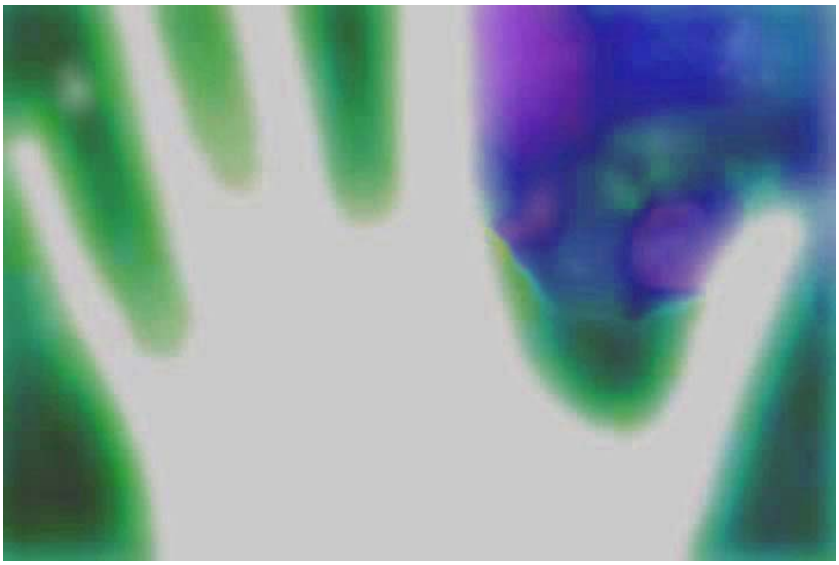
Luminance

Interactive Art Experience



A Winter Quarter Update for
CSU Hayward Multimedia Graduate Program

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shortattentionspan

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What is Luminance?

Short Attention Span is developing Luminance, an interactive art experience based upon a multimedia installation that allows participants to be part of the piece. Participants in Luminance use their own physical body movements to influence digital content on a large screen.

How Does Luminance Work?

Participants in Luminance are completely untethered. The user does not use an input device such as a mouse, keyboard, virtual reality goggles, or any other augmented device. By being positioned in the installation space, the participant casts a shadow upon the screen. This shadow and its movement are captured by a video camera connected to a server which converts the data to point coordinates. These coordinates are then transmitted to a second computer which is projecting digital content. The point coordinate data is used to "interact" with the projected digital content.

The Research Question

Can a new methodology be developed to create complex, playful content for multimedia installations whose interactivity depends solely on physical body movements?

Project Goals for Winter Quarter 2005

In the fall quarter documentation, Short Attention Span outlined the following winter quarter goals:

- A working installation that can be left unattended for users to play with
- Adapt system for usage with rear-capture configuration and acquire parts/materials for same.

- Address minor issues of system latency, accuracy. Fine-tune threshold values for use under different lighting conditions.
- Research a more elegant means of extracting point data from EyesWeb and LK tracker. Look into increasing the number of tracking points.
- Expand the possibilities of visual results/movement to varying subject matter, increasing in complexity. Technically, this will involve establishing pre-existing stage objects which can interact with real-time objects manipulated by the user.
- Test the prototype with users in a controlled circumstance with evaluations and video-documented responses.
- Develop the storyline of the proposed content, as requested by the committee.

Work on these goals has been undertaken during the winter quarter with varying degrees of success

Project Activity – Winter Quarter 2005

"Sketching with Code"

Renowned flash designer and developer Brendan Dawes uses the term "sketching with code" to describe a creative process with Macromedia Flash similar to an artist doodling in a sketchbook or a writer carrying a journal. During the winter quarter, Short Attention Span made use of this process to help unlock the creative possibilities of Luminance and begin the development of interactive illusions to help drive the narrative of the installation.

Clustering

Initially, Short Attention Span believed that the development of a single distinct Flash movieclip object representing a participant's shadow was critical to creating robust interactive experiences within Luminance. Development on creating such an object proceeded within Flash Action Script programming. During development with pseudocode, it was discovered that the mathematical expressions and logic loops needed to effective construct such an object were intense enough to slow down the projection system and create a degree of interactive latency between participant and content to the point that the overall experience would be less rewarding. Therefore, Short Attention Span

made the determination to proceed with creating interactivity with a multitude of objects as opposed to the determination of a single distinct object representing the participant.

But it is believed that determining "clusters" of data points can achieve interactive results similar to producing a single movieclip object. By dividing the stage into segments and determining the segment in which a high degree of data objects exist, it can be assumed that this would be the segment of the stage in which the user's shadow dominated. Interactivity, such as an eye ball "looking" at your shadow, can be subsequently developed

Foggy Windows

The intent of Foggy Windows was to create the illusion of a user being able to "wipe clean" the video screen with physical movements that cast a shadow. In essence, the shadow would be a type of eraser or a rag clearing off a foggy automobile window on chilly morning.

Thus, the sketch was developed as a grid of squares laid out over a background image, animation, or video clip. Each individual square of the grid has a unique Alpha property that can be assigned or manipulated within the timeline of the piece. The alpha property of an individual squares can be triggered to change when a data point collided with the square. Essentially, each square acts as an image mask that can by dynamically adjusted to create unique interactions.

Over the course of the quarter, the programming code of foggy windows changed due to live testing. Initially, a built-in Flash hit test method was used to determine impacts between shadow and the grid. However, it was determined that the hit test method built into Flash was affecting the performance of Luminance in negative ways. Therefore, the programming code was changed to use a mathematical algorithm that equated a shadow coordinate data point with the appropriate position on the grid.

Testing throughout the quarter also revealed that the rate of alpha change on the grid had an impact upon a user's perception of affecting change. Quick changes in an alpha property seemed to indicate higher perceptions of "control" by the user.

Circle Chaos

The Circle Chaos sketch was based upon a sketch first developed during the Fall 2004 quarter in which a dark blue circle of random size, position and translucence was drawn on the Flash stage every second. The sketch is being adapted for use a transition within Luminance so that circles are drawn at each shadow coordinate data point. With each circle, the radius would increment as well as the color fading to white so that ultimately, the screen would transition to a point that a large white circle filled the screen, thus giving the illusion of clearing the screen with objects that would appear to be getting closer to the participant.

Testing of this sketch continues as it has been found that the data feed from Eyes Web is so fast that it is impossible for a user to see and understand the transition that is taking place.

Bezier Curve Morphing

The grid mapping ActionScript function used in Foggy Windows has piqued another brainstorm. A similar function could lay out a grid of nodes which could be used for programming interactions. This would be similar to the Brian Knep technique of defining numerous amounts of nodes, then adding equations to the nodes. Three node points could be used to define a Bezier curve (2 end points and 1 curve focal point). Flash has the ability to draw dynamic Bezier curves. The shadow coordinate data points would be used to give the illusion of a curve changing dynamically with different focal points.

Action Script 2.0

Late in the winter quarter and after numerous testing sessions, Short Attention Span made the critical decision to convert all Flash code from Action Script version 1.0 to Action Script 2.0.

Action Script 1.0 was originally chosen due to the group's current intimate knowledge of the programming and environment and the abundance of robust code sample's shared by the Flash developer community that have been perfected over the years. An excellent example of this is Laco's Tweening Properties and Penner's Easing Equations. This set of Action Script 1.0 code has mathematical equations for performing a large variety of complex tweens via the use of Action Script. This results in improved performance versus the development of processor intensive timeline tweening already built into Flash.

However, testing throughout the winter quarter saw a need for a code structure that would allow for even faster processing of code execution. The object-oriented nature and object class development possibilities of Action Script 2.0 are seen as an avenue for the desired level of performance. It has also been discovered that modified version of popular open source code such as Penner's easing equations have been converted for version 2.0 use.

The decision to change Action Script versions came late in the winter quarter and only after exhaustive levels of testing with version 1.0 code did not achieve the desired results. This change has impacted the current state of content production. While content development has proceeded at a comfortable pace with effective storyboarding, code production and realization of content has been delayed due to the decision to change versions. Short Attention Span made this decision at this stage of overall project realization in preparation for full content production during the spring quarter. The object oriented approach has already paid some dividends as it has allowed for the development of an addition to the movie clip class that clears all rendered data points during moments when user activity is not present, thus demands on overall processing power and increasing initial data response times.

Eyes-Web Fine Tuning

Through a series of iterative testing, the group has identified performance issues for that have driven adaptation and modification within the current Eyes-Web software used for video capture and data conversion. Specifically, we have identified a need to be able to change the contrast settings within Eyes-Web with each testing session. This need is due to the changing lighting conditions from session to session. Understanding of the adjustments needed has been critical to the development of consistent contrast within the digital content being developed.

As a result, Eyes-Web is effectively "tuned" to work with content whose greyscale range is 70% gray or lighter. That is, at levels darker than 70%, Eyes-Web is unable to distinguish between digital content from the projector and participant shadows being cast upon the screen. Therefore, the content imagery created must lie within this tonal range for the data points to be captured accurately.

Interactive Narrative & Content

The second quarter also saw a shift in focus of the primary group activity from an investigation and development of technical details to the discovery and investigation of content for the experience. Some of this discovery was based upon production decisions made for technical reasons as the possibilities as well as interactive limitations revealed themselves to us.

Successive versions of storyboarded content were created to explore the main aims of the project – direct interaction with ever more complex, playful content – based on the growing number of types of interactivity we were developing, and the technical avenues which were proving to be unrewarding (ineffective? Too damn complicated?). In order to engage the widest possible user interest and avoid the well-trod path of prosaic narrative, our content development has proceeded with an emphasis on the depth of interactivity as a storytelling arc rather than just image complexity or traditional narrative.

That is, the progression of a user through the content is one of deepening interaction and stronger effect on the virtual space. Initially, the amount of effect the user has on the content is minimal. The content is lightly responsive and moves with the user. Next, the user is called to "uncover" content, by his/her movements images can be revealed. So the illusion is that the user has moved from the surface of the screen to just below the surface. At the next level, the z axis opens up and the user is moving into a landscape – is now IN the installation. At this level, the user can change various content elements with his/her "touch". The content figuratively and literally darkens, so that it is the user's task to brighten/lighten the environment, a more powerful illusion. The reward for this activity is the arrival in a swirling zone where touch literally creates playful creatures which move in amusing ways. The user as a godlet. The content ends where it started, on the watchful eye.

This storyline aims at taking the user through a progression which rewards the most active user. The more the participant moves around, gestures in exploration, etc. the more feedback and information he/she will receive. The underlying implication is of involvement in the universe. Contemplation alone will not provide a return in this interactive experience.

Production Charts

Using the latest versions of the storyboards, production charts were created to delineate the project's content, activity and team tasks to accomplish the installation. The charts encompass the digital content assets, the content's behavior based on the user's shadow movements, the sound needed and the assignment of tasks connected with all this. The charts accompany weekly to-do lists for all team members. The charts are working documents that are revisited and revised via group meetings, email threads, hallway chats, and other means of group discovery and exploration.

Investigation of Installation Materials

Crucial to the performance of the installation are the particular materials used, both for the practical, technical workings, and for the effectiveness of the user's interactions and resulting illusions. Research was done into various sources and possibilities, including information garnered from the iStory Multimedia Graduate Program team.

In February, Short Attention Span held an informative meeting with Otis Brown of Billingsly & Brown Audio/Visual. Mr. Brown provided excellent guidance regarding the types of media projector and video screen that should be utilized in the installation. Whereas we had been concentrating on the screen specifications, Mr. Brown explained the crucial role of various projectors' performance in our achieving data point capture well while projecting as vibrant digital content as possible. Specifically, Mr. Brown suggested a projector with a bulb of at least 2000 lumens in order to provide a level of brightness appropriate for video capture. Short Attention Span has confirmed that our projector in use does meet these criteria.

Brown A/V has generously provided a loaner screen for testing for certain periods until the end of the quarter. This screen allowed the testing of various installation setups, including rear projection, and also made possible our user testing session.

Test Installation Space

Luminance has been installed in a vacant office on the second floor of the Arts and Education building. The test installation has been critical in the development of the user experience and

interactive content as it allows for the control of variables affecting the installation, such as the lighting of the space and the color balance of the media projector.

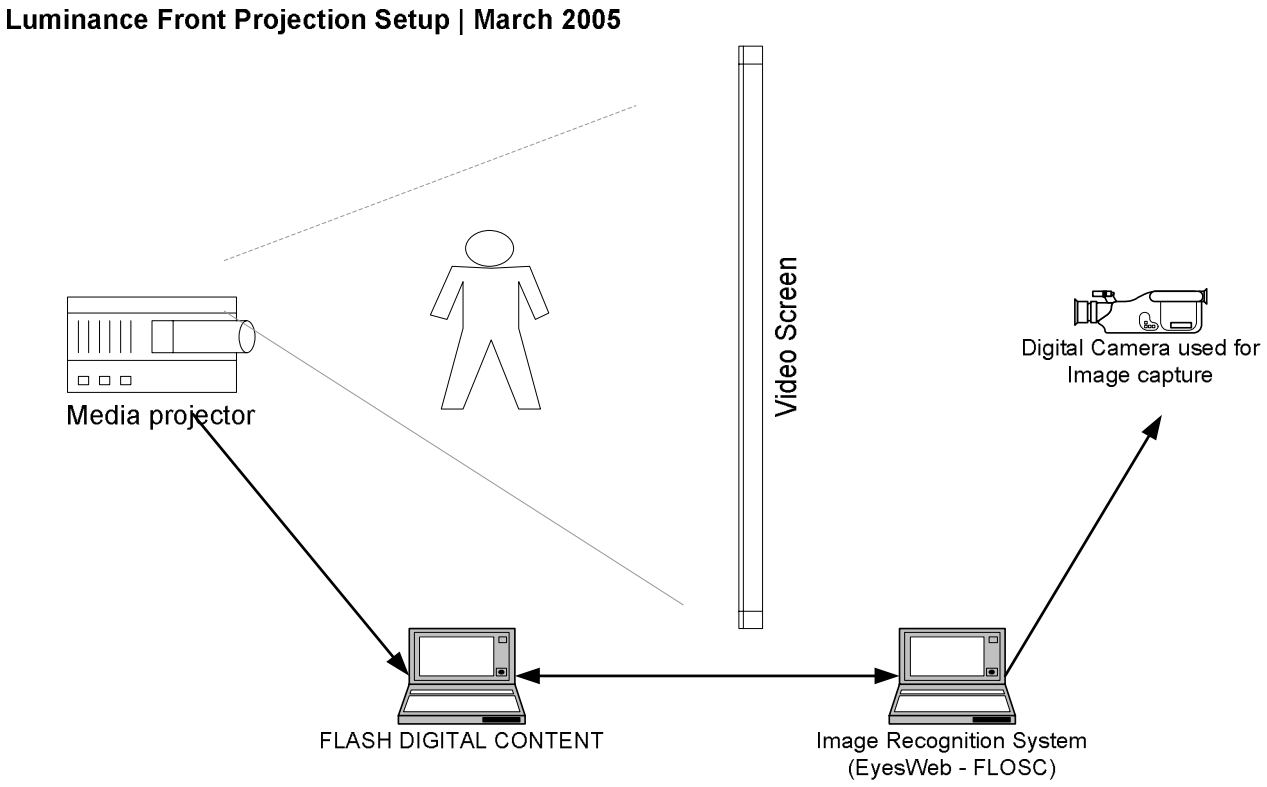
It has also been discovered that interactive scripts will perform much different in the actual installation than when being developed with the test Eyes-Web clips. This difference is attributed to the varying rate of data transfer that occurs in the test installation.

User Testing

On Friday, March 4, Short Attention Span conducted live user testing with a half dozen participants, both strangers and acquaintances of the team. Participants were not given any instruction or guidance other than to stand within the installation space. Content of the installation was periodically changed on the fly to show and test different types of interactive content while Short Attention Span observed their activity. Each user was videotaped. Each participant spent 10 minutes in the installation and was then asked to complete a short survey.

The testing was most useful to revealing areas in which Luminance excels, while also revealing the areas in which improvement would benefit the overall experience.

Physical Installation

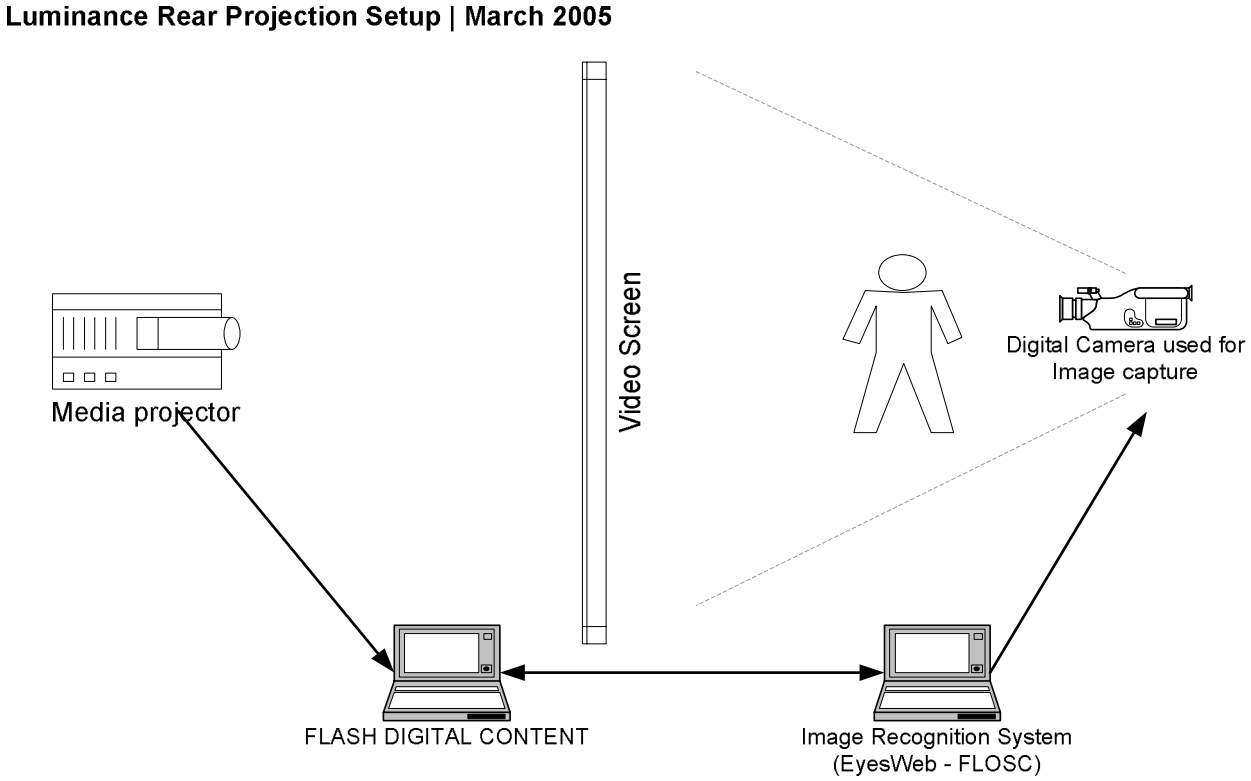


The setup of the Luminance installation evolved during the winter quarter. The video capture camera is now positioned on the opposite side of the video screen from the projector and participant. This allows for an increased capture field and increase in the size of the area in which a participant can move.

Rear Projection Configuration

Testing of a rear projector configuration also took place. The setup is identical to the Rear Capture configuration, except that the participant is positioned in a space between the video screen and video capture camera. This configuration holds promise due to the fact that the user does not block content being projected onto the screen. However, the participant loses the effect of the shadow as a motion indicator.

Short Attention Span concludes that the Rear Projector Configuration may be the most effective and deserves some additional testing. It is obviously critical for the performance of the entire system to be streamlined and developed in a manner that content response to physical movement of the participant is immediate for this type of setup to truly succeed. Immediate response will be an indicator of interactivity superior to the use of shadow position.



Current Findings - User Testing

User testing was conducted during the winter quarter. Testing was conducted using test content. The primary objective of the first round of testing was to establish functional and participant interactivity with the system. Testing of the system proved to be extremely stable as the system ran without interruption for over 30 minutes after correct calibration was established.

Interactivity

Most participants successfully understood the action reaction system created by their movement. Though some users were not clear whether feedback was initiated by the casting of their shadows or some other type of sensor. Another interesting observation was that most users wanted to move really fast. Only a couple users took the time to discover what happens when moving slower.

Time also had an impact on interactivity. As time continued to pass and the types of interactivity did not change, users began to wonder what affect they were actually having, questioning whether the content was changing based on their movement or not. One participant became convinced that the interactivity was based upon physically touching the screen.

Content

From a content perspective, it was clear that the initial simplified content based upon bubbles achieved its goal of giving clues to the participant of the effect of his or her movement. It was also clear that other levels of content and interactivity did not sustain the majority of participants' attention. Content would continue to be developed to be increasingly engaging and unique. Admittedly, this did not come of great surprise to Short Attention Span. Because content covered only first third of the experience, participants had no feeling of closure. Some participants seemed to be more interested in abstract imagery and others in realistic. The more detailed the Foggy Windows visuals, the more difficult it was for the users to figure them out.

Installation Space

More space is needed for the installation as users tended to stand much too close. The tight area prevented them from being able to recognize the underlying images for the "Foggy Windows" section. Most perceived this interactivity as a "Guess the Picture" process, and so were frustrated when they never were shown the whole movie or image involved.

Space also had an affect on the blocking of content, as a lot of content ended up projected on their backs causing frustration. They couldn't see the entire image on the screen. A strong desire of the participants seemed to be to see the whole image.

Some notable quotes:

"Awww, how cute!"

"Most random thing I've done in my life."

"I want to touch it."

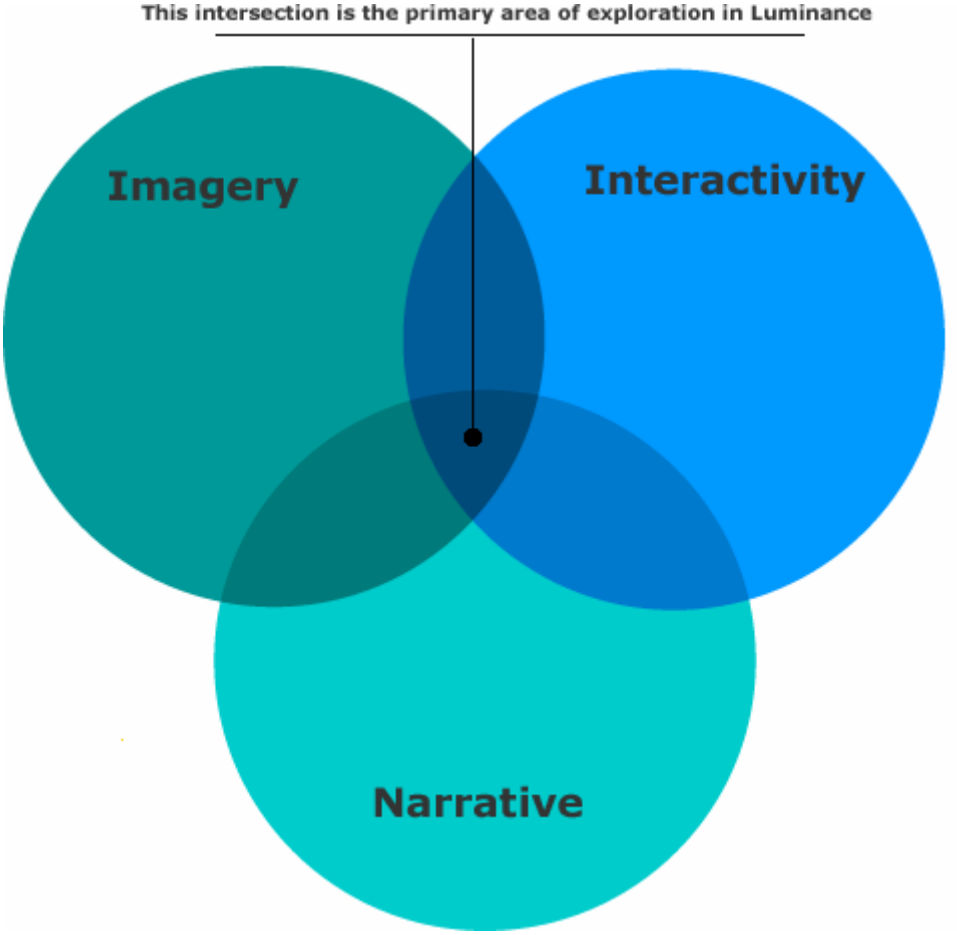
"It's like 'Minority Report'."

"Am I having an affect on this or not?"

Current Findings - Methodology

The design and production aspects of Short Attention Span's process of exploration and discovery have been part of the larger process of uncovering an underlying methodology for interactive art installation. This methodology will provide a response to our original research question and is to include design, production techniques, and the storytelling elements which will constitute the final deployment of the installation.

To date, certain aspects of this methodology are beginning to reveal themselves. What follows is a brief description of some methodology components. It is not intended to be indicative of the total methodology to follow in the spring quarter, but to be an indicator of current thinking within Short Attention Span. Simplified in a self-absorbed and overreaching manner, Luminance is a project exploring the space where imagery, narrative, and interactivity intersect. No one area dominates.



Imagery

The development of imagery within Luminance follows a chain of progression. The resulting imagery will help a participant to comprehend the installation system's usability as well as allow the participant to construct personal narrative threads within the experience. It will evoke rather than explain.

Narrative

The storytelling of Luminance progresses in a manner that does not follow a concrete linear path as seen in a majority of film and music. Rather, the creative pieces of Luminance are being crafted to allow for story development within cognitive brain functions. A critical aspect of Luminance's story is to assist with the participant's education within the system. Short Attention Span's narrative is also crafted of sensibility abstract enough to encourage freedom of individual story development, as

Luminance is ultimately an experience unique to each participant. Ultimately, narrative exists to convey perspective.

Perspective

Two kinds of perspective are critical to the success of Luminance. They work simultaneously. The emotional or cognitive perspective increases user participation via interactivity and creates a sense of the participant's place within the overall piece. The participant is as much a part of Luminance as the technology, hardware, screen, or Flash content. Establishment of cognitive or emotional connection is crucial to the participant's overall perspective within the piece.

Secondly, the visual or dimensional perspective is affected, among other factors, by the overall aesthetics created via color, sound, timing, and positioning. Of course, presentation of sound and image is a necessary piece of all multimedia-based art. With installation and interactive participation, factors affecting the physical environment must also be considered as variables affecting perspective.

Interaction

As with imagery and narrative, interaction within Luminance is based upon a progression, beginning with simple movements creating basic feedback and response. The progression of Luminance within interaction as well as imagery and narrative follows the following 4 basic stages throughout the piece:

1. Observation
2. Exploration
3. Modification
4. Reciprocal Change

Functional designs and storyboards of the content narrative show increasing complex responses but all are originally based upon simple mechanics of physical movement. The movement required for Luminance should not be elaborate physical maneuvers, as those would create barriers to entry and fun within the experience.

Interactivity creates implied communication, yet it requires rule sets and constraints to function smoothly. Programming code creates these rule sets and constraints. The interactivity of Luminance will be successful if these rule sets and constraints allow for the creation of response systems that are of an abstract nature, not restricting to rigid guidelines within the system. For example, the system must allow for the unexpected within the rule sets. Short Attention Span has experienced the unexpected during production as certain code written to do a certain task does something completely different, yet the outcome is even more rewarding. The installation of Luminance must allow for the experience of the participant to reveal his or her own happy accidents.

Project Goals for Spring Quarter 2005

Establish the look of the content, create all movie and still content assets.

Conduct additional user tests of the installation.

Finalize optimum physical parameters of the installation: best active area for user vis-à-vis the screen, distance of camera & projector to screen.

Utilize all findings to document methodology and share with multimedia installation artist community.

Resources

Resources and references can be found on the Short Attention Span website.

http://sasweb.csuhayward.edu

Appendices

1. User Testing Evaluation Form
2. User Testing Consent Form
3. Content Map

Appendix 1: User Testing Evaluation Form

PROJECT LUMINANCE EVALUATION

A Cal State East Bay Multimedia Graduate Program Thesis Project 3/4/05

Please choose one opinion for each statement.

This was easy to do. Yes __ Somewhat __ No __ Couldn't tell __

This was fun to do. Yes __ Somewhat __ No __ Couldn't tell __

I got lost in what I needed to do. Yes __ Somewhat __ No __ Couldn't tell __

Things happened too fast. Yes __ Somewhat __ No __ Couldn't tell __

I'd like to do another one of these. Yes __ Somewhat __ No __ Couldn't tell __

It went on too long. Yes __ Somewhat __ No __ Couldn't tell __

++++++++++++++++++++++++++++++

What was your favorite part?

_____
_____
_____

If there were three things you could change, what would they be?

1.) _____
_____
_____
_____

2.) _____
_____
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_____

3.) _____
_____
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PROJECT LUMINANCE EVALUATION page 2

Additional comments, please:

_____
_____
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Thanks for your participation. Next time we'll have chocolate.

Appendix 2: User Testing Consent Form

PROJECT LUMINANCE TEST
A Cal State East Bay Multimedia Graduate Program Thesis Project

Purpose

In order to effectively evaluate the responses to our art installation, we need to videotape the sessions. We would like to obtain your consent to videotape your usability testing session today. The tape will be used only internally for our thesis project. It will not be broadcast, distributed, or used for any other purpose. America's Funniest Home Videos didn't offer enough.

Consent

I, the undersigned, hereby give my permission for today's usability session to be videotaped for the purposes described above.

Name: _____

Signature: _____

Date: _____

Appendix 3: Content Maps & Production Charts