Edge of Chaos: Artificial Life based interactive art installation

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Abstract
Our paper presents an art installation exhibited internationally throughout 2018 at La Gaîté Lyrique gallery in Paris, KIKK Festival in Namur, and Cinekid Festival in Amsterdam. The collaborative project between artists and physicists examined the aesthetic possibilities of cellular automata (CA) driven kinetic objects to make theories of emergent life tangible to audiences of children and adults alike. Here we present our approach encompassing: narrative, material, hardware and computation strategies. The “Edge of Chaos” installation, inspired by Christopher Langton’s theory, is an artistic realization of emergent systems at the scale of inhabitable architectural space. The use of on artificial life approaches to behaviour offers distinctly different audience experiences to those in responsive environments that follow master-slave interaction paradigms typically found in Human Computer Interaction fields. Through the use of narrative these emergent behavioural systems and their implications for conceptions of life are articulated in way that is engaging and playful. Through the use of recent metamaterial research the project also provokes discussion on the potential of these material systems to lead to new forms of artificial life.

Introduction
This paper describes an interactive installation that was touring three venues in Europe in 2018; France, Belgium and the Netherlands offering an inhabitable interactive environment based on Christopher Langton’s theory of the “Edge of Chaos”. The Edge of Chaos project is the winning proposal to an international competition calling artists and architects to offer their “perspectives on the technological, dematerialized, complex environments and ubiquitous machines that have become natural elements in our lives” (Competition Brief, 2017). The project is situated at the crossroad between art, design and physics, and this paper’s primary focus is on the interaction and artistic aspects of the work that reflect the use of reconfigurable metamaterials, distributed control, and bottom-up strategies for designing responsive environments. The resulting built installation reflects on our Interactive Architecture Lab’s critical position on so called “Smart Architecture” and corporate led “Internet of Things” which while espousing notions of ecology, remain dominantly driven by top-down strategies to controlling the behaviour of the places we live, work and play.

We have been examining ways of creating intelligent environments not through classical Artificial Intelligence techniques but rather through Artificial Life, embracing the aesthetic emergent possibilities that can spontaneously arise from this approach. The competition brief provoked a response by our team to the statement, “We are entering an era of hybrid ecology: AI as landscape, networks as biotopes, data as organisms and media as humus. Where do we go from here?”. We were drawn to the theory of the Edge of Chaos that examines the balancing point where “the components of a system never quite lock into place, and yet never quite dissolve into turbulence either... the edge of chaos is where life has enough stability to sustain itself and enough creativity to deserve the name of life” (Waldrop 1993). Our art installation is built upon a custom CA algorithm that embodied this notion and creates a space for contemplation about the boundary relationships between chaos and order. In the context of the competition we found a means to make these ideas of emergent life more tangible in four integrated parts, namely, narrative, material, hardware and computation.

Figure 1. Edge of Chaos, La Gaîté Lyrique gallery Paris

Methods
Narratively, there are three features within the installation (Figure 1). At its centre, a kinetic tree (animated by servo motors and RGB LEDs) that represents “Life” (the peak of the Edge of Chaos). It is surrounded by an inert “Cloud” representing the vast unorganised matter of an entropic universe (Chaos), and between them an interactive surface that represents the boundary of the “Edge of Chaos”. The
movement and proximity of inhabitants of the installation measured by proximity sensors activates the “Edge of Chaos” triggering the surface to light up and physically transform. Local interactions by inhabitants stimulate our custom CA triggering chain reactions throughout the surface, that depending on the level of interaction and current state of the surface will produce more ordered patterns, or more chaotic sequences. When the “Edge of Chaos” surface becomes highly activated the tree “comes to life” blossoming into full colour and performing its most dramatic kinetic movements.

Meta-materials are materials which get their properties from their structure, rather than their chemistry (Overvelde et al. 2017). Translating this into spatial design we are able to apply this geometric strategy into designing flexible and transformable spaces with tuneable functionality.

As the installation was intended to run for months at a time, interactive motion and lighting needed to be limited to periods where there is stimulation in the environment by visitors to the gallery space. When there are no inhabitants, the installation must in effect “die out”. The results of this enquiry demonstrate alternative strategies for maximising aesthetic use of CA rules while minimising the live time of kinetic elements. This approach also suggests modes of environmental activation and deactivation that are robust as well as playful and suggests approaches to intelligent architecture based on Alife principles.

Conclusion

The Edge of Chaos installation, demonstrates simple but compelling appeal that responsive kinetic objects elicit. Observing the emerging patterns of our installation we can recognise Langton’s mathematic and theoretical principles of “Phase Transition” where structures are able to grow, split and recombine, in spontaneous and surprising ways. This area represents neither Order nor Chaos but lives in between thus never becoming predictable nor too unpredictable to lose the interest of observers.

The open ended and semi-unpredictable behaviour of the Edge of Chaos installation encourages continued play as inhabitants search for understanding in a field of interactions. While controlled by simple rules it displays complexity by virtue of emergent properties and complex and changing environmental stimuli. Our implementation of custom CA code is effective on aesthetic grounds but also in minimising wear and tear of multiple long running exhibitions which contributes to possible applications in longer term architectural applications. Our narrative and spatial approach proves a novel and tangible approach to communicating abstract mathematical theories of complexity. It is also a celebration of the creative possibilities of collaborating across science and architecture.

References


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