Lantern Field: Exploring Participatory Design of a Communal, Spatially Responsive Installation

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ABSTRACT

Lantern Field is a communal, site-specific installation that takes shape as a spatially responsive audio-visual field. The public participates in the creation of the installation, resulting in shared ownership of the work between both the artists and participants. Furthermore, the installation takes new shape in each realization, both to incorporate the constraints and affordances of each specific site, as well as to address the lessons learned from the previous iteration. This paper describes the development and execution of *Lantern Field* over its most recent version, with an eye toward the next iteration at the Smithsonian's Freer Gallery during the 2013 National Cherry Blossom Festival in Washington, D.C.

Keywords

Participatory creation, communal interaction, fields, interactive installation, Japanese lanterns

1. INTRODUCTION

Inspired by traditional Japanese lantern festivals, *Luminous Kite Lanterns* celebrates the ephemeral, fleeting nature of materials traditionally used in Japanese rituals and events, and through both natural forces and digital interactivity, brings awareness to our interconnectedness to nature and amongst people occupying a public space. It is the second of an ongoing illuminated paper installation series by Architect Aki Ishida, *Lantern Field.* The first work in the series, *Luminous Washi Lanterns* (Figure 1), was installed at the Japan Society in New York City in 2011. In the first version, visitors to a tsunami benefit concert interacted with the work by participating in an eight-hour public lantern folding workshop that was led by Ishida and her students from Rhode Island School of Design. Building upon this version, this time with *Luminous Kite Lanterns*, digital interaction was integrated into the design to engage not only the aural as well as tactile and visual senses. During this iteration, the lack of public participation in the creation of the work elucidated the importance of this component in the first version at the Japan Society. Moving forward, this participatory component has become a keystone of the work as the development of the series continues.

Luminous Kite Lanterns (Figure 2) was designed and installed collaboratively by a team directed by Ishida of students and faculty of Virginia Tech. Digital interactivity was designed in partnership with faculty and students of the Institute for Creativity, Arts, and Technology led by Benjamin Knapp, Ico Bukvic, and Brennon Bortz. Sited at the Blacksburg Farmers Market, the project was commissioned by the American Institute of Architects Blue Ridge chapter for their 2012 Design Award Exhibit on September 17, 2012.

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Figure 1: Luminous Washi Lanterns at Japan Society in New York during CONCERT FOR JAPAN, 2011.

Figure 2: Luminous Kite Lanterns in Blacksburg, VA, 2012.

2. RELATED WORK

2.1 Inspiration

Lantern Field was initially inspired by ephemeral events and placemaking that Ishida encountered while growing up in Tokyo, Japan. During Japanese *obon* festivals, in which the spirits of one's ancestors are honored by the lighting of lanterns, public parks, temple yards, or parking lots become temporary stages for an event. Scaffoldings holding hundreds of paper lanterns create walls or overhead canopies that define spaces for dancing and eating. After a few days of the festival, the lanterns come down, returning the parks

and temple yards back to their everyday states. The materials may be gone, but the memory of the experience and the illumination, along with the anticipation of the event recurring a year later, make a lasting mark in people's imagination. It was this sense of ephemeral placemaking through light and paper that initially inspired the work *Lantern Field*.

There are many examples of small, temporary structures in Japanese culture that grow as public participants add to them. At shrines, visitors buy paper *o-mikuji* (fortune-telling paper strips) that they tie to trees in the temple yard or a wooden scaffolding that is built to hold the paper strips. As these scaffoldings become filled with strips of paper over time, they become temporary walls or enclosures of space. On July 7, for the *Tanabata* star festival, children hang paper garlands on bamboo trees for a short lifespan of a few days. Following the tradition of writing short poems, children today write wishes on strips of paper, or *tanzaku*, and hang them on the bamboo branches.

2.2 Participatory Creation

An example of art involving audience participation is *Wish Tree* by Japanese artist Yoko Ono [16]. Exhibited throughout the world since 1981 following John Lennon's death, over a million wishes have been collected and sent to the Imagine Peace Tower in Reykjavik, Iceland. Ono exhibited ten Wish Trees around Washington, D.C. during the 2007 National Cherry Blossom Festival, one of which was acquired permanently by the Hirshhorn Museum and is now located in their sculpture garden. During the summer months when the leaves are full, the museum provides paper tags with strings for the visitors to write wishes and hang on the tree. The museum staff harvests the wishes everyday and ships them to Ono's Imagine Peace Tower in Iceland where they become part of a larger collection of wishes (*Imagine Peace*) [13].

In installations that do not involve audience participation in their making, the work of art is put in place by the artist and presented to viewers as a static, finished piece. The participatory, dynamic aspect of *Lantern Field* shares more of a kinship with a performance than with a static sculpture. Performance theorist Richard Schechner, in his book *Anthropology of Performance*, writes about the collective experience that is shared during a performance:

> Spectators are very aware of the moment when a performance takes off. A "presence" is manifest, something has "happened." The performers have touched or moved the audience, and some kind of collaboration, collective special theatrical life, is born [18].

In a similar way, audience members who participated in the folding of lanterns or writing of wishes during the making of *Luminous Washi Lanterns* stayed or came back hours later to the atrium to view how the installation had grown. The audience was the participant, and as a result, many were first emotionally moved while they made the lanterns, then again when they came back to see their work as a part of a larger, collective installation [12].

2.3 Ambient Art

Russell Beale defines ambient art as "the aesthetic presentation of information, using artistic techniques to achieve a pleasing image that also contains hidden depths, where exposure to it over time allows a viewer to understand something about the information sources that it represents" [2]. Given the broad nature of to what "information sources" may refer, one could argue that most—if not all—artistic installations and performance art provide deepened understanding of their content (including the information source) through prolonged attentive exposure. In an attempt to disambiguate, Bukvic et al. proposed to extend Beale's definition as follows: "Ambient art incorporates aesthetic presentation of information, using artistic techniques to achieve a pleasing output that, in addition to the pre-existing multilayered nature of art also contains newfound depths, and where exposure to it over time allows a perceiver to understand something about the embedded information sources" [5].

In addition to common installation ↔ audience participation (including embedding external information sources), the new definition provides opportunities to consciously define and incorporate information sources that stem from participatory design (participant/creator ↔ installation), as well as communal interaction (participant ↔ participant), the latter being facilitated by the installation itself. We have explored this domain in several past examples, ranging from the *Intelligent Space* concept dealing with the combination of information sources stemming from both participant behavior and external sources (e.g., stock market, space use, and educational progress data) [5], to *Luminous Washi Lanterns* (participant/creator ↔ installation), to interactive installations designed to serve as catalysts for communal interaction [6].

2.4 Sound and Light Installation Art

Lantern Field is one in a long line of architectural/sonic installations. Indeed, for more than half a century now, artists have been experimenting with the spatialization of sound within a space in the context of installation art [17]. Recently, however, there have been a number of similar works that play particularly on the use and disruption of space itself as the primary medium for an installation. For instance, in 2010 Gauthier and Pasquier developed *Auditory Tactics* [8], a project that leverages the use of beamforming for sound reproduction in a way that explicitly intersperses the listener's sound field with multiple smaller, discrete sound fields. The aural landscape of these smaller fields disrupts the larger by juxtaposing content from private spaces against the public soundscape of the installation site (a museum gallery). Instead of disrupting the sound field, *Abstrações* also tracks the position and movements of participants within a field, but to the end of generating an immersive sound field within the space, similar to a portion of the interaction in *Lantern Field* [15]. In a related way, the work of Leslie et al. in *Grainstick* senses participant manipulation of a virtual object within three-dimensional space to modify the projected sound field [14]. Similarly, other installations allow presence and motion within a space to affect a sound field—for instance, Filitriau and Zajéga's *HUM* maps participant motion not only in the three-dimensional sound field but also projects disruptions across time through visual display [7], *dots* by Grigoriou et al. allows participants to manipulate projected visuals and sound in in real time [9], and *Transition Soundings* by Birchfield et al. emits a field of sound and light from a wall that is responsive to participant proximity [3].

A great number of installations allow interaction with light through responsive projected images. *Luminous Kite Lanterns*, on the other hand, allows interaction with the light field directly, wherein participants' motion and location within the space manipulate the projected fields of light throughout the space—their hues and intensities. Other previous installations have been constructed with similar aims. Many of the works of Höweler + Yoon Architecture / MY Studio fall into this category—in their *Light Drift – In-*

tersect, installed along the Schuylkill River in Philadelphia, the locations of participants along the riverfront modify the colors and patterns of illuminated orbs both along the waterfront, as well as in the river itself [11]. More closely akin to *Luminous Kite Lanterns*, *White Noise White Light* (another work by Höweler + Yoon—installed for the 2004 Olympic Games in Athens) is a 2,500 square-foot field of fiber optic lighting and diffused sound. As participants pass through the field, the installation responds by emitting white light and white noise around the participant, growing and subsiding in proportion to the amount of nearby activity [10].

Volume, a collaborative work between United Visual Artists and Massive Attack, is composed of an array of 48 sound-emitting LED columns arranged in a grid [1]. These columns, too, are responsive to motion within the grid. Finally, while *Arcade* by Blinkenlights uses projected light as a medium through which participants can engage with a range of animations and interactive applications projected onto the side of a building, the installation also incorporates participatory co-creation: participants not only engage with the existing interaction but are able to create and submit animations of their own for projection [4].

Luminous Kite Lanterns is an effort to tie together all of these foci. Site specificity deeply informs the architectural concept of the lanterns as ephemeral placemakers. The interaction is built around the concept of multiple superimposed fields—light, sound, human activity, and the lanterns themselves. Participant co-creation brings the designers and public together in creating shared ownership of the work. And finally, the sound and lighting design serve to unite these into a cohesive interaction.

3. IMPLEMENTATION

3.1 Fields of Paper Kites

Luminous Kite Lanterns is an interactive sound and light field that responds to the natural forces of the site and the movement of people as they walk through it. Wind and light-catching kites made of mulberry paper and bamboo are connected on kite lines and suspended from lightweight metal chains. 52 strings of kites are hung beneath 3,000 square feet of the outdoor timber frame pavilion to sway and rotate together in response to wind. Multiple mockups of the kites were made to test different paper dimensions, the apertures in the paper, and the connection detail to the chain to determine the appropriate level of movement and constraint so that it would respond to the wind but remain stable under a gust of wind (Figure 3a).

During the day, the kites capture the sunlight and cast shadows on each other. At night, the kites are lit with RGB LED fixtures to create a luminous outdoor ceiling. The color of the lights shifts from warm white to light red as people enter the space and become intense red as the occupants' motion increases (Figures 3a and 4). The ambient sounds of wood chimes echo through the space as people's motions are captured by sensors, creating a multi-sensory space that responds to presence and activity. Each bay is assigned a set of pitches that form a pleasing collection as well as harmonically relate to the neighboring bays. Within each bay as human presence and motion increase, so does the aural activity within that bay.

3.2 Sound Design

When designing interactive installations for public spaces where the sound needs to serve both as a catalyst for immersion and interaction, yet avoid being dominant or overbearing, it is of particular interest to us to create a natural occurrence with a surreal twist that empowers users to experience it both as a primary and secondary stimulus. Here we define primary as something that is the main focus among multiple stimuli, while secondary as something that exists as a pleasing aural fabric that takes place in the background (e.g., during a conversation). As a result, the aural component of *Luminous Kite Lanterns* focuses on recreating the kinetic motion of a pendulum and harnesses the power of this motion to produce natural rhythmic patterns similar to that of wind chimes. At the same time, the aural events are rooted in a surreal but recognizable source, namely a wooden, bamboo-like sound with the reverberant properties of a metallic chime.

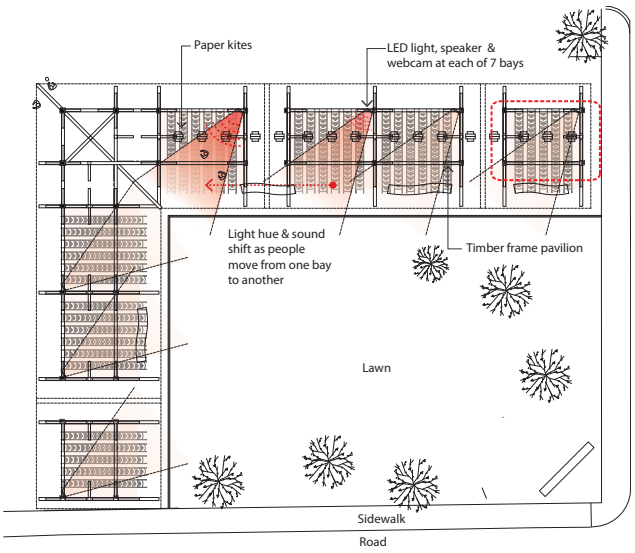


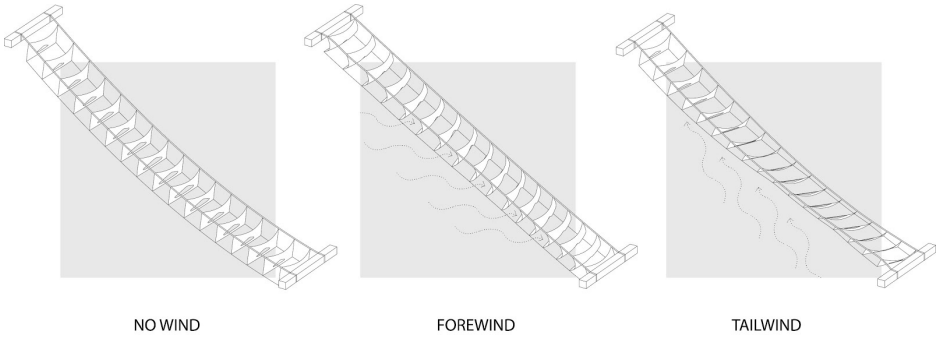
Figure 4: Site plan showing seven bays of the pavilion from which lanterns are hung. Each bay is equipped with an RGB LED fixture, webcam, and speakers.

A speaker, camera, and RGB LED fixture are mounted at each bay, and as the camera captures the presence of people, the ambient sounds are triggered alongside shifts in color hue. Each bay has a unique collection of four pitches, allowing users to create harmonic progressions as they traverse from one bay to another. Inputs to the interaction come from the results of computer vision processing of video streams from webcams in each bay (described further in Section 3.3). These inputs drive the aforementioned pendulum simulation built in Max/MSP[1] to determine a patterned, reverberant aural output based on the kinetic energy observed in each bay. This energy is infused into the pendulum, pushing the pendulum away from its point of rest. As the pendulum strikes four virtual boundaries it generates a pitch. Greater activity within each area results in more virtual kinetic energy, and consequently an increased number of aural events (pitches).

3.3 Interaction Design

One of the primary motivations of *Luminous Kite Lanterns* is to give participants a sense of their own presence within a field of sound and light. Classical field theory is primarily concerned with electromagnetic and gravitational fields, but a field itself is defined in physics as any space in which each point is affected by some quantifiable force in space and time. One can imagine a two-dimensional field as a matrix of points, each associated with a particular location in two-dimensional space. Each point is also associated with a

[1] `http://www.cycling74.com/`



(a) Kites' behaviors in response to wind direction.

(b) Motion sensed in the bay triggers a change in light and ambient sound as one performer starts a dance (left). The hue shifts as she is joined by a second dancer (middle) and finally the effect fades as they move away (right).

Figure 3: Kite behavior and interaction.

vector, the magnitude and direction of which represent the force acting upon this particular point in space and time. Of course, fields are many-dimensional, as each space varies both spatially and temporally.

In *Luminous Kite Lanterns*, participants enter into such fields that evolve over time and space. In particular, these fields spread throughout the interaction space in the forms of shifting light and sound. These field not only exist everywhere within the interaction but also can be disturbed. These disturbances travel as waves throughout the field, carrying energy and information. They emerge from the participants' activity within the field—either moving through the installation or simply standing within the space. The installation senses such disturbances, and emits disturbances of its own in response to this interaction. The disturbance of light, in particular, carries on to further modify the way that the installation perceives interaction within the space.

In order to detect these disturbances, movement within each connected bay of the installation is captured by a Logitech Webcam C210[2]. Because of the need for motion capture in seven spaces, the C210 devices were chosen primarily for their cost effectiveness. A 30 FPS stream from each camera is streamed to one of two Mac Minis driving the installation. A Max/MSP/Jitter patch running on each Mac Mini (Figure 5) processes each incoming stream to quantify the total amount of motion within each space, as well as the total number of persons currently present within each space. Total overall motion is calculated by determining the total change from one frame to the next. A blob tracking algorithm calculates the location of each body within each bay. Each algorithm relies on the indispensable cv.jit library[3]. The lighting of each space is controlled by an American DJ Profile Panel RGB lighting instrument[4]. The same Max/MSP/Jitter patch used for computer vision processing maps the output of this processing to the projected hue of each instrument. This is accomplished by way of an Enttec DMXIS DMX controller[5]. Within each space, light shifts continuously between a warm white hue when no participants are present within a bay, through a range of oranges when several participants are moving through a bay, to a deep red when many participants are moving regularly within the field.

Taken together, changes in these two parameters (presence and motion) are mapped to shifts in both the hue of the lighting within each bay, as well as to the sound spatialization techniques described previously. It is through this interaction that participants initiate disturbances within these several superimposed fields, and the fields respond accordingly. Indeed, one of the richest observations of the installation has been the way in which participants begin to realize the effect that their disturbances have on the fields of sound and light, and begin to interact in ever-subtler ways with the installation—suddenly stopping in the middle of a space, running through the installation, and even staging dance routines with the space. Because the work is situated in a public space, it is activated by those who unknowingly as well as as those who deliberately participate. With webcams capturing the motion of people and objects in the surrounding area, the boundaries of the interactive field are blurred, sometimes penetrating beyond the edges of the pavilion. This aspect makes the work distinct from those that are triggered by haptics, and expands the definition of the site beyond that which is marked by visible boundaries.

The audience feedback also provided critical views of what behaviors might trigger the change in the visual and aural environment. Visitors walked back and forth through the pavilion to activate the sound and light shift, many attempting to understand the differences in the environment's response to the speed and/or amount of their movement. One person said that he wanted to be rewarded for being still rather than being in motion. This possible idea raised intriguing questions about how the atmosphere of the space could be affected by the types of behaviors that trigger the

[2] http://www.logitech.com/
[3] http://jmpelletier.com/cvjit/
[4] http://www.americandj.com/
[5] http://www.enttec.com/

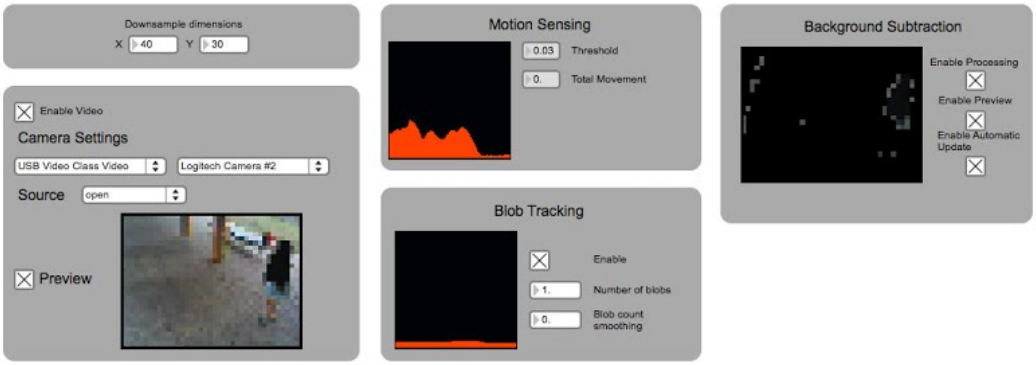


Figure 5: Main Max/MSP computer vision patch.

spatial response. Because there was a built-in two-second delay in the Action → Response time, the speed of shift and colors was slow, which resulted in a meditative quality in the experience of the space. However, if the participants were to be rewarded for being still, this would introduce another form of latency that we must consider.

Through participatory interaction, input from participants is an integral part of the work, as was also the case of the lantern making and wish writing workshop in *Luminous Washi Lanterns*. Similarly, as communal interaction the installation can serve to facilitate and promote a particular form of interaction that may defy social norms (e.g., an installation fostering interaction between two strangers). The information source ensuing from such an interaction is the content exchanged between the two participants. Perhaps most importantly, this communal interaction jointly elicits results that would be otherwise unattainable through the actions of an individual.

4. LESSONS LEARNED / NEXT STEPS

Following the *Luminous Kite Lanterns* implementation, we look forward to the upcoming installation at the Smithsonian Freer Gallery commissioned as part of the Cherry Blossom Festival in Washington D.C.. Successful aspects of the first two iterations, namely the involvement of the public audience in the making of the work from the New York version and the use of space as interface for sound and light interaction from the most recent version in Blacksburg, will converge and be refined in the third realization in Washington. It will in many ways merge our collaborative foundation with the aforementioned areas of interest: participatory design, communal interaction, interactivity, work in public space, and the use of dynamic/generative sound and lights. The new work will further challenge how, in site-specific manners, participants create their own artifacts that become a part of the installation, while acknowledging the presence of multiple individuals and rewarding their both conscious and unsuspecting group interaction with the work.

5. CONCLUSION

Luminous Kite Lanterns, the second in the *Lantern Field* series, brings new forms of interaction to bear on what was originally a non-interactive work through the incorporation of computer vision and a dynamic lighting design and aural landscape. While the first in the series, *Luminous Washi Lanterns* lacked this interactivity, it did incorporate a component of public co-creation of the work, wherein participants helped to construct and assemble the work itself. In retrospect, this co-creation proved equally as important as interactivity—thus, each will remain an integral part of the work in future versions. Here, we have discussed this series of works; their background in Japanese tradition, participatory creation, and ambient and installation art; described the implementation of *Luminous Kite Lanterns*; and, give some initial thoughts on the future of *Lantern Field*. This iterative process of improvement continues even now as the work is prepared for its third installation in Washington, D.C. and on to further future realizations.

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