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Re:Cycle - a Generative Ambient Video Engine

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A series of related creative decisions gave *Re:Cycle* its final shape. The decisions all wrestled with variations on a single problem: how to find an appropriate balance between aesthetic control on the one hand, and variability/re-playability on the other. The paper concludes with a description of future work to be done on the project, including the use of metadata to improve video flow and sequencing coherence.


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Re:Cycle - a Generative Ambient Video Engine

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ABSTRACT

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Categories and Subject Descriptors

J.5 [**Arts and Humanities**]: *Fine Arts.*

General Terms

Design, Experimentation, Human Factors.

Keywords

ambient video, generative processes, video art, ubiquitous computing, high-definition display, ambient display, "calm" technology, "slow" technology, design

1. AMBIENT VIDEO

Ambient Video is video intended to play on the walls in the backgrounds of our lives. In the spirit of Brian Eno's "ambient music", Ambient Video must be "as easy to ignore as it is to notice". [1] Eno's dictum can be expanded to three interrelated criteria that an ambient video art piece must meet. First, it must not require your attention at any time. Second, it must reward your attention with visual interest whenever you do look at it. Finally, because ambient pieces are designed to play repeatedly in our homes, offices and public spaces, they must continue to provide visual pleasure over repeated viewings. The ubiquitous screens in our domestic, corporate and social environments provide rich ground in which ambient imagery can thrive. This includes the increasing use of public screens - a steadily growing venue for a range of video expression, including ambient video. Cubitt and others point out that the orientation of much of the public "urban screen" programming privileges ambient viewing and intermittent attention. [2] [3]

However, the three criteria for ambient video success are difficult to meet, regardless of venue. Eno saw this problem twenty five years ago when he wrote about his own ambient video art: "These pieces represent a response to what is presently the most interesting challenge of video: how does one make something that can be seen again and again in the way that a record can be listened to repeatedly? I feel that video makers have generally addressed this issue with very little success..." [4] The problem remains a difficult aesthetic challenge. Some creative avenues are simply inconsistent with ambient experience. Narrative both attracts and relentlessly holds our attention, so most ambient works are essentially non-narrative (although there are some exceptions to this rule). Fast cutting also draws attention to itself,

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so ambient works are generally slower paced. The astounding spectacle of the classic cinema of attractions is also inconsistent with ambience, although this is a more complicated case. [5] The complication arises because it is possible to position ambient video as a more modulated and low-key version of the cinema of attractions. The visual attraction must be subtle enough that it doesn't command attention, but also interesting enough to support attention when it is bestowed, and to sustain interest over repeated viewings. The viewer's orientation to an ambient video work can thus be seen as a subtle dance, or to use Cubitt's term, a "dialogue" between the "system-cinema" and the autonomous viewer. [6]

The aesthetics of ambient video art works can be traced in earlier cinematic and video work, and in specific elements of contemporary cinema (e.g., the use of slow-motion, the creative manipulation of time, the expressivity of layered video constructions). The lead author has argued that he and other ambient video artists rely on three aesthetic interventions to create ambient works that can claim to be art. [7] The first is a reliance on strong composition, lighting and cinematography. Since ambient video is slow-paced, the form needs visual compositions that will sustain over exceedingly long screen durations - typically around one minute, but sometimes even longer. (To put this in perspective, most broadcast nature documentaries, even if slow-paced, rely on shots that are seldom longer than five seconds in duration.)

The second aesthetic intervention is the treatment of cinematic time. Ambient artists thrive on subjects that present motion in a fixed spot without requiring a camera move to track the subject. Water, clouds, and fire are perfect examples. However the motion of these subjects provide more visual interest if the time base is altered. Typically water and fire are slowed down, and clouds are speeded up. In the author's work, this strategy is used whenever possible, with some shots slowing motion in one part of the frame (a foreground stream, for example) and speeding motion in another part of the same frame (background clouds at the top of the frame). Cinematic time is therefore treated as plastic - a malleable parameter to be shaped drastically by the artist.

Cinematic space is treated as plastic in an even more intensive fashion. This third aesthetic intervention is far more complex and difficult to achieve - the aggressive use of video layers and layered transitions. In the lead author's work, cinematic space is first fragmented, then recombined. Shots are deconstructed into visual elements, and new elements from the incoming scene are slowly introduced on top of the existing scene, until they completely replace it - and the new shot has been created. (See Figure 1 below for a simplified version of this process.) This process continues throughout the film, as one landscape forms within and over its predecessor in an endless chain. Each transition occurs in several stages, and each stage is carefully planned, mapped and executed with detailed attention to visual flow and the changing gestalts of the outgoing and the incoming shot. In the example below, the waterfall appears magically - tumbling down one of the mountain passes to the lake below. The transition then gradually reveals the entire next shot with the waterfall in its proper context - losing the lake and the original mountain range.

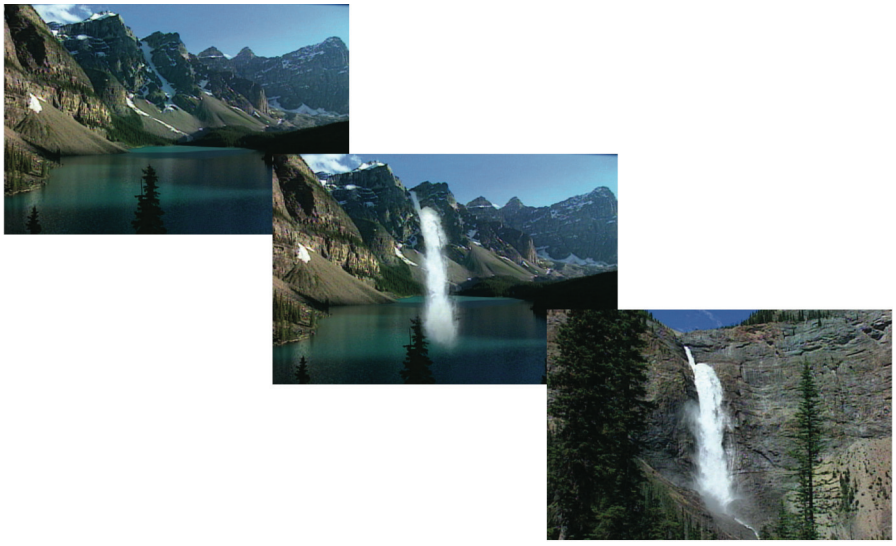

Figure 1: Scene Transition from Rockface

2. THE CREATIVE CHALLENGE AND A GENERATIVE SOLUTION

There is one outstanding potential problem for ambient video art that is conceived along these lines. An ambient piece that is intended to hang in a space of recurrent viewing (the home, an office, public space) will be seen many times, making the final creative challenge - that it sustain over repeated viewings - more difficult to overcome. No matter how strong the imagery, and how intricate and aesthetically pleasing the transitions, after a certain number of viewings the images, the sequencing, and the transitions will all be remembered and anticipated. A series of factors complicate this question. The first is an overarching creative problem for the creator. An ambient work cannot be so visually compelling as to demand our attention, but it must be interesting enough to support visual interest at any time - especially after the first few viewings have begun to extinguish

any novelty factor. As we have seen, the ambient video artist is creating a modulated version of Gunning's cinematic "attraction". [5] Because an ambient video will not be stared at with undivided attention, viewer focus will be intermittent after a certain number of viewings, and longevity will therefore be increased. However, after further time, a large number of repeated viewings may become problematic. A certain amount of memory and anticipation might add to viewing pleasure at first, but at some point extended repetition of identical sequences will lead to diminishing returns. The piece will indeed become more ambient - that is to say, more of a background experience - but the cost is a lowered sense of visual pleasure.

The potential of ubiquitous computation can address this problem. [8] A generative ambient video piece can use simple computational capabilities to continuously vary the sequencing and combinations of the selected ambient shots and visual transitions. A computationally-varied ambient video piece benefits from two related concepts identified in the dialogue around ubiquitous computing: "calm technology" and "slow technology". Ambient video is a "calm technology" because it allows the viewer freedom to place the experience at either the center or the periphery of her attention. [9] Ambient video is also inherently consistent with "slow technology". [10] Computational variability can further extend the ambient work's effective ability to use visual pleasure to slow perceived time and privilege reflection and contemplation.

2.1 The *Re:Cycle* Engine

Re:Cycle incorporates a variation on the aesthetic strategies of the earlier works (strong imagery, manipulation of time base, and careful use of video layers and layered transitions). *Re:Cycle* maintains the first two aesthetic strategies, but explores the development of a recombinant aesthetic that applies random processes to video layers, transitions, and sequences.

The commitment to a recombinant video system that relies on random process is an exercise in generative art. Generative art is a wide-ranging approach towards the making of art. Galanter notes that it predates the computer, and claims it is "as old as art itself". [11] Most definitions maintain that generative art is created through a relatively autonomous system, typically "constructed through computer software algorithms, or similar mathematical or mechanical autonomous processes." [12] The Generative Art Conference is the oldest scholarly conference dedicated to generative art. Their definition recognizes a role for code and computation, but privileges human creativity: "Generative Art is the idea realized as genetic code of artificial events, as construction of dynamic complex systems able to generate endless variations . . . This generative Idea / human-creative-act make an unpredictable, amazing and endless expansion of human creativity. Computers are simply the tools for its storage in memory and execution." [13]

Generative art manifests across a variety of forms and media: music, writing, visual arts, moving images, and networked computers. Random processes are often part of the design of generative works, with examples ranging from early surrealist games through the more recent Oulipo artists and now with a large number of contemporary computational works. Generative artists vary considerably in their relative emphasis towards either the final output or towards the generative process itself. They also differ in the degree of autonomy of the generative operations within their works - one can categorize generative works as either closed systems or open systems. Increasingly, some generative works also rely on interventions by the artist or observers, creating an experience that is both generative and interactive. Other generative art works rely on the use of the net as either a source of imagery, or as a modifier for the generative processes, or both. The interoperability of personal devices and the ever-growing access to networks through ubiquitous computing amplifies interest in these variations. As Cubitt states, "As artificial life and artificial intelligence allow more and more machines and machine networks to become agents in the making of software and effects, we stand at the threshold of a new era in which we no longer demand of our devices that they produce to our command, but that they become our equals in dialogue."[6]

Re:Cycle is a closed generative system, relying completely on two databases for its operation. The first is a database of ambient video shots, the second is a database of transitions. The twenty video clips in the shots database are all visually strong, at least sixty seconds long, and shot in the same general region (the Canadian Rockies). Many contain cyclical and visually interesting motion of clouds or water. The time frame in several of these shots has been manipulated in order to give the motion even more visual interest.

There are four transitions in the transitions database. One of the four is a luminance transition. This transition will use the brightness values within the shot to drive the change from one shot to its successor. The incoming shot will appear first in the brightest sections of the current shot, then in the mid-range brightness areas, and finally in the darkest areas. When the transition is complete, the second shot has replaced the first completely. (Figure 2) The other three transitions work in a similar fashion, except they are based on chrominance values, not brightness. There are three chrominance transitions: red, blue and green - corresponding to the video color palette. Each of these starts the transition in the areas of the shot with the highest chroma value in the selected color, and continues the transition down through the range of chroma saturation until the transition from one shot to the next is complete.

Figure 2: Stages of Luminance Transition

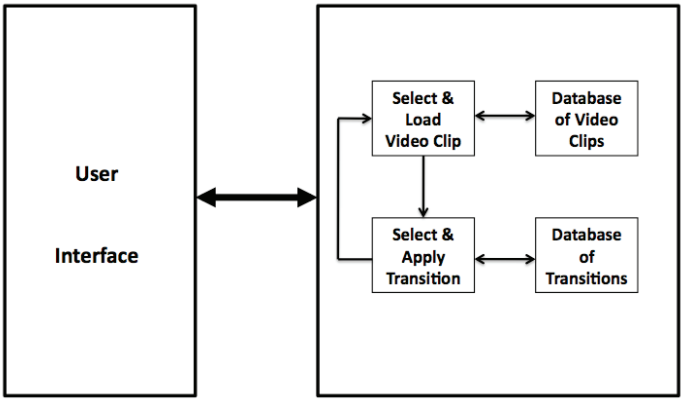

Figure 3: Generative Engine

Figure 3 shows how the generative system uses these two databases to structure the presented video. When a shot is on the screen, the system selects a new shot at random and a new transition at random. It uses this transition to drive the change from one shot to the next, and then repeats the process indefinitely.

This engine has the capacity - especially if the database of shots is large enough - to present an ambient video art work that can run indefinitely, and still provide interesting visuals and transitions. The resultant doubly-randomized video stream will generally not repeat particular shot sequencing with any frequency, and will generally provide a different transition for each change. The recombinant aesthetic will play out both temporally and spatially. The random sequencing will provide temporal recombination, while the interplay of random shot and transition selection will drive each shot change with a fresh spatial recombination.

The engine has been programmed in Max MSP Jitter, a common programming environment developed initially for work in sound environments (Max; Max MSP), and later extended to include video (Jitter). Our reliance on an open-source cultural aesthetic is in itself an exercise in recombinant engineering. Our code combines widely-shared "jitter-patches" with specific modifications and additions made by our student programming team. Shared Jitter code included the four basic transitional devices (luminance, red chroma, blue chroma, green chroma) at the heart of the engine. Our student team assembled the component patches into a random-access mechanism that draws the video clips from the video database and the transitions from the transitions database.

2.2 Addressing the Creative Challenge

The goal of *Re:Cycle* is to create an ambient work that will run indefinitely, and do so without repeating either shot sequences or specific transitional moments. This increase in playability does come with a price - and that price is a loss in aesthetic control over the details of sequencing and transition. One can see this as a tension built into the system. A linear video maximizes aesthetic control - the video artist carefully plans and executes the sequencing and the visual transitions. In the lead author's previous linear video art this was done with careful - even obsessive - attention to every detail of the transition. The design decision to utilize random sequencing and randomized transitions has added longevity, but has sacrificed a measure of creative control. The design problem then shifts to a more subtle challenge - how to find the right balance between variability/re-playability on the one hand, and aesthetic control on the other.

Other artists working in generative visual art have faced a similar set of balances and trade-offs. Lev Manovich's *Soft Cinema* aims to combine the demands of narrative coherence with a recombinant database aesthetic. [14] *77 Million Paintings by Brian Eno* is an extension of his own earlier linear ambient video work into a generative form. [15] *77 Million Paintings* uses a database of largely non-representational graphic images, but includes extensive use of layers and visual recombination in order to maximize re-playability. *Re:Cycle* is situated somewhere between these works. Like *Soft Cinema* it relies on recorded video and representational visuals, not on pure graphic material. At the same time, like *77 Million Paintings*, *Re:Cycle* rejects narrative and is therefore more free to rely on completely random recombination to support re-playability.

The development of *Re:Cycle* has been a dialectical process - the balance between aesthetic control and re-playability has been revisited at every stage. One can frame each significant creative decision an attempt to maximize success across both ends of a continuum:

re-playability <=> aesthetic control

The lead author's previous linear ambient art was situated towards the right hand side of this dynamic. The shot sequencing and shot transition decisions were locked in, so the intrinsic re-playability was ultimately limited. In the linear video the strategy was to rely on the strong aesthetic control (careful shot selection, manipulation of time base, intricate visual transitions) to support a certain amount of re-playability. The use of the generative database has increased re-playability through a strategy of recombinant variation, but the cost is the loss of aesthetic control over shot sequencing and shot transitions.

Re-playability could be further increased with a larger database of shots. This would decrease repetition of specific shots and specific shot sequences because of the higher numbers involved. However, an indiscriminate increase in numbers could undermine aesthetic impact. To avoid this, any additional shots selected would need to be of the same high visual quality as the original set. We will adhere to that guideline, and we are continuing to seek strong shots to add to our database of clips without sacrificing visual impact.

We also needed to restrict our choice of transitions in order to protect aesthetic quality. There are a host of video transitional devices: the hard cut, the dissolve, innumerable shape-based wipes, and the more complex transitions such as luminance keyed transitions and chrominance keyed transitions. [1] We decided to forego most of these possible transitions, and restrict ourselves to luminance and chrominance keys precisely because they were more visually complex and therefore more interesting to watch. They have the associated advantage that as the viewer watches them unfold, the flow and the details of the transition are less predictable than dissolves or simple shape-based wipes.

However, the luminance and chrominance keys were not the perfect aesthetic solution for all shots. They tended to be generally of sufficient visual interest, not as much as a carefully tailored and designed transition, but more so than simple cuts or dissolves. We did use two tactics to increase their aesthetic utility. We noticed that some shots with very strong regional contrasts simply did not transition well from many of the other shots in our shot database. Our first tactic was to remove some of those shots, sacrificing some re-playability because of decreased shot numbers, but increasing our aesthetic impact through the avoidance of a number of poor transitions. Our second tactic was to increase the "feathering" of the edges of the wipes. "Feathering" refers to the softness of the edge of the transition as it proceeded. A sharp transition often produced a feeling of random video noise and visual "busy-ness". A softer transition was slightly less dramatic in some cases, but over the range of random shot transitions tended to be less noisy and more aesthetically pleasing.

FUTURE WORK

We feel that we have a good initial prototype of a working system, but we also feel the need to make it stronger - i.e., to increase re-playability, aesthetic impact, or both. We have already mentioned one of the tactics to do so - we will be collecting a larger number of strong shots for our shot database. We will also be exploring two other strategies: increase the variety of shot transitions, and incorporate the use of metadata to increase aesthetic impact.

The strategy for increasing the variety of shot transitions is simple. We will still rely on our four basic transitional devices: luminance, red chroma, blue chroma, and green chroma. However, we will apply two variations to this basic set. First, one can run any of these transitions in two directions. For example, you can run a luminance transition that starts with the brightest parts of a scene and proceeds to change image until it reaches the darkest parts of a scene. However, you can also run a luminance transition that starts with the darkest parts, and proceeds through to the lightest. In the same way, one could run any of the three chrominance changes in two directions. By incorporating both directions for each of our four transitions, we will increase our effective number of transitions to eight. Secondly, one could use either the current shot, or in the incoming shot as the basis for the transition. If you decide to include both variations as transitional drivers, the number of possible transitions doubles again. We will therefore have a transition database with sixteen possible variations instead of four. This change will increase the re-playability of the piece, with no loss in aesthetic control.

The strategy, or rather, the set of strategies for the incorporation of metadata is more complex - in several dimensions. We plan to

[1] The terminology "wipes", "keys", and "keyed transitions" derives from the earlier language of cinema and analog video production and post-production.

associate metadata with individual shots, and use the metadata to guide sequencing and transition. This will increase aesthetic control, but it will also be more difficult to implement, require more careful planning, and have a cost in variability and re-playability. The metadata will be used to encourage certain sequences of shots and transitions, and to block others. For example, we have observed that for some shots, certain transitions tend to work well. We've seen that shots that are heavy in red tones throughout respond unpredictably to transitions based on green chrominance values. We could use metadata to tag these shots, and block green chroma transitions. In doing so, we will reduce variability but ensure a higher level of aesthetic quality.

Metadata can be incorporated in three different ways. Metadata can be "hardwired" in by the artist, or recorded automatically during production (time, date or GPS information for example), or computed on the fly during playback (ranging from relatively simple dominant chroma-value determinations to more complex operations such as facial recognition). However they are acquired, metadata can be used to prevent predictable transition problems as described above. At a higher level. metadata can be used to modify absolute random access and give a level of editorial flow to the sequence. We are considering the categorization of shots in order to favor sequences that are informally grouped to support semantic or aesthetic connections. An example might be to define sub-categories (rocks, streams, clouds) for the shots, and program the engine to build a series of short sequences based on these categories. Another example might be temporally-based sequences that generally progressed from morning to mid-day to dusk, or from spring to summer and winter. All of these metadata applications are appealing because they are an opportunity to increase the coherence of the image flow. We recognize that any increased semantic coherence will have a commensurate loss in overall variability and re-playability. However, the collection over time of a larger and more varied database of shots will mitigate this problem and allow us to further maximize *Re:Cycle*'s aesthetic impact while maintaining our level of variability and re-playability.

Finally, we have not yet addressed the question of creating an appropriate sound track for a generative ambient video system. This is a direction we must undertake in the future. The role of sound in a generative ambient piece is a rich and necessary vector for both scholarship and creative development. There are a wide range of sound styles and specific tracks that would add to the ambient experience of any given video. A companion generative electronic music system is the most obvious choice, but metadata could also be used to trigger an appropriate recombinant soundscape based on a database of sound effects. Either representational or impressionistic soundscapes would work with ambient pieces such as *Re:Cycle*, and the addition of sound will be a direction for future work.

3. COMPUTATIONAL CULTURE AND GENERATIVE AMBIENT VIDEO SYSTEMS

Our current ambient video engine is in the early stages of its development. Looking forward, however, we can consider the effect that more mature generative video systems will have on our individual and collective lives. Moore's Law and its corollaries in other technological directions seem to be alive and well. [16] Computational devices are becoming more powerful, more varied, more networked and more ubiquitous. Video screens are steadily increasing in size, number, and quality at the same time as they are decreasing in price.

Distributed computation within an increasingly multi-screened world will support new varieties of visual experience. The development of a robust ambient visual aesthetic, enhanced by the ability to vary and shape that experience through embedded computational devices, can become the basis for a fresh form of mediated experience. An intelligent ambient video screen can become a window into a world that is an antidote to our current hypermediated entertainment models. Today's popular media forms - television, home theatre, or games - all seek to seize and unrelentingly hold our attention. Ambient experience privileges the viewer and her own personal context in the moment. The choice of when and how to watch is freely given, not manipulated. The viewer can choose to glance briefly, to linger with a longer gaze, or to ignore and live her life in other ways. When she does choose to look, she can also choose to view imagery that reflects and supports values not often offered by other media: flow, calmness, connection with our natural environment, and through that, to our selves. All of this is consistent with the nature of the ambient video experience, and can be extended through the incorporation of computational and generative presentation systems.

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