The Art of Engaging:
Implications for computer music systems

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The art of engaging with computer music systems is multifaceted. This paper will provide an overview of the issues of interface between musician and computer, cognitive aspects of engagement as involvement, and metaphysical understandings of engagement as proximity. Finally, this paper will examine implications for the design of computer music systems when these issues are taken into account.

Interactions

Developing our understanding of the nature of the artistic engagement with sound will inform the design of compositional systems; their interface, their software structure, their software functions, their place in a compositional environment, and the nature of music representational systems they employ. These aspects of a computer music system impact in different ways on the experience of engagement they influence the concrete interactions with the artist and so are the starting point in this discussion of engagement.

Interface

Communicating with a computer music making system requires transference of musical intention from artist into digital form, reciprocally feedback from the digital realm to the artist. The dialogue which is established can be multimodal owing to the computer's multimedia input/output abilities.

Typically input is gestural via computer keyboard and mouse, often with a MIDI controller. In some systems more elaborate physical inputs are employed in, for example, the HyperInstruments developed at MIT (Massachusetts Institute of Technology) and various controllers developed at STEIM (Studio for Electro Instrumental Music). Many systems allow for manipulation of visual representations in for the form of common music notation, graphic scores, structural chunking, or linking of process components. Systems in this group include all sequencers, MAX, UPIC, M and others. Thirdly, textual input, usually in the form of a computer programming language is employed either wholly or in part. Systems making extensive use of text include Csound, Symbolic Composer, Stella and HMSL (Hierarchical Music Specification Language). Direct sound input, other than via Pitch-MIDI conversion, is available in a limited number of applications and should be expected to increase in the future. Applications employing this interface method include some sequencers (e.g. Cubase, Logic), and MAX with DSP (Digital Signal Processing) extensions.

Brown, A. R. 1996. “The Art of Engaging: Implications for computer music systems.” In, Brown. A. R. (Ed.) *ACMA ‘96 Conference Proceedings,* Brisbane: Australian Computer Music Association, pp. 27-35

Output generally includes sound, graphics, text and number; sound of course being primary. Audible feedback usually consists of all or parts of the music being created, but can also include overviews through selected sampling in faster than real-time playback, segment collages as granular or combined sounds, or overviews in data reduced format (such as reduced sample rate or bit depth) for audio drafts. Graphical representations include common music notation, other symbol systems and mappings in two or three dimensions, allowing for a rich diversity of visual feedback. Many graphical representations reflect pitch and time mappings, common in sequencers, others show timbral representations, FFT's and other spectral descriptions, while others show process mappings, Patchwork for example; finally, spatial mappings often in 3D provide location and vector feedback. Text and number outputs can be used particularly to interrogate music in its computer represented form, e.g. MIDI data, sample values, or programming language code and function results.

It is clear that the computer music artist has a wide choice of modes of interface engagement, far greater than acoustic musicians. Choice of interface mode often depends on availability, personal choice, task requirements, response time, ease of use, prior training and so on. As computing power increases an increasing number of interface options are becoming viable in real-time enabling the experience of engagement to flow at the speed the artist works, which appears to be an important consideration for many audio artists, such as Pierre Boulez who commented that with tape composition:

> "you were always hitting mechanical conditions which worked against the creative conditions you wanted to impose. So when I spoke to Max Matthews at Bell Laboratory in New York I understood the importance of the computer, not only to synthesise sound -which was one aspect of it- but to create the technology which was able to respond to the quickness of the mind today." (Ford. 1988:26)

Software structure

Modes of interaction which are well established, such as linguistic dialogue, develop structures in which they operate. Internally language structures include syntax, while externally dialogue structures include taking turns when speaking rather than overlapping, situation-dependent degrees of elaboration and so on. Interaction with computer software is an area where rules of engagement are evolving. Text-based interfaces generally follow the dialogue model interaction, while graphical systems allow multiple representations (in multiple windows) to exist concurrently and for the user to jump between them and zoom to different levels of. In most current computer music software the relationship between different representations even of the same mode is generally haphazard, resulting in a great complexity of visual structure compared to minimal audio feedback complexity.

Software functions

The needs of different artists at different times is impossible to fully predict. The need for a system to respond to the desires and expectations of the artist is critical to effective engagement with the system. Any lack of functionality causes breakdowns in the flow of involvement with the making process, on the other hand the availability of functions new to the artist can be a source of stimulation, rather than engagement.

Software developers have approached the functionality of system with a combination of two approaches; firstly, providing numerous built-in functions, secondly, allowing users to develop functions of their own. Music sequencers have tended to favour the first approach with the result that increasing numbers of functions are added with each revision to cater for previously unanticipated needs. Musical programming languages, including Symbolic Composer and MAX, have taken the latter approach to varying extents, with the advantage that systems become customisable, but with the disadvantage that increased non-sound-making time and education is required.

Compositional environment

The music making process usually involves a network of tools and resources. The computer musician is distinguished from other musicians in that the computer plays a central role in that network. The influence of the other tools and aspects of the making environment should not be underestimated as significant to the engagement of the artist in the making process. The availability of a quite, comfortable space with a quality sound system in which to work is important, along with access to other people, books, CD's, and communications technologies where information and inspiration can be sourced. Computer systems should increasingly be considered to include these environmental aspects. It may be that increased effectiveness may have as much to do with these factors as with the computer hardware and software.

The notion of being more productive with a particular set of people and/or tools than without is referred to as distributed intelligence (Pea 1993). Examples of distributed intelligence at work are that particular organisations continue to function at a high level despite personnel changes, that teams produce better outcomes than any of the individuals could singularly manage, and that a performer is able to be more musically expressive with their instrument than without.

Representational systems

Fundamental to understanding the artist working in a computing environment is the notion that the digital representation of the work bounds the interactions with the work. This fact is not so much a problem as a truism, it is not to be avoided but understood. Effective work on classifying and describing the parameters of music and their digital representations can be found in Huron (1992). The notion of representing is almost as old as music itself, certainly as old as music notation, which is the most established representation. Engagement with a computer music system, then, is largely engagement with the chosen representation system(s).

Taking on board some assumptions from the field of semiotics, for example that representations, or signifiers, will be incomplete because they are contextual, it becomes clear that the similarity between an artist's cognitive formalisations and the digital representation employed will be critical in enabling engagement. Any dissimilarity will cause breakdowns and misunderstandings, as well as awkwardness in implementing manipulations and modifications. For example, musical perception and memory seems to be selective in the features they observe and maintain and so while digital representations are also selective, the features selected may not coincide with those of a particular artist at a particular time. This becomes evident in the difficulty of automating the pattern matching of 'similar' phrases beyond strictly limited domains. While representations which privilege aspects of music similar to common music notation, such as MIDI, can rely on the cultural currency of those features they fall down significantly where computer music systems are involved in the interpretation (realisation) of the score, an area outside the intention of common music notation and its derivatives.

Making processes

In this section two issues relating to music making processes with computers are addressed; formalisms and complexity. Artists engaged in music making, be it primarily creative or interpretive, where computers are utilised are often presumed to be following formalistic processes. This perception has been reinforced by composers such as Xenakis who use stochastic processes, Hiller's use of random and probabilistic processes, Cope's (1991) work utilising feature identification and reproduction, and by the general understanding of computers in the society. The music making process with computers can however span the spectrum from formalistic to subjective processes, and any combination of these. In this section a couple of issues

Limits and opportunities of formalisms

The use mathematical formalism is significant in defining compositional styles for composers, but does not directly influence the level of engagement. The degree of control allocated to the formalism, and therefore the computer, is a decision in the making process leading to more or less abstract subjectiveness. Serialist composers, Webern in particular, sought objective refuge in formalisms, similarly stochastic composers, notably Xenakis, considered the deferral of decisions in this way a positive feature of the computer for music composition. The notion that objectivity is increased in this regard is a smoke screen; rather, subjectivity is deferred from moment to moment choice to a meta-level which defines criteria by which these moment to moment decisions will be made. Loy explains:

> "What has become of composing where formal practices are used is simply the relocation of the compositional decision-making process to a higher position. It means the incorporation of higher-level musical elements, such as algorithms, into the fabric of the compositional process. Some low-level elements of the compositional decision-making process may be taken over by an automatic process, but the composer must still both choose the process and accept the results." (Loy 1989:299)

The use of formalisms in the making processes, does empower many artists to make music who otherwise might not relish traditional methods. Also, combinations of algorithmic and direct making strategies enable a composer to focus in detail on some aspects, for example harmonic systems or form, while deferring others to the algorithm.

Complexity and simplicity

For an activity, such as music making, to be engaging over an extended period of time it needs to be complex enough to be interesting. As well, for audiences listening to the music, interest and understanding play a tightly choreographed duet with complexity. Computer systems enable music of complexity well beyond human perception, and novelty-advances beyond cultural absorption rates.

Computer music making has been variously accused of both complexity and simplicity. Complexity in the ability to produce more sounds, more quickly, for longer than deemed useful or tasteful, and simplicity in repetition. Computers repeat effortlessly, and this feature has been employed in minimalist styles most notably. Less obviously, the repetition of samples, of phrases with identical articulation, of formulaic stylistic elements.

Examples of repetition via computer music systems can be seen in dance music, auto-accompaniment software and use of sample playback synthesis systems.

Control of complexity in computer music making, constitutes one of a number of constraint satisfaction criteria found in all music making situations. The artist who is engaged in the making process should work within their, and so similarly others, cognitive constraints. It is when the making process is purely theoretical or ill-considered that extremes of complexity and simplicity are likely.

Engaging

While there is much useful debate about computer music system design and different representations of music in these systems, the nature of engagement in relation to these is less often debated. The art of engaging is primarily one of involvement in the art of making (Csikszentmih ·lyi, 1992). It is about setting and achieving tasks, about immersion in the making, about increasing understanding and awareness through process, and about aesthetic experiences resulting from the engagement. In this way the art of engaging is personal, and the art of engaging with computers is about the personal relationship between the artist and computer system. In this way computer music making is similar to other artistic pursuits.

> "The most characteristic quality of the making of a work of art is the intense interaction between the artist and his materials. The composer is controlled by his medium almost as much as he controls it. This interplay is what makes the process of aesthetic creation unique among human activities. The voice and body are the most direct instruments with which man expresses his feelings. Sound and motion are the composers materials; he develops and refines, shapes and forms them, embodying his own deeply subjective insights in the relationships between the" (Aronoff 1969:16)

The field

One significant aspect of engaging is the acknowledgment that interaction with the medium, in this case the computer, is not only with the interface and representation but with the field. The computer system embodies the field and the field embodies the artist. The field consists of the whole community of music making though music makers. It is most significantly the artists peers, and as well the critics, teachers, students, audience, programmers and so on. Making takes place with a knowledge of the history of making, the current trends in making, and the future directions for making.

Computer music systems arise out of the needs of artists and as such contain their preferences, views and capabilities. As an artist makes new art they work within those boundaries while also pushing them. At some points the systems will stretch no further and new ones emerge. Software which enables additional functions to be added by users may keep up with the field through those inclusions. Examples of the field contributing to the definition of a system include, plug-ins for Digidesign, functions for HMSL or Symbolic Composer, and objects for MAX or Logic.

The artist in turn is part of the field. In contributing new techniques, software, sounds, structures, processes and realisations they add to the field. Through appreciation and criticism of others work they control the field. Engaging in music making includes engaging with music makers and conventions, the field.

Tasks

The first requirement for engagement in computer music making is the formulation of task. The goal may be to have a commissioned work completed or to prepare for a particular performance. Such goals usually break down into smaller tasks such as choosing themes, creating a form, constructing sounds, experimenting with new techniques, each of which can be engaging on its own. The presence of a larger goal is required to maintain engagement over a longer period than the completion of single tasks.

Immersion

Engagement in tasks is more than getting a job done. For engagement to lead to aesthetic experience for the artists there must be a level of commitment to the task and a degree of focus enabling immersion in the music making process. Immersion is more complex than single-minded attention, it includes an awareness of the task in all its complexity. In describing successful musical behaviour Bamberger concludes that "the mark of the sophisticated musician is the capacity to shift focus, to select for attention multiple kinds of features and relations and to coordinate them in various ways depending on 'when and what for.'" (Bamberger, 1991:174)

Understanding

In the relationship between artist and computer which is both creative and responsive the artist constructs meaning from the interaction, moulds the medium and is moulded by the process. Engagement in music making leads to understanding in a deep way, to the development of musical intelligence (Gardner, 1983). This is understanding in the figural sense (Bamberger 1991), about 'felt' features of the music, it is understanding which relies on engagement, as apposed to formal knowledge about how the music system works, or facts about the representations employed.

The development of understanding is recursive in the interchange between artist and medium, as new areas of understanding emerge they enable exploration of new ideas and so on. Boden's description of the creative process includes the notion of multiple layers of understanding where the most skilled artists evolve understanding at the highest levels. "Consistently H-creative people have a better sense of domain-relevance than the rest of us. Their mental structures are presumably more wide-ranging, more many-leveled and more richly detailed than ours. And their exploratory strategies are probably more subtle and more powerful. Anyone can consider the negative. But they may have many other (mostly domain-specific) heuristics to play with. If we could discover some of these, our educational practices might be radically improved: some of Mozart's powerful exploratory techniques, for example, might be taught to aspiring musicians. These rare individuals, then, can search - and transform - high-level spaces much larger and more complex than those explored by other people." (Boden, 1990:254)

Aesthetics

Artists successfully engaged in their music making gain aesthetic pleasure in the music and in the process of creating it. The engaged artist finds the journey satisfying, despite (or because of) difficulties. It is likely that the internal coherence of music made by the engaged artist will be a stimulus for aesthetic experiences in the audiences of that music also.

There is an historical tendency in computer music to focusing overly on the formalistic nature of music because of the necessity to articulate it to a computer system. This is evident is articles in the Computer Music Journal such as Englert's who states in a discussion of composition as an act of creation that his work "intentionally ignores the listener's perception and questions of aesthetics; [because] only facts that can be verified in the music are considered." (Englert , 1994:5) Although this undoubtedly makes the research more manageable, it denies the essence of the composer's experience, and is therefore questionably about composing at all, although it may still be usefully about compositional tools or techniques.

Having now looked at how the art of engaging from the personal view it is reasonable to examine how our understanding of these processes might be described more broadly and so influence the design of computer music systems.

Designing for Engagement

Maintaining an experience of involvement when making music with a computer system can be assisted if the system is designed with an understanding that the flow and focus during making processes should not be overly disrupted. As has been discussed, aspects of the system, including interface and representation, are important but vary between individuals and contexts. What does not vary is the experience of engagement, as achievement, involvement, understanding and aesthetic experience.

Designing systems to maintain involvement and assist in understanding is critical in those systems maximising task achievement and aesthetic experience. In order to assist in such design a number of issues at the heart of engagement, as raised by the philosopher Heidegger, will be addressed in this section. These issues are metaphysical ones which underscore the notions of interface and involvement discussed above. In an attempt to ground these, at times abstract, concepts examples relating to the design of computer music systems are employed.

Familiarity

In looking at Heidegger's view on engagement, which associates loosely with his notion of Being-in-the-world, he introduces the idea of becoming involved with technological representations to the extent that we no longer perceive the objects but only their representedness for a musical sound or function, in this sense the representation is ready-to-hand. It is when the computer is ready-to-hand for the musician that it functions as a musical instrument. The establishment, development and maintenance of features enabling readiness-to-hand of the computer music system that should be paramount as the designers intention. There is a difference between hearing through perceiving and understanding through engaging in Heidegger's theories:

"It requires a very artificial and complicated frame of mind to 'hear' a 'pure noise'. The fact that motor-cycles and wagons are what we proximally hear is the phenomenal evidence that in every case Dasein [humanexistance], as being-in-the-world, already dwells alongside what is ready-to-hand within-the-world; it certainly does not dwell proximally alongside 'sensation'; nor would it first have to give shape to the swirl of sensations to provide the springboard from which the subject leaps off and finally arrives at a 'world'. Dasein, as essentially understanding, is proximally alongside what is understood." (Heidegger 1962, Sect. 34, p. 207)

The design of computer music systems should utilise symbols which exist culturally as ready-to-hand such as natural language, common music notation (for some), conducting and dance gestures, and the overtone series in harmonic and timbral relationships. The objective is to increase involvement by utilising the fact that users are intimately familiar with those signs, gestures and language. They are not interacting with those signs but directly with music through them. Just as an experienced instrumentalist engages with their instrument. The fact that the readiness-to-hand of a technology need not be only gestural, as in acoustic instruments, but can equally be linguistic or visual enables the computer music system designer, and user, to work in a multimodal fashion.

Understanding and interpretation

One of the often cited advantages of a computer music system is the fact that the music making process can be externalised and thus reflected upon. The fact that reflection, bringing to consciousness, inherent in technology reveals to the user information to be understood is the essence of technology for Heidegger. In this way "Technology is therefore no mere means. Technology is a way of revealing." (Heidegger 1954 Edn. 1978 p.318)

Being the essence of technology does not mean that revealing through reflection is blindly useful in the making process. Indeed the reflection and interpretation required of an external representation is precisely the anathema of the engagement experience for the artist which is described in this paper.

> "Whenever we treat a situation as present-at-hand, analyzing it in terms of objects and their properties, we thereby create blindness. Our view is limited to what can be expressed in the terms we have adopted. This is not a flaw to be avoided - on the contrary, it is necessary and inescapable. Reflective thought is impossible without the kind of abstraction that produces blindness. Nevertheless we must be aware of the limitations that are imposed.î (Winograd and Flores 1987:97)

What needs to be understood by designers of computer music systems is that both engagement with a system as ready-to-hand and interpretation which acknowledges blindness need to be balanced in the system. This implies that a computer music system should on the one hand be stable, reliable, predictable, quick, consistent and flexible to enable engagement, but as required be deconstructable, reconstitutable, extendible, redefinable, even confrontational enabling conscious reflection.

Systems which are primarily designed for smooth engagement, such as most sequencers, too often are inflexible when it comes to constructing new functions, representations and thus lead the user down predefined paths both cognitively and artistically. Systems which are concerned with flexibility and user definition, such as programming language extensions e.g. Stella, Csound and HMSL, are so continually in need of user direction that consistent engagement is less likely.

There seem at least two approaches to meeting this challenge, firstly, a system can implement both structured and unstructured components and interchange between them. DMix (Oppenheimer) follows this approach, although technically appealing it may result in even greater complexity and thus entropy. A second approach is to follow a middle path, neither as rigid as sequencers, nor as flexible as a text-based programming language. MAX (IRCAM) follows this path, with a simple lock/unlock function switching between an engagement-use mode and a reflect-edit mode. The success of this program in the computer music community, and Visual Basic (Microsoft) in the general computing community, can be attributed partly to their achieving a balance between efficient task engagement and appropriate customisation.

Towards-which

For the engaged artist to be involved with and emersed in a computer system in the way described as ready-to-hand, brings to light a new question; Involvement in what? Towards-what is this engagement focused? Which task or context is the artist concerned with? Heidegger's term 'toward-which' raises these questions.

The computer music system is designed for a task and its essence is phenomenologically located in the task. The designer cannot predict what context the user will be in when using a computer music system, but some generalisations of 'normal' use in our society are usually assumed. The nature of different tasks and contexts has given rise to the multiplicity of computer music system that have arisen. Contemporary popular music drives the development of sequences and MIDI sound modules, with notions of regular rhythms, ostinati looping functions and General MIDI instrumentation. More considerate of the context issues is software such as Patchwork, Csound and Symbolic Composer, which are somewhat adaptable to new circumstances and hardware which is mobile and employs multimodal interfaces.

The notion of designing computer music systems for practical uses means that the designer needs to be aware that the engagement in music making, not the knowledge or awareness of the system , enables that making. Consideration needs to be given to the ways in which the system enables engagement and understanding rather than how it imitates, or automates, music making processes of artists.

The dilemma of design

If, as I have argued, the art of engaging surrounds involvement with (sound in music's case), and multi-modal understanding (musical, gestural, linguistic, and symbolic) in the context of a task and directed toward meaningful and aesthetic outcomes; then the dilemma of design is that looking at the computer system from a system point of view is counter to considering the system as ready-at-hand, as a medium through which to be involved.

Engagement is primary in music making. The implications for computer music makers and system designers is to understand how systems promote involvement. Involvement on the physical front through interface, on the cognitive front through representations, and on the practical front through awareness of the context and field. Artists are driven to engage with their art and will do so under extreme difficulties, it is hoped that by teasing out the issues presented that these difficulties might be minimised through a better understanding of what is the art of engagement.

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