USING GAMING ENGINE FOR VIRTUAL PROTOTYPING 
AND IMPACT ASSESSMENT OF COMPLEX 
INTERACTIVE ART INSTALLATIONS

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ABSTRACT

With the increased access to affordable environment sensing devices, we’ve seen a rapid development of increasingly more complex interactive art installations. These newfound artistic structures span beyond purely artistic, at times embedding real-world data in a form of ambient art. Due to their inherent conception and production complexity, such projects are often difficult to describe in writing. They also commonly require unconventional interdisciplinary production teams that may have had little contact with each other which may also lead towards challenges in communicating ideas among the production team members. Such challenges may prove critical in assessment of creative proposals and their fundability. In the following paper we present an alternative approach to concept and prototyping phases of complex installations that take place entirely in virtual domain using 3D gaming engine. Based on conclusions gathered from a real-world funded project in which this approach was first piloted we offer an overview of its potential advantages over more traditional means of content delivery.

1. INTRODUCTION

1.1. Ambient Art

Ambient art is defined 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.” [1] Although in its original form the term focuses primarily on visual, as is the case with a growing number of recent art installations [2,3], its applicability should be by no means confined to visual domain. While a study of existing literature has yielded no examples of a musical counterpart to the ambient art, this may be in part because “ambient music” is a generic term that has little overlap with its visual counterpart, and as such examples we sought might be encapsulated under other terms, such as interactive art installation. Additionally, we observe that the “hidden depths” in the original definition may be also seen simply as a multilayered structure commonly we’ve come to expect in traditional art forms, including music, and may require additional clause that would distinguish the two.

Finally, from an artistic perspective, we argue that art should be also capable of existing independently of its influences and/or data streams and as such art should not be regarded as a mere vessel for visualization of data but rather as an self-sufficient art form further enriched by the addition of external data input. This observation is of particular importance when making a distinction between the art and information. Consequently, we propose to amend the definition of ambient art 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.

The newfound definition of ambient art can and indeed does take on many different forms:

1. Art that also represents data with a perceiver being exclusively a consumer even though the data stream may be a result of actions of other potential perceivers, e.g. stock market data [3],
2. Art in which the data stream is based on perceiver(s)’ input [4], allowing participants to shape the very art form, and
3. An interactive multidimensional loop combining options 1 and 2 where perceiver can be both a consumer of the ensuing art and a contributor to the data stream shaping the very art they perceive.

1.2. Increased Access, Growing Complexity

With the advent of affordable gaming controllers focused on embodied interaction [5] (e.g. Nintendo Wii [6], Playstaton Move [7], Xbox Kinect [8]), we’ve seen a development of the interactive art installation genre and with it its growing scope and complexity. Today, it is not uncommon to encounter sizable interdisciplinary production teams working together on an art installation and bringing together expertise from disciplines that have traditionally seen little cross-pollination.

All these developments have led towards a series of challenges in producing convincing, competitive, and ultimately fundable proposals. After all, due to sheer complexity installations involving a mix of internal and
external variables are often cumbersome to put into words and as such it is difficult to communicate their conceptualization to potential sponsors. They also face potentially an uphill battle when facing competition from more traditional projects.

1.3. Virtual Prototyping

Cecil and Kanchanapiboon define virtual prototyping “as an engineering or science based VR model which can “mimic” or simulate a target system’s (or object’s) behaviour, response, appearance, and geometry with a degree of realism comparable to the actual system or object [9].” Offering cost-savings and increased prototyping flexibility this model has extended its reach well beyond engineering. More recently, with the proliferation of powerful 3D gaming engines [10,11], we’ve seen a growing interest in their adaptation as a means of virtual exploration of building architecture [12]. Perhaps one of the greatest advantages of virtual prototyping in projects that commonly require interdisciplinary engagement is ability to communicate critical information in a common, universally accessible way—through a virtual first-person experience.

The following section provides an overview of a project in which authors have harnessed the power of virtual simulation for the purpose of making a more compelling proposal.

2. INTELLIGENT SPACE

Originally commissioned by the Wake-Forest University School Masters of Business Administration program and Wachovia Bank, Intelligent Space project focuses on retrofitting a floor in a downtown Charlotte, NC sky rise co-shared between MBA students and Wachovia employees with a series of interactive art installations for the purpose of conveying a sense of a pleasing, engaging, intelligent, and information-filled space. The project aimed at addressing following four goals:

1. Support principles of environmental sustainability
2. Creating space that supports the primary uses within the space
3. Implementing installations with three types of modules: (1) transitional, (2) social and café spaces and (3) educational avatars, and
4. Investigating how humans may interact with spaces containing interactive digital media.

The collaborative team consisted of and Virginia Tech Digital Interactive Sound and Intermedia Studio (DISIS) [13] (core design and prototyping team and audio-visual artists), Winston-Salem State University Fine Art Department (visual collaborators), Wake Forest University Babcock Graduate School of Management and Wachovia, Inc. (sponsors and at the time future occupants of said space) and Workplace Strategies (architects).

Based on preliminary research the project stakeholders solicited proposals through DISIS in order to explore aforesaid potential with the ultimate goal of producing a series of artistic modules. While it was clear that solicitors were seeking innovative ways to complement intelligent sustainable architecture with interactive art forms, no concrete vectors or expectations were provided.

2.1. Communication Challenges

As part of the initial presentation a series of concepts were demoed providing a hypothetical scenario of how the space might interact with its occupants. Given the complexity of proposed scenarios, concepts demoed as part of the presentation were confined to isolated components of a more complex ecosystem, while the system as a whole was presented using visual imagery and supporting verbal explanation. The intention was to populate advanced space with a series of interdependent ambient art modules whose purpose is to extend information feedback to form an interactive multidimensional loop.

While presentation had clearly engaged the target audience, several members have expressed confusion and consequently scepticism with the main reason being inability to completely grasp proposed interactions and their projected impact.

2.2. Virtual Prototyping

Project’s complexity and unusually diverse interdisciplinary group of stakeholders clearly required a more immersive conceptualization before it could attract the necessary unanimous support from its stakeholders.

Consequently, the team offered to explore virtualization of the proposed project. In response, Wake-Forest MBA program secured adequate funding necessary for the execution of what became known as phase I.

2.3. Phase I

The purpose of phase I was to identify key elements of the installation, their interactivity vectors, and anticipated outcomes. This process took mainly via teleconferencing calls among the team members and stakeholders in order to identify relevant input streams for the ambient art. The ensuing data was then translated into virtual domain and represented with simplified ambient art concepts. The virtual simulation was to offer basic interactivity (first-person experience with basic physics simulation) and a preset array of interaction points users would be able to explore at their own pace. The production team was complemented with two undergraduate student researcher positions and the project took place over 3 months with the bulk of the work taking place during the final three weeks.

A number of technologies were considered for this step, including Second Life [14]. The team finally settled on Unity3D [11] cross-platform gaming engine that offered rapid prototyping environment with basic
support for 3D sound spatialization and content independence from the third-party infrastructure.

3. THREE MODULES

The final prototype consisted of three architecturally discrete modules that interacted with its users in three unique ways while cross-pollinating their data streams with each other: Transitional Space, Café X, and the Educational Avatar.

3.1. Transitional Space

The first module populates the L-shaped hallway, the only way for the Wake-Forest students to reach the communal Café X area. At the midpoint between the elevator and the Café X lies a small diagonal alcove that serves as a Zen refuge from the bustling activity that occupies the rest of the floor. In this module, visitors’ motion throughout the two perpendicular hallways fuel a persistent and relaxing aural soundscape. As users traverse this space, their motion generates water ripples that emanate throughout the entire length of the hallway. The 90-degree intersection between the two hallways is also the place where the energies of arrivals and departures intersect. Here ripples splash against virtual walls engulfing the Zen refuge, thus generating a soothing aural fabric for those who may find themselves inside it. Multiple individuals engaged in a collaborative discourse passing through are capable of generating much greater ripples than individuals, suggesting that their collaborative potential is greater than the sum of their individual efforts.

In the middle of the alcove there is a virtual well containing visual rendition of recent history of human traffic dynamics. It monitors activity trends and annotates collaborative spikes, like commonly searched keywords, encouraging participants to reflect upon the fact that their actions will inadvertently impact others around them.

3.2. Café X

The café is the place of convergence. This is where students and faculty converse, discuss, and forge potential collaborations. This convergence is reflected in an audio-visual installation reflecting a dynamic image of a landscape with a river, hills, and forests whose parameters are influenced by internal and external factors, such as the stock market dynamics, building’s structural health, activity currently taking place on the floor, and ongoing collaborative projects. These streams manifest themselves by altering parts of the aforesaid landscape. For instance, lack of activity on the floor would make river run dry, while great collaborative successes could not only strengthen the flow but also alter its course. Likewise, other external factors could affect the audio-visual state of the installation, such as exchange of seasons or the current weather. The transitional space links to the Café X and contributes its level of transitional activity, helping participants anticipate arrival and departure of new collaborative energies.

3.3. Educational Avatar

The third module, like first flows into the Café X. Students participating in the Wake-Forest MBA coursework are given an opportunity to develop personal avatars, offering stats that reflect student’s accomplishments and a growing list of credentials. Students performing well on an exam or completing a course will gain points in their personal profile enabling them to engage in new collaborative opportunities while using earned points to also affect the Café X and Zen refuge installations: after accumulating a set amount of points they will be able to alter installations’ properties. In part to promote collaborative thinking, those who choose to pool their points and jointly alter the aforesaid installations will be able to invoke a change that is greater than the sum of its parts. As a result one could envision new trees growing on the hills, or in the case of
greater collaborative contribution and erosion that fundamentally alters the landscape’s structure.

This module would make students stakeholders in this space and its dynamics. Participants would be able to monitor their progress through their virtual selves which would in turn encourage them to actively participate in as well as learn from the ensuing living interactive environment.

3.4. Facilitating Comprehension

In order to clarify how said modules might affect occupants of the space, the team relied upon a combination of virtual stimuli, including more common options, such as:

- Triggers users could interact with by clicking on them,
- Hotspots or areas that automatically engage particular options once a user enters them,
- Contextual pop-up menus and options associated with specific triggers and areas,
- Virtual tour guide whose verbal instructions were triggered whenever user entered a particular area or initiated a particular action, and
- Additional location-aware pop-up windows that complemented virtual tour guide descriptions with additional written explanation users could access when located within respective areas.

To further facilitate comprehension, the team relied upon the visualization of elements that are otherwise invisible in real life, as is the case with water ripples generated by user’s traversal of the Transitional Space module and the visual cues in the Educational Avatar module.

4. OUTCOMES

The final product was delivered in a form of two executables supporting Windows and Mac platforms respectively. Unlike the original proposal, the feedback virtual simulation elicited was overwhelmingly positive. The target audience also exhibited significantly greater level of understanding of how the artistic components may affect space’s occupants. Consequently, the team was encouraged to proceed to the phase II—physical prototyping.

Phase II’s initial focus was on prototyping the Transitional Space and for its execution the team focused on interfacing MaxMSP/Jitter [15] with Unity3D. The intention was to use IR-capable camera with fisheye lens and IR LED lights and feed motion data (Jitter) into a physical simulation (Unity3D) and in turn drive water ripple sound sources through an array of ceiling-mounted speakers. During the course of this phase it became apparent that a robust linking mechanism was necessary to ensure seamless integration of the two tools. Consequently, μ (mu) library was developed [16].

During the phase II, Wachovia amidst the global economic crisis was assimilated and the project effectively abandoned due to lack of funding. This unforeseen turn of events provided for an opportunity to capitalize on the newfound technologies. Consequently, Transitional Space and the μ technology found their way into the Elemental installation as part of the opening setup of the Taubman Museum of Art in Roanoke, VA, and later as part of the NIME 2009 conference at Carnegie Mellon University.

5. CONCLUSIONS

Although no formal study was conducted in order to quantify the difference between the impact of a virtual art installation prototype and its alternatives in the case of the Intelligent Space project such an approach has made a profound difference among its target audience—changing the overall perception from that of confusion to unanimous support, ultimately paving way towards completion of the physical prototyping phase and consequently implementation of newfound ideas and technologies in several offspring projects. More so, the team believes that virtual implementation of interactive installation art modules has facilitated communication among a number of disciplines, some of which commonly do not receive much contact with each other. Leveraging the said experience the team therefore posits that virtual prototyping of installation art offers benefits similar to that of other forms of virtual prototyping and as such may be seen as better alternative over traditional means of conveying proposal ideas.

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7. REFERENCES


