

Revisiting Interactive Art Systems

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1. INTRODUCTION

In their pioneering paper "The Creative Process Where the Artist is Amplified or Superseded by the Computer" (1973) Cornock and Edmonds describe a model for the classification of artworks according to their systemic behaviour. In this presentation I revisit this model, discuss its subsequent development (Edmonds, Turner & Candy, 2004) and present an extension to it that incorporates my own research into the use of the theory of *autopoiesis* (Maturana & Varela, 1987) as basis for an expanded description of the 'interactive art system'.

2. ART SYSTEMS & AUTOPOIESIS

Cornock and Edmonds identified the 'art system' as consisting of the *artist*, the *participant and participants*, the *artwork*, the *environment* in which these elements are placed, and the dynamic *processes or interactions* that result. This is a classic system-oriented model and will be familiar to anyone who has studied systems theory in any discipline.

Maturana and Varela identify similar elements and relationships within their autopoietic model of *biological* systems and it was to this model I looked when considering how Cornock and Edmond's might be developed further.

The essence of Maturana and Varela's work is a description of how self-maintaining systems interact. Their work describes how such systems are able to maintain their structural organisation over time and co-evolve in response to each other and their environment. Despite being initially concerned with living systems, the concepts they introduce can be applied to systems generally and, I will argue, are particularly suited to describing interactive artworks.

By considering the relationship between the participant and the artwork in their terms I will demonstrate that it is possible to gain additional

insight into the interactive process and the nature of interactivity. Similarly, by comparing the systemic properties of the artwork to those of an autopoietic system (such as the participant) I will show that the range of systemic properties that can be considered in the interactive art systems model can be expanded.

3. ACTIVE MIRRORS & MOVING PICTURES

As an artist, the goal of my research into interactive art systems has been to support my creative practice. I will illustrate my presentation with a demonstration of current Active Mirror, Memory Place and Moving Pictures art systems.

The Active Mirror engages the participant, or participants, in a fast-moving feedback loop of interaction. Memory Place adds a memory to the system and rewards stillness rather than movement. Moving Pictures self-construct over time in response to changes in their environment.

All three art systems will be part of a major exhibition of new work by Sean Clark to be held in Leicester in August 2011. The evaluation of these artworks will form the next stage in the author's study in to the nature of interactive art systems.

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ColourNet: A System Of Interactive and Interacting Digital Artworks

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describe the *ColourNet* digital art system and will demonstrate how people can interact with a smartphone artwork and a screen-based work that each interact with one another.

Author Keywords

Digital arts; Interaction; Color

ACM Classification Keywords

H.5.m. Creative interactive interface architectures

General Terms

Design; Human factors

Introduction

Ernest Edmonds' *ColourNet* system includes the possibility of separate, possibly mobile, artworks by others to be included within the distributed system. The version to be demonstrated at CHI consists of two digital artworks – the core Shaping Form component and the Transformations by Sean Clark. Both components are able to interact with multiple users simultaneously and can work independently. However, they are also able to interact with each other by exchanging color information via the Internet.

Abstract

ColourNet is a digital art system composed of a set interactive and interacting artworks. Although the artworks are able to work independently, they can also operate together to provide enhanced possibilities for human interaction and creative participation. We

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The Shaping Form ColourNet Core

Shaping Form is an established series of artworks by Ernest Edmonds [1,2]. The version used in *ColourNet* takes the form of a generative system that produces an image composed of changing blocks of color. The color values and proportions of these components change over time in accordance with a generative algorithm.

The image can be displayed on an LCD screen or projected as shown in Figure 1. A video camera monitors the space in front of the image, gathering information about audience (user) behavior. A given level of movement triggers a 'fast response' sequence that gives users feedback: they have been 'seen' by the artwork. The changes accumulate and alter the longer-term evolution of the colors and their proportions displayed by the artwork. *Shaping Form* learns and evolves in response to its experiences [3].



Figure 1: A projected Shaping Form.

Transformations

Transformations is an artwork by Sean Clark that consists of a web page designed for use on a smartphone. The page displays 25 colored squares in a 5 by 5 grid. When the user touches one of the squares grid changes in response. The configuration of this new grid is dependent upon its previous state and the position of the square touched.

More than one instance of *Transformations* can be active at the same time. If just one person is using it then the nature of the grid transformations, resulting from their interactions, are quite simple to identify. If, however, multiple people interact with it simultaneously then the transformations appear to be more complex.



Figure 2: a) A Transformations starting configuration; and b) the same grid after a series of user interactions.

When operating as an independent artwork, the color pallet of the *Transformations* grid does not change. From a starting state such as in Figure 2a, user interactions result in a change in the position of the colored squares, such as in Figure 2b.

The artwork is typically accessed on a smartphone, with users in different locations having no direct

communication with each other. However, it can also be presented in a gallery environment on a projected screen. In this configuration multiple users are able to interact with the artwork on their personal mobile devices while collectively viewing the projected image.

ColourNet: Interactions Between Shaping Form and Transformations

Both the *Shaping Form* core and *Transformations* were conceived as art systems in which interactions between the artwork and its users are essential to the development of the piece. In Figure 3, the *Shaping Form* component is represented as System A, with the artwork able to interact with users via its video camera and screen. System B represents *Transformations*, with interactions taking place between the artwork and the users via the touch screen on the smartphone.

ColourNet, represented as System C, introduces the possibility of interactions between *Shaping Form* and *Transformations* (shown by the dashed line in Figure 3). In *Shaping Form*, whenever it updates its image, the new 'highlight color' is passed to *Transformations*. This is then used to set the color of the central square in the color grid. In *Transformations* whenever a square is touched the color value is passed to *Shaping Form* and triggers a 'fast response', with the incoming color used as the background color for the process.

The result of introducing interaction between the *Shaping Form* and *Transformations* is that they now operate as sub-systems of a new art system, *ColourNet*. The sub-systems can still be interpreted as individual art systems, but the relationship between the two now becomes a vital part of the dynamic of the piece.

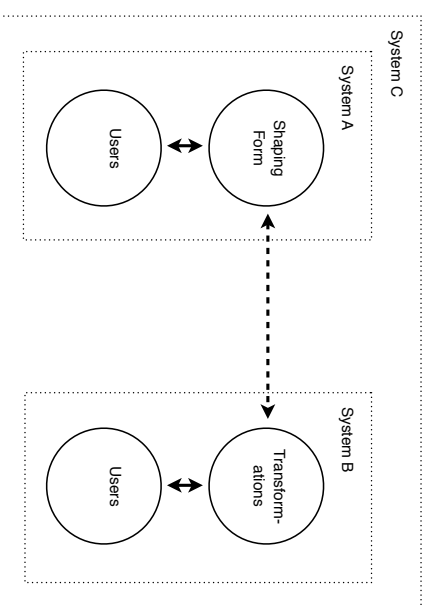


Figure 3: The *Shaping Form* and *Transformations* systems.

The role of the users within the combined system also changes. In Figure 4 the users are now divided in to three groups. G1 contains those who are only interacting with the *Shaping Form* sub-system, G2 are those who are only interacting with the *Transformations* sub-system, and G3 are those who are directly interacting with both.

For the users in group G1, their experience of *Shaping Form* is different when the artwork forms part of *ColourNet*. In particular, the pace of the piece changes, with additional, 'fast response' states being triggered – the source of which cannot be determined without awareness of the full *ColourNet* art system. For those in the G2 group, the squares in the *Transformations* grid begin to change color – with the colors, again, coming from an unknown source.

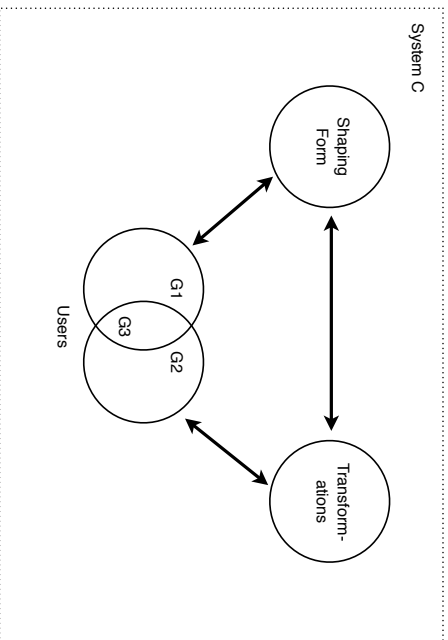


Figure 4: User groups within the *ColourNet* system.

Only the users in the overlapping G3 group are exposed to the full nature of the *ColourNet* art system. By interacting with *Shaping Form* and *Transformations* simultaneously, the users will first see that they are able to trigger instant color changes in *Shaping Form*, and then discover that the resulting 'highlight color' is returned to the centre of the Transformations color grid.

The Exhibition of *ColourNet*

ColourNet was first installed as part of Ernest Edmonds's Light Logic exhibition at Site Gallery in Sheffield, UK, between 17th November 2012 and 2nd February 2013 [4]. *Shaping Form* was displayed in an upper window of the gallery (see Figure 5) for viewing at night, with a copy of the screen shown on an iPad in the main gallery for viewing during the day. Scanning a QR code located inside the gallery accessed the *Transformations* web page.



Figure 5, *ColourNet* at the Light Logic exhibition

Acknowledgements

We thank all staff at Site Gallery, but particularly Kira Askaroff for her help in exhibiting *ColourNet* as part of the Light Logic exhibition.

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Dropsketch Installation

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Abstract

Dropsketch is a Smartphone drawing system that enables users to anonymously create and share simple black and white sketches of their surroundings. The free app, available for iPhone and Android devices, contains an easy-to-use sketching tool and the facility to 'drop' completed sketches on a shared map. It makes use of the Smartphone's built in positioning system to identify the location of the sketch. The app is used to drive the *Dropsketch* installation that allows participants to interactively explore the ever-growing database of incoming sketches.

Author Keywords

Digital arts; Interaction; Sketching

ACM Classification Keywords

H.5.m. Creative interactive interface architectures

Introduction

Dropsketch [1] was developed for the iPhone in 2011 and was first shown publicly as part of the *Digital Art Systems* exhibition at the Interact Gallery in Leicester, UK [2]. The Smartphone app can be downloaded for free and provides the user with a simple black and white sketchpad. Users are encouraged to make quick sketches of their environment, or anything else that comes to mind, and anonymously 'drop' them on to a shared world map. This can then be seen by other users within the *Dropsketch* app as well as by visitors to the *Dropsketch* website (see Figure 1).

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During the *Digital Art Systems* exhibition, a screen was installed in the gallery that automatically displayed all incoming *Dropsketch* sketches. The exhibition was well publicised in the city of Leicester and featured in the local press [3]. Somewhat surprisingly, a large number of users from *other* parts of the world were also attracted to the system, with contributions arriving from around Europe and the UK, North and South America and Saudi Arabia. During the two-month exhibition, *Dropsketch* accumulated over 1,000 user-contributed sketches of numerous subjects.

Technology

The iPhone and Android *Dropsketch* apps are free to download from the relevant app stores. In order to share the sketches, the user's device must be connected to the Internet, either via Wi-Fi or 3G (which may incur charges to the user. This is made clear in the app). The installation uses a Mac or PC computer with the Chrome web browser. The ideal physical space is one in which people are able to stop and interact with the installation. Copies of the installation can be put on multiple computers, in multiple locations.

It should be noted that the incoming sketches are not filtered or censored, although inappropriate images can be removed if necessary.

Context

I have had a long-standing interest in the computer support of sketching. In fact, I contributed a paper to the first Creativity and Cognition conference in 1993 relating to the topic [4]. The *Dropsketch* drawing tool is connected to this early work in that it offers simple unencumbered pencil-like tools in preference to object-based drawing tools.

I see mark making as the fundamental creative act; the first thing we learn in 'art' classes at school and something most of us continue to do every day. The *Dropsketch* installation attempts to aggregate these simple sketches and 'doodles' in such a way that the whole becomes greater than the sum of the parts.

What might initially appear to be trivial and throwaway begins to take on new meaning when seen as part of a collection. Patterns and themes appear in the incoming

stream of sketches – faces, words, animals, buildings and cartoons. Some marks remain mysterious, such as the example in Figure 4. Might it be a map of where the contributor lives or works? As word of the installation spreads, and more people around the world use it, the universality of the desire to make a mark becomes even more apparent. It's also, quite simply, fun to use.

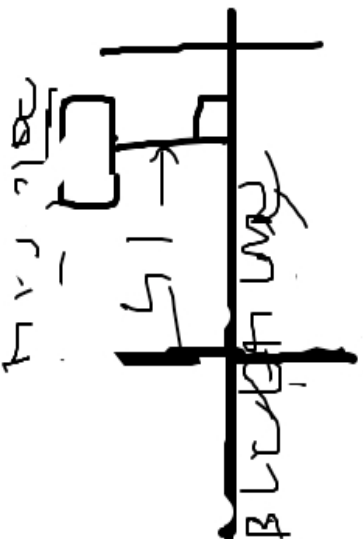


Figure 4: An anonymous contribution from Thailand

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Connected Digital Artworks

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This paper describes an art installation that illustrates the concept of the Connected Digital Artwork. The installation is being run simultaneously at the HCI Interactions Gallery and EVA London. The concept of a 'Cybernetic Ecology' is introduced and its relationship to the Internet of Things is discussed.

Networked, Connected, Systems

1. INTRODUCTION

This installation presents a selection of LED and screen-based connected digital artworks produced by the author as part of his forthcoming solo exhibition "A Cybernetic Ecology".

The artworks individually and collectively explore the concepts of "flow" and "connectedness" and present a contemporary realisation of the notion of a systems aesthetic (Burnham, 1968).

The installation in the HCI Interactions Gallery in Bournemouth is being run simultaneously with a similar installation at EVA'16 in London, with the artworks connected via the Internet.

2. THE OPERATION OF THE ARTWORKS

Each artwork is able to accept inputs from, and push outputs to, the other artworks in the network. In the pieces exhibited here, inputs and outputs take the form of numerical values that are exchanged via an Internet web service. As such the network is closed to human interaction. However, open configurations are possible where human participants form part of the network. In artworks such as "A Colloquy of Glass Jars" (Clark, 2015), communication between the artworks is through sound and light, enabling humans to participate. In the collaborative piece "Cities Tango 2" the inputs and outputs also included images, the exchange of which was triggered by the movement of viewers near the artworks (Edmonds and Clark, 2015).

When an artwork accepts a new input value it reorganises itself in order to maintain a rule-driven pattern of organisation. Having achieved a fully organised state, any values that are no longer required by the artwork are output via the web

service and become available for use as the inputs to other artworks.

The process of the artwork reorganising itself is presented to the viewer as a dynamic grid of colours based on the values that make up the structure of the artwork. The rules used to reorder the grid, referred to as its organising principle, involve algorithms that order the colours according to their hue, saturation and lightness levels.

3. A CYBERNETIC ECOLOGY

The constant exchange and reuse of materials within the network of artworks is intended to be analogous to an "eco-system" where inputs taken from the environment are processed by an organism in order to maintain its internal structure. Material that is no longer needed by the organism is then released back in to the environment and forms the inputs to other organisms.

A network of connected digital artworks is referred to by the author as 'A Cybernetic Ecology'. The term captures two key influences behind the work, that is cybernetic theory and ecological thinking. It is also a line from the Richard Brautigan poem "All Watched Over by Machines of Loving Grace". This poem imagines a future world of harmonious co-existence between living and technological systems (Brautigan, 1967).

4. CONNECTED DIGITAL ARTWORKS AND THE INTERNET OF THINGS

The exploration of the "connected digital artwork" - a digital artwork that is intrinsically connected to its viewers and other artworks - has lead the author to consider a number of other propositions.

Firstly, should connectedness be seen not simply as one aspect of digital art but instead its key affordance? The author would argue that this is indeed the case and that “digital art” is on an inevitable journey to becoming “connected art”.

Secondly, might viewing a network of connected digital artworks from a systems perspective be something that has value when considering the “Internet of Things”? As ever larger sense and control networks are developed, the author suggests that a “Systems Theory of the Internet of Things” might become increasingly valuable.

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Tango Apart: Moving Together

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Abstract

Tango Apart: Moving Together is an interactive digital art system that has two or more communicating parts in different locations. Although each part is able to work independently, they also operate together, connecting the different locations and providing an aesthetic communication channel and creative participation. In particular, the work will connect CHI2016's Interactivity with its Art Exhibition. Through the addition of mobile phone components, CHI participants will be able to join and experience the work throughout the conference, out and about in San Jose and back home afterwards.

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Author Keywords

Interactive art; Communication; Distributed

ACM Classification Keywords

H.5.m. Creative interactive interface architectures

General Terms

Design; Human factors

Introduction

The primary aim of this proposal is to install an artwork that is shown both in CHI2016 Interactivity and the Art Exhibition. It is an artwork that connects the two events together and provides a communication channel between them. Whilst it is not a simple direct video-link it does include the transmission of images between the two locations. As the exhibition lasts much longer than the conference a third element is included so that the coherence of the work is maintained throughout the Art Exhibition. This third element will be in Leicester, England.

The key issue that this artwork addresses is the aesthetics of distributed connected interaction. It explores the creation of new aesthetic experiences in and around connected spaces: Interactivity and the Art Exhibition on the one hand, San Jose and Leicester on the other.

Tango Apart: Moving Together is an artwork that is in many parts (with a minimum of two elements, or 'nodes') that are distributed. That is to say each node is in a physically distinct location, perhaps different rooms in the same building or, equally, different cities or continents. It is a development from *Cities Tango 2*, first shown in 2015. In both works, each node interacts with active participants, and people who pass by, in their locations and also interacts with the other nodes across the Internet. The colours and the images seen are influenced by, and show, the partner nodes, forming a **virtual tango** between, in the case of *Cities Tango 2*, Leicester and Rio de Janeiro. *Tango Apart: Moving Together* also connects San Jose with Leicester but, more significantly, it connects CHI2016's Interactivity with the Art Exhibition, providing a virtual connection between the two related components of CHI. Interactivity will communicate with the Art Exhibition.

An additional element of the work is the availability of unlimited extra nodes on smart phones in which preferred colours can be selected by touch that then influence the colours at all the other nodes, from Leicester to San Jose.

Historical Context

Tango Apart: Moving Together is an extension of *Cities Tango 2*, which was itself a development of *Communications Game* by Edmonds, first shown in 1971, and his recent *Cities Tango* Internet version [2]. Both *Tango Apart: Moving Together* and *Cities Tango 2* incorporate recent work by Sean Clark with this historical development.

Communications Game
Communications Game, originally a proposal for the Computer '70s trade exhibition, was based on the idea that the core of the artwork would be people interacting with one another through a network. Being 1970, the network idea was not, of-course, based on any concept of the Internet.

The proposal provided stations for a maximum of 15 participants and for a minimum of two participants. The stations are arranged such that a participant can only see one, two, three or four stimulus-providing units within his station and a station is part of the group activity only when it is occupied by a participant. Each unit can be acted upon by the participant in response to a given stimulus. No instructions are given to participants on the manner in which the system of units operates.

The first realization of the *Communications Game* was shown in the Invention of Problems II Exhibition at the City of Leicester Polytechnic (now De Montfort University) in 1971. Only three networks of units are used and each unit is equipped with an input switch for turning on lights in units of the same network and a single light for output. For each participant, the lights provide the stimuli and the switches are the means for the participant to respond.

Cities Tango
The artwork, *Cities Tango: between Belfast and Sydney* [3] is an example of the recent works, based on the core concepts of *Communications Game*, that use the Internet to implement distributed interactive art. In this case, the two cities, Belfast and Sydney, interact with one another across continents and time zones. In particular, the colors, stripes and timings used are driven by

movements at the remote location, so that in the European day Belfast may see 'night' colors, for example, and Sydney may see 'day' ones. On the other hand, the display, from time to time, of real time images from the remote location is influenced by the local audience.

Immediate responses to movement are seen by the 'audience' in their own location. The live connection is sensed through the real time images. It created a small stir, for example, when people in the Sydney gallery recognized Ernest Edmonds appearing on their display. He was, of-course, in Belfast.

Cities Tango 2

Cities Tango 2 is a collaborative artwork made by Ernest Edmonds and Sean Clark. It was first shown in the *Primary Codes* exhibition at Oi Futuro Flamengo, Rio de Janeiro and at both De Montfort University and Phoenix Arts in Leicester, UK [5].

In this work, the *Cities Tango* concept was again used, but the colour stripes of the earlier work were replaced by the Transformations colour patterns by Sean Clark. This had the significant consequence that a mobile phone artwork was added to the network of nodes, making the possible number of interacting elements unbounded.

Transformations

Transformations is an artwork by Sean Clark that consists of a web page designed for use on a smartphone. The page displays 25 colored squares in a 5 by 5 grid. When the user touches one of the squares grid changes in response. The configuration of this new grid is dependent upon its previous state and the position of the square touched.

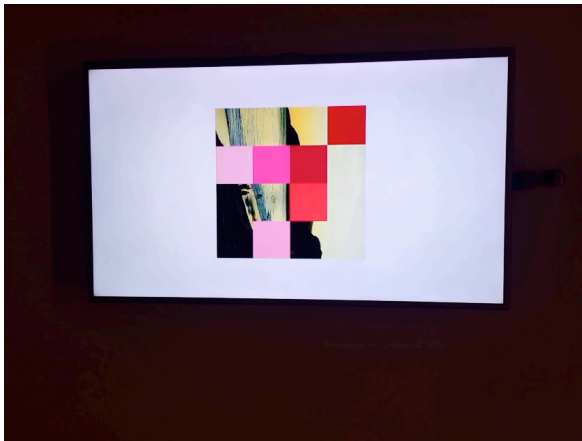


Figure 1: *Cities Tango 2* in the Primary Codes exhibition.

More than one view of the *Transformations* grid can be active at the same time. If just one person is using it then the nature of the grid transformations, resulting from their interactions, are quite simple to identify. If, however, multiple people interact with it simultaneously then the transformations appear to be more complex.

When operating as an independent artwork, the color pallet of the *Transformations* grid does not change. From a starting state such as in Figure 2a, user interactions result in a change in the position of the colored squares, such as in Figure 2b.



Figure 2: a) A Transformations starting configuration; and b) the same grid after a series of user interactions.

The artwork is typically accessed on a smartphone, with users in different locations having no direct communication with each other.

ColourNet

An important pre-cursor to this work, from another stream of development, was Edmonds and Clark's *ColourNet* systems artwork that was first shown at the Site Gallery, Sheffield UK, in 2012 [4] and also included in the CHI2013 Interactivity [1]. *ColourNet* takes the distributed interacting nodes idea used in all of the works from *Communications Game* to *Cities Tango* and extends it to include the possibility of different nodes being independent interacting artworks, initially exemplified by a fixed location work interacting with multiple smartphone/tablet based artworks. *ColourNet* thus influenced *Cities Tango 2* and the current work, *Tango Apart: Moving Together*.

Physical Realization

Tango Apart: Moving Together has, at its core, two or more nodes each of which consists of a standard screen hung in portrait orientation, a web cam and a computer, such as a MacMini, connected to the

internet. The software is based on web technology, so the hardware demands are very basic and general. One such node is placed in each location [Interactivity, Art Exhibition, Leicester UK]. All of the nodes communicate with a server that controls the complete system and passes information between the nodes.

In addition, the public is invited to scan a Tag to enable them to add instances of the work's nodes on their smartphones or tablets. In this way, extra moving locations are added to the network of communicating elements.

Acknowledgements

The authors thank Site Gallery and Oi Futuro Flamengo as well as the staff and, especially, the curators Laura Siliars, Caroline Menezes and Fabrizio Poltronieri for their encouragement and support.

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‘Flown’ - Sculptural Light Installation

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Abstract

‘**Flown**’ is a sculptural installation by artist Esther Rolinson. It is a hand-folded animated acrylic structure that has been constructed through the process of drawing, model making and research into materials and technology. This is a proposal to exhibit a developed version of ‘**Flown**’ using generative programming and the addition of an interaction design made in collaboration with Sean Clark.

‘**Flown**’ was commissioned for the Illuminating York Light Festival and made with the assistance of a team of creative technologists and programmers including Sean Clark, Graeme Stuart and Luke Woodbury. ‘**Flown**’ has been detailed as a scalable kit of parts that can be reconfigured to its location. In this showing it will be scaled down to fit into a group exhibition appearing as a cascading form or geometric haze molding around the gallery architecture.

Author Keywords

Art, art technology, collaboration, light sculptures, drawing

ACM Classification Keywords

H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

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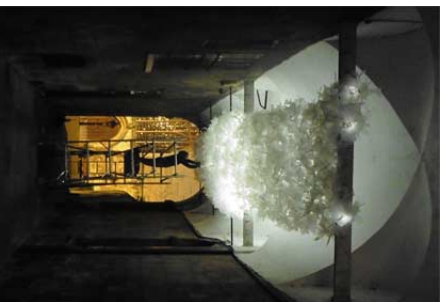


Figure 1: 'Flown' being installed in York Oct 2015



Figure 2: 'Flown' York Oct 2016

Introduction

"My intention is to make objects and architectures that invite reflection on each persons' relationship to the places they inhabit and remember. I want to make the familiar patterns of movement that I experience in the everyday visible, such as the motion of water or the simple act of breathing".

'**Flown**' is a large abstract light sculpture constructed from a multitude of small interlocking geometric shapes. It appears as an illuminated mist animated with delicate patterns of movement and is based on the notion of an ephemeral cloud-like structure that has drifted to ground. It is as if we are viewing it at a molecular level, watching light refracting through its cells.

At full scale '**Flown**' is constructed from over 800 hand-folded pieces of polypropylene, animated with LEDs. It was commissioned for York's annual light festival, 'Illuminating York' and was viewed by over 50,000 festival visitors in October 2015. This video showing an extract of the work: <https://vimeo.com/145522112>

In this version of '**Flown**' we will use a practiced construction method to make a smaller structure that has the quality of a frozen waterfall or a cluster of ice particles. From this established format we will expand the works animation language with a sensitive interaction design.

Background

'**Flown**' was made over six-months through an intuitive drawing and model making process. It is essentially a drawing rendered in three dimensions and based

directly on pencil drawings of interlinking, rhythmic forms. During its construction Esther employed the same instinctive drawing-like approach to working with the acrylic, using the folds and supporting rods to create marks. The piece has a minimal support system of ropes specified by project sponsors GDH Livigun Engineers. The geometric forms are back-lit with LEDs and attached onto the ropes using wooden rods.

In its first showing '**Flown**' was programmed with software written in 'Processing' by Graeme Stuart. This created sequences of soft wave-like movements interspersed with staccato phases evocative of bursts of lightning. These behaviors were developed over a two-year period in partnership with Dave Everitt and Sean Clark in relation to the three works '**Melt**', '**Splinter**' and '**Thread**'. The programming was steered by poetic descriptions and drawings of organic patterns such as waves, trickles and rushes. The behaviors can be altered in terms of speed, scale, intensity and color and applied to any three-dimensional array of lights to create continuous motions through a structure. An aim in developing them was to sensitively animate light to express the drawing language used to design the physical forms.

Evolution

The next step for '**Flown**' is to experiment with the complexity of its animation. An ambition is to create subtle nuances that influence the viewer's sensory experience with organic movement patterns that are complex but familiar. The programming approach will adhere to the work's original aesthetic whilst introducing intricacies in the movement design that have been planned but not yet practiced. The process will be incremental. In the first instance researching



Figure 4 'Flown' York - Detail

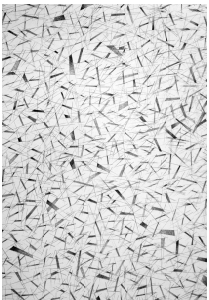


Figure 4: 'Flown' York - Detail of drawing

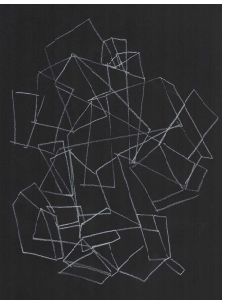


Figure 5: 'Flown' Pastel Drawing



Figure 6: Esther Rolinson and Sean Clark working on 'Splinter'

generative movement patterns based on the flow of ink in water as seen in the video link below, then progressing on to create a meaningful interplay between generative patterns and changes in temperature, light and moisture. <https://vimeo.com/131406907>

The temperature, light and humidity sensors will be installed both in and around the artwork. The subtle differences in the readings from the sensors will then be used to trigger generative changes in the lighting states of the artwork.

Exhibition Set-up This version of '**Flown**' could be between 2 and 4 meters square. It can be arranged and sized in numerous ways and could be located on a wall, cascading from the ceiling downwards or spanning the corner of a room. The location and configuration can be negotiated depending on the layout of the exhibition. The piece will be composed of smaller scale versions of the acrylic forms. As it is light-weight it requires minimal fixing and can be held in place with batons drilled into the wall.

Collaborative Dialogue The development of '**Flown**' is part of an ongoing collaborative dialogue between Esther Rolinson and Sean Clark that has arisen over the past three years working on '**Melt**', '**Splinter**', '**Thread**' and the first version of '**Flown**'. Both share an interest in connectedness and systems and explore these ideas through their diverse art practices; Esther through the process of drawing and making and Sean through the use of technology as a vehicle to create and understand connected systems and objects.

The development of '**Flown**' as a responsive piece is informative for new work emerging from both artists. Sean Clark has an on-going interest in applying a systems-theoretic approach to the development of digital artworks. This piece can be seen in such terms, with the artwork's inputs (sensors) and outputs (lights) intimately connecting it to the gallery environment and providing opportunities for the creation of feedback loops and the emergence of complexity

Esther Rolinson's works are concerned with creating sensory connections between viewer and form. She uses structures and animation to make installations that resonate with the felt experience. This phase of development for '**Flown**' raises questions and ideas around: the identity of works as singular pieces, the sequencing of movement, and what environmental information is pertinent to each work.

The use of environment sensors - temperature, light and moisture - will allow the artwork to respond subtly to the exhibition environment. Human beings are highly tuned to these environmental properties and are able affect them by simply being in a space. Viewers may also discover that specifically interacting with the sensors - by affecting light levels with their hands or blowing on the sensors - causes responses from the artwork. Our intention, however, would be to allow viewers to discover and explore these possibilities themselves.

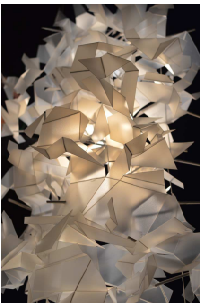


Figure 7 : 'Flown' Prototype - a small scale version of the work

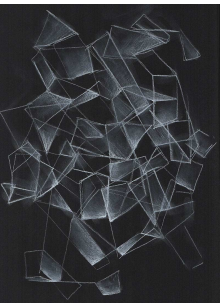


Figure 8 'Flown' Pastel Drawing



Figure 9: Esther Rolinson cutting



Figure 10: 'Flown' Prototype - a small scale version of the work in daylight

Esther Rolinson – Biography

Esther Rolinson is based in South East England. She completed her Visual and Performing Arts degree at Brighton University in 1993 and since that time has worked solely as a visual artist working with drawing, gallery installations, three dimensional design, digital imaging and light. Recent exhibitions in 2014-15 include:

- Computer Drawing – DP Henry and Beyond, LCB Gallery, Leicester
- 'Still Holding', Drawings, Townner Gallery, Eastbourne
- 'Melt, Splinter and Thread', Cube Gallery, Phoenix Arts Centre, Leicester.
- 'Underwing' Drawings, Wall Gallery, Musgrove Park Hospital, Taunton.
- 'Melt, Splinter and Thread' - Work in Progress, Digital Media Print Gallery, Hastings.

Esther makes independent and site-specific surfaces and structures, focusing on the idea of sensitizing environments. She digitally animates found and self generated images that are often developed as sculptural works. These are exhibited as temporary and permanent works such as 'Drift', a light work embedded into the seating wall, Brighton (2008), and 'Supple Solid', a large scale projection commissioned by the British Council, Berlin (2002).

Esther's work explores the architectural applications of three-dimensional structures, animated light designs and digital technologies. Her work sits at the borders between art, architecture and computer technology. Her major permanent works include: 'Stream', a lightwork, Hastings (2002), 'Air Wave', an articulated acrylic surface, Bracknell (2004), 'Trace Elements', a

large scale LED installation, Coventry (2006), and 'Align', a lightwork, Lewes (2006).

Esther's drawing practice is the basis for many works such as the sand blasted granite floor 'Flow' commissioned for Musgrove Park Hospital, Taunton 2014. Her drawings are also exhibited and sold in their own right. Esther's work can be seen at: <http://www.esterrolinson.co.uk>.

Sean Clark – Biography Sean Clark is a digital artist, a web and mobile developer and a Visiting Research Fellow at the Institute of Creative Technologies at De Montfort University. In his commercial work he is interested in social networking, mobile multimedia, collaborative computing and location-aware information systems. In his arts work he is inspired by systems theory, the nature of interactivity and creative explorations of flow and connectedness.

His artworks include individual and collaborative pieces that explore the interconnected nature of the world around us through the use of computer hardware and software. These have been exhibited nationally and internationally, including recently in Leicester, 2011, 2012, 2013, 2014; Cardiff, 2013, 2014; Sheffield, 2012 ; Paris, 2013; Sydney, 2013, 2014; London, 2014; Rio de Janeiro, 2015; Beijing, 2015). He is increasingly making use of so-called 'Internet of Things' technology in his creative practice. Examples of this can be seen at: <http://seanclark.me.uk> and <http://interactdigitalarts.uk>

Signal: A Systems-based Creative Collaboration

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1. INTRODUCTION

This paper describes “*Signal*” a new connected digital artwork created by Esther Rolinson and Sean Clark. In common with much of their collaborative work, including the award-winning artwork “*Flown*” (Rolinson & Clark 2016), *Signal* began as a hand-made drawing by Esther Rolinson, before being developed in to a light piece and then an Internet-connected digital artwork with the involvement of Sean Clark. This paper describes the systemic nature of both collaborative process and the artwork itself.

2. SIGNAL

The incarnation of *Signal* described here (and exhibited at the conference) takes the form of three framed screens, each containing a small internet-connected PC. Each screen displays an image composed of the original sketch plus an animated set of coloured concentric circles moving at different speeds.



Figure 1: The three screens forming *Signal*

Circles grow out from the centre of each screen, reach the edge of the drawing and then return to the back centre, where they are swapped with a colour from another screen. The process continues with a constant recycling of colours as they pass between screens.

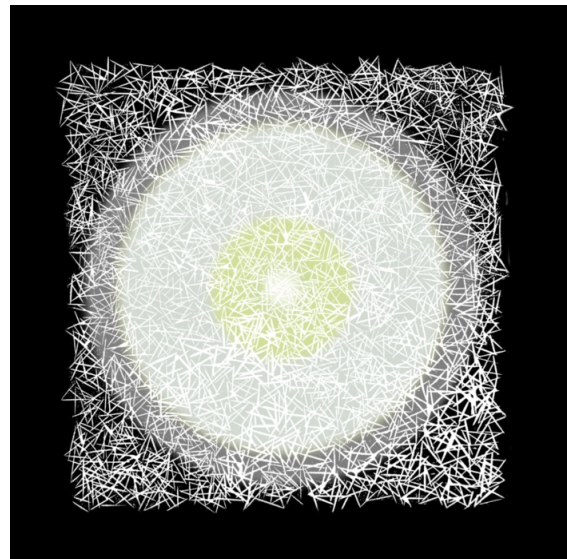


Figure 2: Concentric circles of colour in *Signal*

2. OPEN AND CLOSED SYSTEMS

Signal can be seen as a single closed system made up of three individual open systems. The colours contained within each screen are continuously being exchanged with the other screens, and hence are unlikely to be the same form one minute to the next. However, the pool of colours used across the whole system remains the same. This is intended to be analogous to an ecosystem in nature where individual organisms maintain their living structures through an intimate exchange of materials with other organisms. It is

also a realisation of the Connected Digital Artwork concept previously presented at the EVA London conference by Sean Clark (2016).

When first exhibited, *Signal* formed part of the larger *A Cybernetic Ecology* exhibition (Clark 2017) where the three screens were also able to exchange colours with other artworks in the exhibition in a way similar to that developed for *ColourNet* (Clark & Edmonds 2013).

The colours accepted by *Signal* when operating as part of this wider network had to fall within the palette of colours that the artists felt were appropriate for the artwork to maintain its aesthetic integrity. Again, similar to a living organism, the system was only open to the material necessary to maintain its structural form.

3. A SYSTEMS-BASED COLLABORATION

A systems-based approach was been used throughout the construction of *Signal*, as well as in its contextualisation.

The hand-made drawing that forms the centre of the piece was produced by Esther Rolinson using a rule-based technique as part of a meditative drawing process.

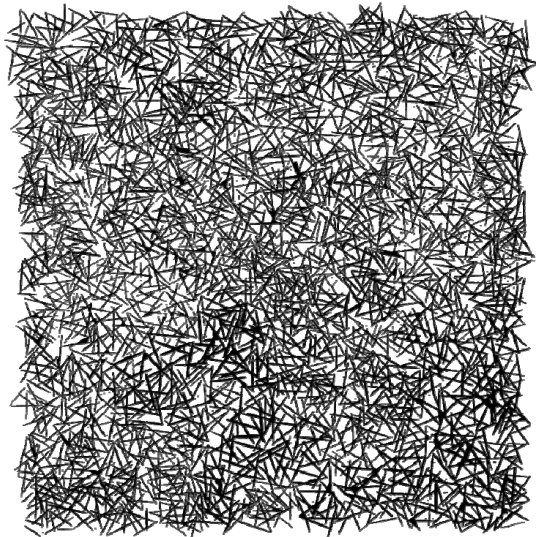


Figure 3: The original hand-made drawing for *Signal*

The use of rules of construction is then applied to the development of the animated elements and then to the connected behaviours.

At each level, it would be possible for a committed viewer to make sense of the rules used to construct the work. However, the multiple layers used add to the complexity of the piece and it is not expected by the artists that viewer need understand the full systemic nature of the artwork to appreciate it.

4. NEXT STEPS

As the collaboration develops, opportunities for closer connections between the Esther Rolinson's drawing systems and Sean Clark's digital systems are being explored.

This is presently focussed around the use of drawing capture to generate patterns and rhythms that can be used in the creation of the rules for the digital animations.

Similarly, we are looking to find ways to use the patterns produced by the digital aspects of the work to inform the sketching process.

We hope that the result of this collaboration will be the development of a hybrid analogue/digital arts practice. Something that combines the sketching process and digital technology in a way produces new artworks that explore territory beyond that of either existing medium.

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