

Thawing colours: dangling from the fuzzy end of interfaces

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In this paper we present *Thawing Colours*, a tactile, visual and sonic installation, which uses suspended spheres of melting ice to paint on surfaces, woollen strings to provide a means of interaction, and concatenative synthesis—the stitching together of many small fragments of sound—to provide a digitally mediated response to motion and vibration by resynthesizing the input sound using a corpus of pre-prepared sounds. In one sense, it is an evolving, site-specific physical installation, a painter or designer that produces images over the course of several days. With some intellectual license, it can be taken as a naturalistic interface for querying a database of sounds, or as a particularly large and unwieldy musical instrument. It is literally a fuzzy interface, with boundaries extending out through the fibres of the woollen strands used to attach coloured balls of ice, and through the supporting cables into the foundations of the building, and through the fingers, palms, and bodies of the participants. We argue that there is a niche for interfaces that are whimsical, ludic and exploratory, and that as part of exploring this niche, we can take an ecosystemic view on interfaces: embracing their physical properties, their situation in an environment, and the byproducts and feedbacks therein.

Interactive installation. Embodied interaction. Concatenative synthesis. Signal Processing. Arts, fine and performing. Signal analysis, synthesis and processing.

1 INTRODUCTION

The piece, *Thawing Colours (TC)*, created by the authors is an interactive installation piece that unfolds over time; each day, spheres of ice, pebbles and pigment are suspended over a large sheet of paper. Sensitive contact microphones capture vibrations within the physical structure, which are then amplified, and sent to a concatenative synthesis system for digital interpretation. The audience is invited to interfere with the piece, which creates a soundscape of live and resynthesized noises, as well as affecting the mark-making carried out by the dripping water and pigment. The piece was conceived as an experiential artwork, to engage the audience in playful interaction. During the piece's development, a number of points of engagement with physicality and interfaces arose. In this paper we describe the piece in more detail, and then discuss its qualities as an interface¹. We

see this as related to Bill Gaver's ludic design work (Gaver, 2002), Rudolf Frieling's art of participation (Frieling and Groys, 2008), Simon Waters' performance ecosystems (Waters, 2007) and Tim Ingold's lines of interaction and experience (Ingold, 2007). We also find resonance with a call for interfaces with 'a low entry fee, with no limit on virtuosity' (Wessel and Wright, 2002; Frisk, 2005). Finally, this relates to the author's other works: *ChaoDependant* (Perello et al., in press) an interactive installation based on a physical system sonified through sensors and synthesis, and *Truth Table*² which is a ludic interface to multi-source internet searches, and to the other author's work: *Like Fish in Sand*³ an audiovisual physical interactive installation which uses water and sand as playful and distortive projection surfaces, and *The Surface Inside*⁴ an audiovisual piece to perform ecosystems on surfaces while moving along paths.

¹ A video showing *Thawing Colours* in action is available at <http://vimeo.com/davemurrayrust/thawingcolours>. More images and construction details can be found at <http://mo-seph.com/projects/thawingcolours>

² *Truth Table*: <http://mo-seph.com/projects/interactable>

³ *Like Fish in Sand*: <https://vimeo.com/30694250>

⁴ *The Surface Inside*: <https://vimeo.com/33247804>

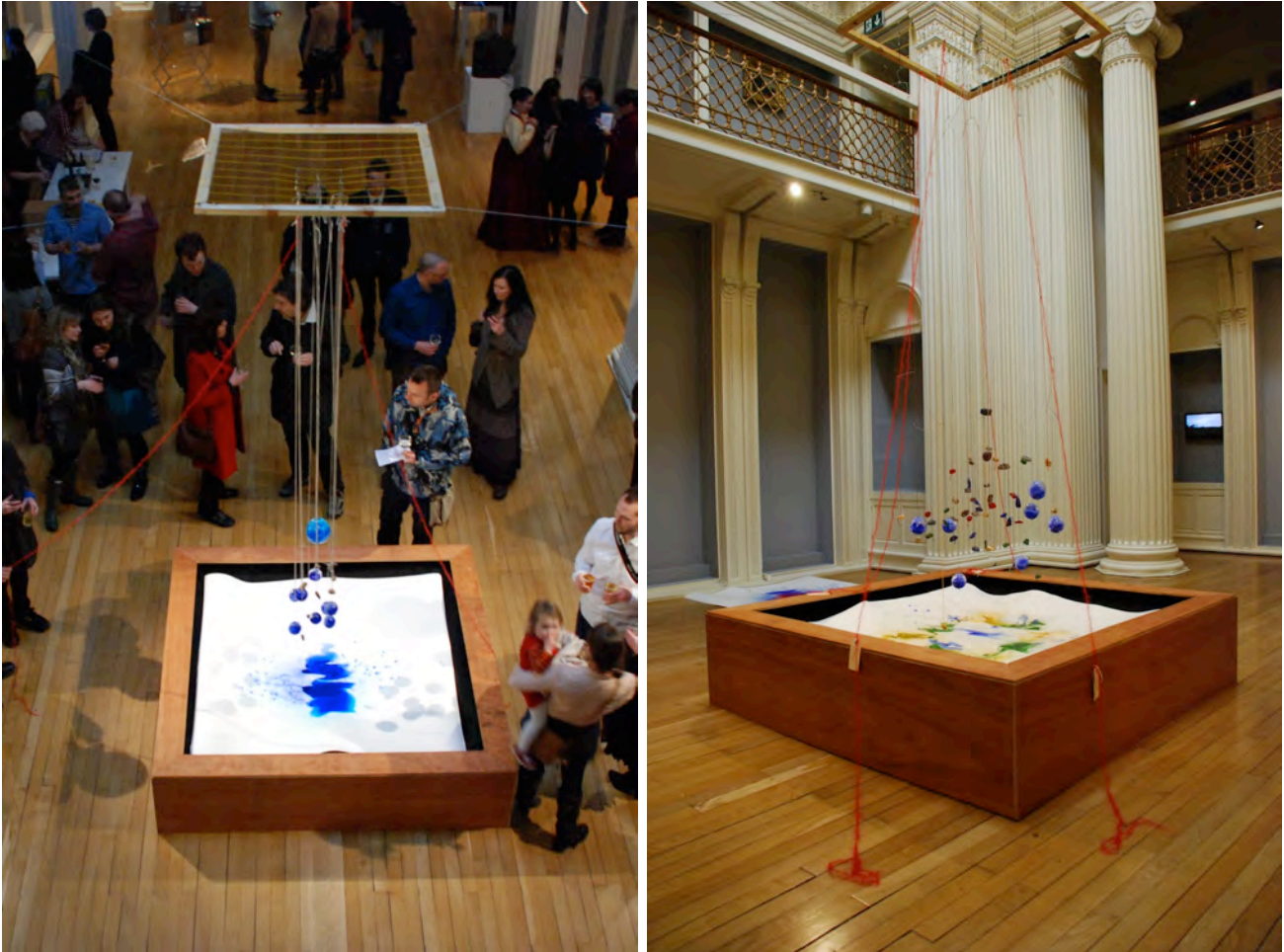


Figure 1: Thawing colours. Left: at the start of the exhibition, showing the wooden frame and wire grid, the paper and collection pool. Right: partway through, showing the growing collection of pigment-covered suspended stones, some melting ice and the additional wool added to encourage audience interaction.

2 DESCRIPTION

2.1 Physical Presence

Physically, the piece consists of a grid of wires, suspended above the audience (Figure 1, left). Ephemeral ice shapes are added to this base: spheres of ice, containing pigment and pebbles are hung from the grid, using woollen strands attached to metal hooks. The metal hangings are designed to allow rotation and movement, and to interfere with each other, the wool, and the metal grid. Sheets of thick, absorbent paper are suspended below the ice, to catch the water and pigment that drips down, with a pool beneath to catch any possible overflow not absorbed by the paper. Over the course of the exhibition, new ice is added every day, in different colours and configurations; each batch of ice has a particular effect on the paper surface, and constructs its identity based on the colours used and those already present. As the paper becomes saturated, it warps, creating an organic terrain onto

which new drops fall; this lends the piece a geological and hydrological feel, as mounds, rivers and lakes emerge, complete with sediment deposition and concentration of colour through evaporation.

2.2 Analogue and digital electronics

To begin the transition into the digital realm, a hypersensitive array of contact microphones is glued to the metal grid, sent to a custom preamplifier¹, and input to a computer. Some minimal processing is carried out to reduce feedback and tame some troublesome frequencies; this live signal is sent directly to the speakers, and used as the input for further processing (see Figure 2). CataRT (Schwarz et al., 2006, 2007) is a library for the Max/MSP programming language, which supports *concatenative synthesis*: creating output

¹ <http://www.zachpoff.com/diy-resources/alex-rice-piezo-preamplifier>

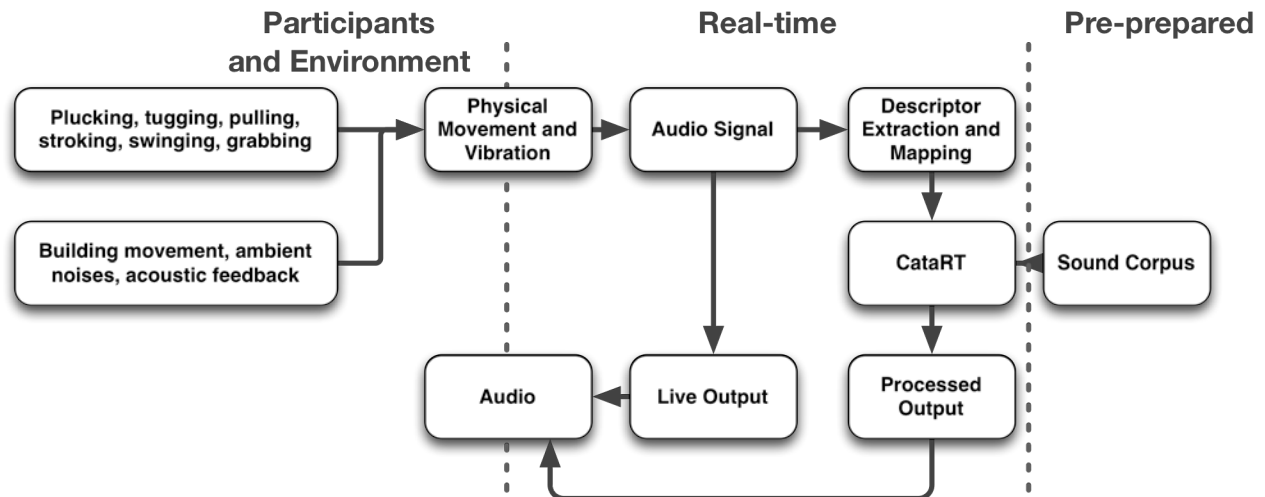


Figure 2: System diagram – flow of information between participants and the real-time synthesis engine

by concatenating many tiny fragments of audio from a corpus. Here, *descriptors* are calculated from the incoming audio – such as pitch, periodicity, spectral centroid – and then matched to descriptors of sound fragments in a database. In this manner, the incoming sound is re-interpreted, using a corpus of sounds obtained from ice melting and shattering. This re-interpretation is delayed from the live sound, to allow it to be experienced as a discrete voice.

2.3 Interaction and conceptualisation

In a soundless room, the piece is silent. The main participant interaction with the piece is through physically manipulating the balls of ice, interfering with the woollen strands and ultimately, activating the movement of the metal hooks from which they depend. To encourage the visitors to begin the exploration of the “thread that will become an audible trace” (Ingold, 2007), extra pieces of wool with the tag “Pull Me Gently” are suspended which can be stroked, plucked and tugged, and cause the piece to move in sympathy, building up rhythmic oscillations which are converted into audible sound. Many of the sounds produced this way are not directly audible – thin wires brushing against each other and wool or metal rocking on metal produce incredibly quiet sound, while plucking the woollen strands creates a low frequency vibration without sufficient power to move enough air to be heard. It is only the use of sensitive microphones, which respond to vibrations within the structure that elucidate this microcosm of hidden sound. At the same time, the sensitivity of the microphones used means that the piece is sensitive to its environment, becoming part of a performance ecosystem (Waters, 2007); it is not isolated, but the interface extends out to include the acoustic environment, picking up feedback and speech, and the infra-

acoustic world vibrations of the building: rumblings from the foundations, footsteps, shifting floors. All of these vibrations are re-interpreted into the vocabulary of ice and water: sounds are matched to similar fragments; the creaking of the building becomes squeaking of outgassing ice, plucked strings become drops of water and metallic impacts are replaced with the shattering from heat-stressed ice blocks.

3 FUZZY INTERFACES: REFLECTIONS AND CONNECTIONS

Thawing Colours is an open-ended piece, a facilitator of interaction that works with processes, presence and materiality. There is no particular form of interaction desired, no goal to be achieved. Like the Drift Table (Gaver, 2002), it encourages exploration and investigation, a *ludic* approach to joining in. In the absence of a formal evaluation, here we attempt to connect the piece to some broader concepts, and reflect on which parts were successful.

A simple interface can hide a depth of interaction: on a first pass, one discovers that tugging a string brings a cascade of sound; later, the live sound can be heard as distinct from the processed; then, the effect of different types of plucking and pulling on the timbre of processed sound emerges; eventually movements involving the whole structure allow for different areas of the sound-world to be accessed. This journey can be seen through the lens of *engagement*, as participants—the *parts* that *take* part (Frieling and Groys, 2008)—discover a gradually unfolding set of possibilities inherent in their interactions with the piece. It can also be seen a development of *virtuosity*. In particular, as creators of the piece, we developed our own virtuosity in

playing it, as an instrument – or *infra-instrument* (Bowers and Archer, 2005). Through the process of constructing and improving the piece, we were also encouraging and developing its virtuosity as an improvisational partner, and in interpreting and responding to *our* desires and nuances: ‘we encounter ourselves in the work’ (Pallasmaa, 1996). From talking with and observing participants, it was clear that there were very different levels of understanding of the piece. Many, especially in a crowded gallery context understood that some kind of response was taking place, but were not aware of the mechanism, or relationships between the live sound and the re-synthesis. Many visitors would hesitate to touch the piece, or briefly pull a string to verify that something happens and then return to observing. We feel that without the possibility for *tranquil interaction* (Ilmonen, 2007), for example at the opening with many people and a high level of background noise, many visitors are unable to explore the interaction possibilities the piece offers. There is a tension here, between providing open-ended, multi-layered experiences, and guiding or prompting visitors to explore the depth of possibilities. With more analysis and refinement, it would be possible to provide clearer jumping-off points to help initiate development of understanding and technique, without losing the exploratory feel of the piece. It would also be possible to create an environment around the piece which encouraged a slower, considered interaction.

Interface design is often discussed in terms of “interface to...”, which brings with it conceptions of control and intention, and the implication that there is a thing which is being interfaced. In this case, a formulation of “interface between...” is more appropriate—the piece is the interface, and comes into being through the interaction between different worlds, rather than the harnessing of one to another. The simple act of adding a hypersensitive microphone creates an interface between the separate domains of the physical environment and the digital system. The boundaries of the interface are blurred, as they extend through the smallest threads of woollen strands, along the suspending cables into the foundations of the building, and of course through the fingers, skin and embodied presence of participants. Nic Collins suggestion of “laying on hands” (Collins, 2006) is apposite here: although the participants hands do not directly touch the circuitry involved, there is a sense of intimate connection with the electronics, as minute movements are captured and amplified. In the action of drawing sounds with wool threads, the body slips into the virtual realm of processed sounds while simultaneously being present in the interaction of ice, colour and paper.

With a small amount of academic license, *TC* can be interpreted as a whimsical approach to database

querying (Tremblay and Schwarz, 2010). There is a mapping between input sounds and those in a corpus. By modulating the sounds of the piece, a skilful performer can select regions within sound space from which output sound can be constructed. This is unlikely to replace MySQL or NoSQL as a database query language. However, there are useful points here for interface design. In many cases, accuracy, power and reproducibility are the primary concerns. Here, it was more imperative to be engaging, to be suggestive, to be accessible. With practise, it is possible to cause individual samples from a corpus of several thousand to be played. At the same time, with no questions of syntax or screen-based literacy to contend with: complete novices can elicit some kind of understandable response. Many systems require an up-front learning of structure and control, and discrete bits of functionality must be explicitly discovered and learnt to progress (e.g. adding clauses to query statements). Here we have a query system that can be used immediately, but allows a gradual refinement of precision, through a physical, tactile interface. From a methodological point of view, the mapping between input sounds and those in the database is a slightly opaque process. Querying the database using features directly extracted from the input results in an unsatisfying experience, as the signals occupy different areas of parameter space, and a very limited subset of the corpus is used. The mapping of input parameters to corpus parameters was carried out in an ad-hoc fashion, roughly matching ranges of each descriptor. While workable, this is cumbersome, and unsatisfactory, and is a part of the work where stronger methodological or technical approaches could be brought to bear.

Much of the impact and richness of the piece comes from its physicality. Using vibration as the connective tissue articulates an interface built on an “organic” skeleton. “Natural” materials – wood, wool, stone – are the main points of contact; they are not *sensors* or knobs wired up to control something else. These components *are* the interface connecting the digital and corporeal. This means that it is not only the behaviours envisaged by the creator that are available – the full range of physical reactions are potential means of engagement. This leads to the interface being more intuitive, more open ended, and more *comprehensible* – it does not need to be designed with a particular conception of a *user* in mind, but can be receptive to the inventive ways people find to interact. At the same time, the richness of the piece can be an issue; by combining several processes together, there is no clear statement or story that can be extracted. In particular, although the painting produced by the piece and the sounds produced have their origins in the same phenomenon, there is no direct relationship between the drips of water and the

sound made; there are no parallels in the patterns of paint and of audio. It could be argued that there are two separate pieces, one which paints and one which makes sound, which happen to be physically super-imposed, or share some elements. However, when physically present and interacting with the piece, the individual tends to bring these two elements together: sounds, images, and space are combined and processed simultaneously. This is an area that could be strengthened significantly, to create a more substantial relation between the physical traces and the ephemeral interactions.

With this in mind, the auditory and semantic coherence of *TC* is important. The sounds of metal and wool provide the first voice of the *TC*, which is immediate, responsive and surprising in its range: much of the acoustic activity occurs in the low frequency spectrum, going down to ~25Hz. This voice has a very different feeling to the dripping and splashing of water droplets that constitutes the painterly activity of the piece. Using a corpus of water-derived sounds adds a second voice to the piece, creating a three way conversation when participants+environment are included. This third voice relates to the water and ice used to carry out the mark making, the physical traces that reveal the developing and transitory nature of the piece components; the sounds are not just used formally, but for their semantic relation to the other elements. There is a similar feeling to both voices through their exposure of otherwise inaccessible soundworlds – both involve presenting very “small” sounds: through hypersensitive microphones and through “close miked” recordings of the microsounds of ice melting respectively.

Another aspect of interface design to consider is statefulness. Does the same action produce the same result each time? In this case, there is very little modifiable state stored in the physical system: a delay on the descriptors sent to the concatenative synthesis engine is the only digital memory used (apart from a fixed corpus of sound). However, there are several layers of physical state, working at several timescales. At the coarsest scale, physical elements are added to the piece, which interfere with each other, and modulate the sensitivity. Over the course of an exhibition, the piece becomes more physically cluttered, and more acoustically sensitive as there are more pieces of wire, wool, melting ice, and pebbles ready to swing, tangle, brush and bounce off each other. There is the state inherent in the melting of ice; a daily rhythm of decreasing mass, affecting the swing of the elements, allowing for different tanglings and fusions. There is the state created through the flowing of water and pigment, which has no *direct* bearing on the sound created, but results from, and records, the splashing and movement created through interaction, it is ultimately the physical trace

of the intertwining of the elements that constitute the piece and the action of participants. And finally, there is the physical energy contained in the piece at a given moment in time: displacement, oscillation, the varied rhythms and resonances of the grid, the hooks and armatures, and the suspended weights. It is this final state which is most directly accessible to a participant: while on a base level, the more energy that goes in the louder it gets, different modes of vibration can be encouraged, between frantic shakings of the grid and slow pendulumic sweeps of the balls of ice.

The point we would like to make here is the balance between digital and physical state. Digital state is often seen as more manageable: memory is cheap, storage can be used long- or short-term, it is invisible, commodified, tractable. While these are generally useful qualities, in this case, rejecting them provides something richer. The physical state of the piece is directly observable – there are correlates between motion and sound, and participants can affect these in an intimate, relatively unmediated manner.

4 CONCLUSIONS

We have presented *Thawing Colours*, an installation piece which uses concatenative synthesis and hypersensitive microphones to create a responsive partner in open ended interaction. We have discussed the area between engagement and virtuosity, and how the creators of a piece can look to imbue the work with virtuosity as well as allowing it for participants. We have argued that using a naturalistic interface allows for a different way of interacting with databases, a gentle, ludic approach to querying, which can be backed up by a rich physical system, creating a *fuzzy interface*, with no clear boundaries, no clear goals, yet semantic coherence, richness and depth.

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