Reflections on the Nature of Interaction[1]

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Digital art may be static or dynamic with a totally fixed behaviour but often such artworks, or art systems, interact with the world in some way. These interactions may be with objects in the environment or may be with an audience sensed through image or sound analysis. The most complex interactions are potentially those with the audience, with purposeful enquiring (human) systems. Whilst a concern for interaction in computational art has been with us for a long time (Cornock and Edmonds, 1973), it still deserves careful consideration. What is the nature of such interaction and what is the range of forms that it might take? How might those forms determine the kind of computational mechanisms that are appropriate for the artwork?

Burnham argued for the importance of understanding artworks in their environmental context and that all things 'which processes art data...are components of the work of art' (Burnham, 1969). So by that definition, the audience is part of the artwork. As early as 1966, Roy Ascott had developed a theoretical position in which participation and interaction between the audience and the artwork were central (Ascott, 1966). He later gave up the practice of making art objects all together: 'In California in the 1970s, introduced to the computer conferencing system of Jacques Vallée, *Informedia*, I saw at once its potential as a medium for art and in 1979 abandoned painting entirely in order to devote myself wholly and exclusively to exploring telematics as a medium for art' (Ascott, 1998). In other art forms, such as *Happenings*, participation was also prevalent. Kirby described rather basic examples of participation in Allan Kaprow's *Eat* thus, 'Directly in front of the entrance, apples hung on rough strings from the ceiling. If the visitor wished, he could remove one of the apples and eat it or, if he was not very hungry, merely take a bite from it and leave it dangling' (Kirby, 1965). Participation in the artwork by becoming part of the art system and interacting with whatever the artist provided was becoming a familiar experience, whether it was typing at the keyboard or eating the apple.

In the 1960s and 1970s it was also current wisdom that engagement and interaction had a positive part to play in any creative activity. Thus, participation in art was considered to be important. Learning by doing, interactive science exhibitions and so on were very popular concepts. However, notwithstanding 'Happenings' and exhibitions that invited the

audience to play, participation was much easier to promote than to achieve. This is where the computer came in.

Considering the computer as a real-time control device, given that we can specify rules for how it is to respond to external stimuli, it can be seen to put behaviours into effect by taking in sense data and controlling output devices such as video projectors and speakers. The work done in Artificial Intelligence and on Robotics in simulating intelligent thought was an important inspiration for this kind of work[2]. Theoretically, Cybernetics and General System Theory offered interesting ideas about how computational systems could be used to model and implement animal-like behaviours[3]. These fields seemed interesting, therefore, in the development of engaging participative artworks. The computer offers something quite new in respect of enabling interactive artworks to be made. This new opportunity does not depend on agreeing with the form of Artificial Intelligence that believes that the programs can stand as some kind of scientific theory of human thinking, but some of the techniques developed in those studies are certainly valuable. The questions come down to quite normal ones for the artist. How to think about and how to make the work? How to enable engagement and sustain audience interest? What makes interaction meaningful and how does that influence our understandings of ourselves? (Edmonds et al, 2006).

The media used in digital art apply to many art forms, including painting, performance, film and participation. Where the medium is static such as printing, the technology issues concerned with the output devices (e.g. printers, video projection) are well defined. However, the situation is quite different when it comes to interaction in art. *Interactive art* is concerned with the way the technology *performs*, as well as how it appears. Here, there remain many unresolved issues despite considerable advances in the technological possibilities since the concept of interactive art first appeared.

In today's interactive art, where the artist and the audience play integral participant roles, the computer's role has immense potential. In the past, it was a dream yet to be realized as artworks that could transform viewers into participants. The opportunities for including audience participation have been increased by the advent of digital technology. Collaboration in art practice has grown significantly, in the sense that the visual arts have developed some of the characteristics of film production, with teams of experts working together on projects.

In the early days of experimental interactive art, Cornock and Edmonds put forward the idea that the computer could have an important role in defining the specification of the art work and also managing the real-time result of that specification. This role is quite different to the computer as a means of producing graphic art images. By 'specifying" and 'managing', they meant that the computer controls the way an artwork performs in relation to its environment including its human audience, or, arguably the more appropriate term, its 'participants'. Because the role of the computer was envisaged as critical to the experience, they speculated that such work could transform the artist from an art specialist in creating artworks to a catalyst for creativity (Cornock and Edmonds, 1973).

A baseline for considering sound can be taken as white noise, which is perceived when each audible frequency is equally loud, when nothing, no shape or form, can be distinguished in the sound. By analogy we can ask what white interaction would be: nothing? Nothing that we can observe perhaps? That may be as good a starting point as any. So we develop the language of interaction from the null neutral case. As with the other elements that have been mentioned, the true interest is in the nature of the interactive experience itself rather than in anything that it might signify. The nature of interaction is, therefore, a key issue.

Interaction is not material. It is experienced, perceived, understood but we cannot touch it. It is a somewhat difficult concrete reality to deal with, but it is the concern of many artists today. The questions we ask ourselves include, for example, the nature of *engagement* in an interactive art system. How do we explore engagement and its impact on our sense of ourselves and of our relationships with the world around us? We ask about *complexity* in the context of time and interchange. We try to find what can *emerge perceptually* beyond and over an interaction as specified in concrete terms (Edmonds et al, 2006).

Consider some examples of my own generative art work in terms of the mechanisms behind them. . A Video Construct is searching through a set of rules and, as it does so, it generates the sequence of images that form the output of the work. Each image represents the state of the search at that moment. In my 'Interactive Video Constructs' the artwork reacts to events detected by sensor systems. An image analysis system that analyses the scene as the pictures are captured is incorporated into the generative program. The performance of the work, i.e. the generative path that it takes, is then reactive to what participants are doing

In the non-interactive systems, the sequence of states was entirely determined by the 'search strategy' used by the software to explore the rules[4]. In the interactive case, however, the 'search engine', that automatically operates the search strategy, has available to it a stream

of data that is a coded, or symbolic, representation of the behaviour of the viewer. This data modifies parameters in the search and leads to a perceived sense of reaction by the system to the participant. Because these Interactive Video Constructs are described within the computer by a set of rules, it is possible to add an extra computer program that uses the history of interactions between participants and the work to modify the generative behaviour by changing the rules or changing which rules are used. By recording and analysing the interactions, the software 'learns' from experience about human reaction to the artwork. The Video Construct changes its behaviour in the light of its experience with human participants interacting with the work. As it learns it changes the way that it develops rather than simply changing the stimulus-response rules that govern its behaviour. In summary, the 'Learning Interactive Video Construct' is an art system that evolves in response to participant interaction with the work.

Consider the issues in a broader context. In General Systems Theory[5] the behaviour of a system or the interrelationship of one system to another is seen to be complex. An interaction involves an exchange but need not necessarily lead to a significant change in behaviour. More recently, it is frequently pointed out that interaction cannot be simply understood as if, for example, '... what happens to a system in an interaction is determined by the perturbing agent and not by its structural dynamics...' (Maturana & Varela, 1987, p. 196). An interactive system is an open system that exchanges information or matter, in both directions, with its environment. One key concern is the relationship between any *input* and later *output*. In the simplest such system, any given input is followed, after a certain interval, by a certain predictable output. One depresses a switch and the light comes on. If we add the notion of an internal state, then a slightly more complex version can be described. The output associated with a given input may be a function of both the associated input and the current internal state or, as it is often described, the mode that the system is in.

To take the simple example of an interactive system with an internal state, consider a remote control device that can operate both a TV and a, so-called, digital set-top-box. It may have two buttons (**TV** and **BOX**, say) which, when pressed, produce no observable reaction. Instead, they change the mode so that any following button press is directed to the indicated device. Hence, each of the two modes lead to the device displaying a different set of responses to the same set of user actions. For example, the 'power' button may turn the TV or the box on, depending on the current mode.

Even in this very simple case it is interesting to consider some of the interaction structures in place. The **TV** and **BOX** input buttons are not associated with action-response behaviours. Instead, they change the

internal state and, hence, the action-response behaviours of *later* button depressions.

Of-course, there is no reason why an input might not both generate a direct response *and* change the internal state. Thus, we can consider various kinds of input to an interactive system. We can identify ones that:-

1. generate a given response after a given time
2. change the internal state (and so influence later behaviours)
3. both respond and change the internal state.

In addition to *responding* in these various ways, a system can take actions (generate outputs) purely as a result of internal mechanisms. For example, an automatic controller might turn the room lights on and off at certain intervals. Hence we can also consider various kinds of output, that:-

1. are responses to inputs (relative to the current state)
2. are generated autonomously (relative to the current state)

Clearly, these outputs can be different parameters of the same output event, such as the pitch and amplitude of a note). A similar point can be made in relation to inputs, of-course.

So the question arises of what we really mean by *interaction*? In some respects, with delayed response, as a result of mode change, and even delayed influence on autonomous output, in the same way, *interaction* does not seem an appropriate word to use. Perhaps the words *influence, stimulus, interchange* are more evocative of the meaning discussed above. Perhaps the *influence* of one system on another could be said to come about as a result of *stimulus, interchange* or even *co-operation and conversation*, if we add a layer of meaning to the situation. We may talk about the audience's *influence* on an art system where the development of its behaviour is affected by the interactions that it has experienced.

Thinking in these terms, we can consider the artwork and the audience as interacting systems that influence one another. We can consider the development of computational art systems that are open to influence and that develop over time as a consequence. Equally we can think of the influence that such systems will have on their audiences. We therefore need to consider this kind of computational generative art in open systems terms from the very core of their design.

Notes

1 This paper draws from and elaborates part of the discussion in Edmonds (2005).

2 The technical issues are well reviewed in Barr et al. (1990).

3 Bertalanffy's work on General Systems Theory was a key development in the theory of scientifically modeling biological behaviors. See Bertallanffy (1968). See also, Ross Ashby's Introduction (Ashby, 1956) for an early view of the same topic from the cybernetic perspective.

4 In computing systems it is common to consider the computer program to be searching through a vast array of possibilities looking for one that satisfies what is required. The method used is known as a search strategy.

5 See, for example, Bertallanffy (1968).

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