Augurscope-Augmented Reality Architectural Visualization

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VISUALIZATION

Primitive cultures rejected photography because they equated the moment when light is captured with taking a fragment of their spirit. Somehow this relatively small device, they thought, could harness and translate spirit into image. Modern culture easily dismisses this primitive concept as a misunderstanding of the process of photography. Instead we often consider the camera as merely a recording device. Tools that gain ubiquity, like cameras and now the computer, become service devices – they do our will and are expected to have little voice of their own.[1] We take for granted the history and value of perspective devices as crucial turning points in the evolution of design. Yet our modern culture is drawn to the power of imagery and we appreciate photographs that harness the energy of the moment, or the richness of experience. Indeed, the exquisite photograph does contain a certain undeniable spirit.

The seemingly mundane task of acquiring technical information for creative endeavors is often the impetus for ideas. In the case of architecture, the site analysis phase of design is often the first intimate time the designer has with the subject he/she is working with. Often, the architect employs photography, surveying, and drawing as the interface for such interaction. These devices play a role in translating information – but just as an interpreter may impact meaning with bias, so do devices for gathering information. The site photograph does capture a momentary spirit of a place and this depiction affects architectural decisions.

The relentless search by designers for the perfect tool that translates and inspires while being accurate and comprehensive is the Holy Grail for architecture. While the ultimate tool of perfection may never be realized, it is this pursuit, I argue, that is the enactor of change in architectural discourse. This paper will relate a brief history of the perspective devices related to the technology of the Augurscope as a perspective device. I will describe what the Augurscope is, its development and its limitations. Finally, I will theorize how the Augurscope may function as the pivotal device for capturing the essence of a design proposal. It is this otherworldly effect of seeing virtual artifact linked with existing space that conjures emotional reactions that lead to an enhanced spiritual experience and therefore an enhanced design process.

THE IMPACT OF PERSPECTIVE ON HISTORY AND THEORIES

The idea of how the methodologies used in perspective to make architecture, in fact, impact the way architecture is made represents one of the very interesting potential outcomes of considering a new device for making architecture. Alberto Pérez-Goméz suggests that there is, “always a perspectival hinge between forms of representation and the world.” He also stated that there is an, “intimate complexity between architectural meaning and the modus operandi of the architect.” In other words architects must use something in order to design whether it is models, drawings, or computer imagery and those creations are the “perspectival hinge” between idea and reality. The “hinge” is typically forgotten because geometrical space is often assumed to be real space. While eliminating the line between the represented and the real is valuable, doing so without understanding what is lost in the translation is dangerous.[2]

The Renaissance was strongly influenced by its techniques for visualizing architecture though various ways of creating perspective.[3] The camera obscura was an early device used, at first, to view an eclipsing sun and subsequently variations of it have been used to mechanize viewing three-dimensional scenes. Mechanical aids then inspired thoughtful investigation of the geometry of perspective.

> In the early seventeenth century, however, Guidobaldo del Monte was the first to seriously consider the position of the observer, the distance to the object and the angle of view as points of departure for a perspective construction, which would enable the eye to take in the object in a single glance. This awareness of the embodied observer as an element in perspective construction was absent in earlier writings, in which the observer and the viewing distance remained implicit.

While Pérez-Gomez admits that perspective was used more to represent architecture, "Filarete's treatise on architecture... was the first to include perspective in the architectural processes of ideation." The techniques Brunelleschi employed allowed him to better understand the site and the city therefore making it "...possible to infer a projective intention to draw the site in perspective, and then to proceed to design the building in volume."

Fillipo Brunelleschi could be cited as a forefather to the augurscope with a device he constructed to view the Florentine baptistery. Here he makes a panel that is placed physically in the environment to perceive a design and benefit from physical and temporal events simultaneously:

> On a small rectangular wooden panel, Brunelleschi painted a symmetrical representation of the octagonal baptistery in Florence's Piazza San Giovanni, as seen from the threshold of the Duomo. He then perforated the panel at the vanishing point and asked observers to verify the 'correctness' of the representation by looking through the orifice from the back of the panel toward a mirror that the observer held in the other hand... Furthermore, according to Manetti, Brunelleschi did not paint the sky on the panel; instead he applied a reflecting surface. Following an argument by Guilo Carlo Argan, Damish claims that Brunelleschi assumed that the sky simply could not be represented in perspective because it could not be geometrized...It is certainly possible to construe this experiment as a search for a precise tool of architectural ideation and representation...

This single eye looking through a single hole that in-turn projects an idea onto a site offer evidence of the first augurscope however crude it may be. Perhaps the experimentation with viewing architecture in space had a dramatic effect on the designs created during the Renaissance. Regardless of the ephemeral effects of working with perspective, the seed was planted for more deliberate and sophisticated concern for how perspective is constructed and how it is viewed from that point forward.[4]

If we jump ahead to the nineteenth century and consider how perspective has changed in its relationship with design, "the systemization of drawing methods enable[d] the process of translation between drawing and building to be reduced to an equation." [5] The Renaissance idea of perspective as a method for thinking about design was replaced with mathematical accuracy in order to substantiate the discipline as a precise member of the industrial revolution. The mechanization and simplification of architecture through the exacting tools of perspective peaked during high Modernism. As Modernism lost its favor to be replaced with much more complex designs, computer technology allowed for the accuracy still demanded in architecture while making it possible to comprehend more complex and fantastic designs. For typical three-dimensional computer visualizations, the geometry is based on the models created during the Renaissance.

An equally important facet of perspective related to architecture is the viewing of architectural space through photography after its invention in the mid nineteenth century. Since the inception of photography, a manipulation of perspective through the device of the camera and lens has created views for the world of distant works of architecture – many of which are never visited physically. Essentially, this device freezes a single view that exists in a single circumstance. In the pursuit of perfection, corrective measures have been used to control the view to such a degree that one must wonder what the real experience, in fact, really is. Large format photography and its manipulation of perspective allow architects to "correct" perspective through shifting the lens parallel to the film plane. Strangely, the lens correction, while beautiful, is

Figure 1. Portable Augurscope.

the equivalent of looking at architecture through one's peripheral vision. The highly idealized image has influenced the discourse of architecture by manipulating the view. While one might consider this a bad thing, I would argue that the difference between real experience and the idealized experience created by the camera is the gap between real and fantasy that the spirit of architecture resides within.

The device of an augurscope relies on the historical foundation of perspective while allowing a relatively new way to engage the dynamic that connects virtual with physical. Virtual environments are also not bound by the rules of nature, like the large format camera, but they may communicate these "corrections" through a strong link to the physical experience. In other words, by being bound to a physical space, one is aware of the modifications to that physical space much more than a single image provides. One can see the relationship with the real and virtual – always aware of the space in-between.

THE AUGURSCOPE

The advancement of the ability to visualize the actual environment with an imposed idea is an obvious need for an architect. From elaborate computer renderings to simple sketches, an architect must communicate ideas to laypersons as clearly as possible while doing so efficiently. The

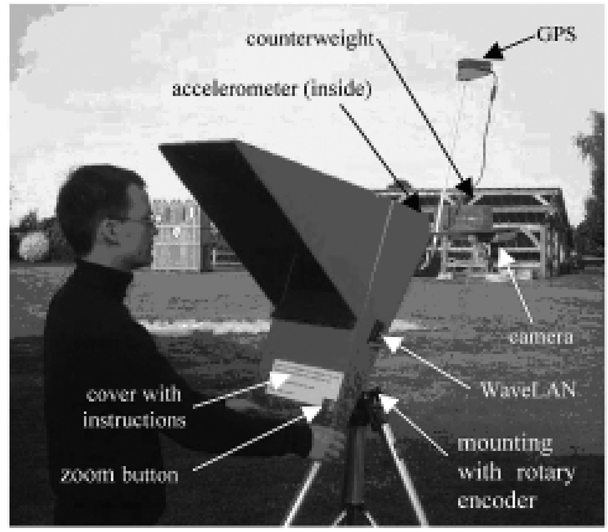

Figure 2. Detailed Parts of Augurscope.

Augurscope has the capability to integrate live video, 3d models and haptic manipulation of the viewport. Effectively, the device can bind the capability to visualize with the product being visualized.

According to Holger Schnädelbach, in a recent paper written about the making and testing of an augurscope, "the augursope is a portable mixed reality interface for outdoors. A tripod-mounted display is wheeled to different locations and rotated and tilted to view a virtual environment that is aligned with the physical background." Mr. Schnädelbach and his team are one of many researchers considering this technology to advance the way physical and virtual can be blended together to offer new ways to perceive our environment, understand history, or simply visualize that which is not there.

In the Schnädelbach research project, his team struggled with many issues in making this idea a reality – most importantly, how to make it portable given the cumbersome size and weight of the technology. They chose to use a tripod with something that resembles a professional video camera attached to the top of the tripod. However, this video camera not only views the world, but also tells the main computer GPS location, orientation, perspective and in-turn the computer overlays a digital image on top of what is real that corresponds the 3D information. Every listed part of the process offers many technological hurdles, the accuracy of all of the devices is essential and the coordination of their respective pieces of information is also necessary. Suffice to say, there are many complexities in the system in order to make the device as dynamic as possible (fig. 1 and 2).

The advantages of such a device are nearly unlimited. While many of the researchers are still trying to get their arms around the technology others are already considering what the end result will mean for various disciplines. I am focused on how this may prove to be an invaluable advancement in the discipline of architecture. This device could show relationships in reality that one may otherwise overlook (e.g. the location of utilities underground when viewing a site, or possibly a color coded organization of program when looking at a skyscraper, and even how it may feel to walk under a soffit). Another way this device could be employed is to interactively engage the physical environment for the assembly of a building. One could potentially design in real time on the site, literally constructing a building in its environment instead of designing at a desk removed from an environment. Indeed, one could even take this technology into the office and inhabit a designed space virtually while physically "working at the office." Working with this technology in the physical environment has been the original idea of the device, but it clearly works just as well for one to imagine a space removed from the current one occupied.

The reality of virtuality leaves much to be desired. Photorealistic renderings are extremely successful at producing very realistic work, but the average architect rarely has the technology, budget or time as a major production studio to produce high-end renderings. As a result, most often architectural renderings are very rough yet still photorealistic renderings. As a user of computer generated information to communicate ideas, I am often disappointed with the depiction of the physical world. Computers do not represent grit of the world, nor does it represent the subtle details and dynamic changes of the environment without time-consuming preparation and extreme processor capabilities (e.g. the very sophisticated renderings of such movies as Toystory, Shrek, etc.). Of course, as architects demand more quality and detail, the client expectations match realism and unintentional design decisions are often taken literally. Ironically, I suspect that a device that accepts reality as just that allows the layperson to clearly accept the developmental product overlaid to also be development material.

REALIZATION OF THE AUGURSCOPE: TECHNICAL AND DESIGN DEMANDS

The success of blending physical and virtual through an augurscope relies on the device being an extension of the human senses – in this case vision and touch (however, sound is a potential third sense that can be used). Attention to the ergonomics of such a device is also necessary for it to become as much of an extension of a person as possible. The device invented at The Mixed Reality Laboratory opted for a tripod-mounted computer display where one operated it as if they were filming a scene. While this method is very effective for initial research, and I think a necessary step for engaging the research, other pieces of technology are available to be employed that blend physical and virtual. Transparent goggles that overlay images are available but perfecting the existing light and LCD display prove difficult. Minimizing peripheral equipment is also necessary to make one as mobile as possible – advancements in wireless technology will help to facilitate this. Finally, accuracy is paramount, without it one has a visual collage, with accuracy, one has a critical and valuable assessment tool.[6]

Viewing is the stumbling block in the desire for a successful augurscope. There are many difficulties in making two scenes match accurately. The curvature of the lenses on the surface must be accounted for and the brightness/contrast ratio must be considered. All of these issues only represent the final delivery, and before the image can be delivered, it must match the perspective of the scene and the optic device used. If it is a person's eyes, then no zooming must take place, however stereoscopic vision has its own effect of controlling depth-of-field and level of detail when viewing.

The less cumbersome the hardware, the more portable and comfortable the viewer will feel. Here it is comfort and ease-of-use that adds to the experience. If the equipment can be reduced to such a point that it can be carried in a backpack, then many issues have been avoided. With the technology available at a civilian level, we will probably focus on devices that move in a self-contained unit. Minimizing the size of the device and seriously considering the absolutely necessary functions will help to avoid additional burden.

Station points will all aid in keeping the accuracy of the augurscope appropriate for its application. However, the dynamic of eye motion relative to head motion relative to body movement through scene all present challenges to make the augurscope display the accurate scene. Eliminating eye movement by filling the peripheral vision is one technique (with some sacrifice of subtleties). Combining head motion with body motion and reducing the movements to pitch and yaw while allowing the GPS to identify location will potentially consider the bulk of the general movements.

None of these issues are insurmountable. Heads-up displays have been used for many years but the overlay does not necessarily relate to the scene. Making that relationship work is the primary focus in the early technological development of our first augurscope. The other issues can be dealt with through refinement.

SPIRIT OF THE AUGURSCOPE

This paper has focused on the architectural issues related to the augurscope, but the benefits of such a device go well beyond the discipline of architecture. The work on our version augurscope has initiated with a computer scientist, a geologist and myself – a somewhat atypical grouping. We are still laying the groundwork for realizing the device and are exploring the advantages of the device to our various disciplines and we all have discovered the values of this device albeit though different applications. The Geoscientist wishes to see that which is not there – basically, he wishes to see striations in earth that can't be uncovered easily or safely, yet still be able to do so in the physical environment. To him the portability is imperative and the accuracy is necessary in order to make realistic comparisons in the field. This is an opportunity to take information from core drillings and relate that information to a perspectival view of a landscape.

The computer scientist is interested in the art of relating all of the complex data that exists in a dynamic natural environment in an intuitive way. The information required from the environment in order to operate such a device could be elegantly simple, or surprisingly complex depending on the desired eye, hand, body and environmental conditions necessary to construct the view. Coordinating such complex information requires knowledge in many fields including video technology, GPS technology, optics, and perspective manipulation – and linking this data to many discipline-related sources such as a topographical map or a set of drawings related to a building.

In the discourse of architecture, however, accuracy and efficiency are necessary, but the power to evoke a sense of space and the opportunity to put oneself in a place otherwise uninhabitable make a device like the Augurscope invaluable. Successful architectural representations are often judged by their ability to perceive oneself in space and these pieces have an essence of their own. Most representations, however, rely upon a translation of geometry – a person puts his/herself into the image at the scale of the image. This is entirely different than the Augurscope model where a viewers and their visualization are represented at full-scale. The change is in how one translates his/her sense of scale. The Augurscope has many of its own translations and drawbacks but its experience is within perspective space at full-scale. However virtual the product may be, the device is still bound to a reality and therefore the experience exists somewhere between – and that is where the spirit of space lies.

Photographs, perspective drawings, orthographic drawings and even scale models all require one to shrink-oneself to engage a space perception. The ability to experience at the scale of perception if what gives this advancement of technology a new classification and I anticipate a worthwhile way to experience the essence of space as the designer anticipates what that may be.

NOTES

1. Susan Sontag. On Phtography. Doubleday, New York. 1977 p 238.

2. Pérez-Gomez, Alberto and Pelletier, Louise. (2000). Architectural Representation and the Perspective Hinge. Cambridge: The MIT Press. p 6-7.

3. Dubery, Fred and Willats, John (1983). Perspective: and Other Drawing Systems. New York: Van Nostrand Reinhold Company. p 71.

4. Pérez-Gomez, Alberto and Pelletier, Louise. (2000). Architectural Representation and the Perspective Hinge. Cambridge: The MIT Press. p 19-25.

5. IBID p 84.

6. Schnadelbach, H., B. Koleva, M. Flintham, M. Fraser, S. Izadi, P.Chandler, M. Foster, S. Benford, C. Greenhalgh, T. Rodden. (2002). The Augurscope: A Mixed reality Interface for Outdoors. Proceedings of the SIGCHI Conference on Human Factors in Computing Systems: Changing our world, Changing Ourselves. Minneapolis: Conference on Human Factors in Computing Systems. p 1-8.

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