Interior Cities: Inhabiting Interactive Cityscapes through the Webcam and the Shared Screen

Catty Dan Zhang
University of Tennessee Knoxville
Knoxville, TN, UNS
dzhang36@utk.edu

Abstract

This paper documents a multimedia interactive installation which explores the networked camera spaces as tools for placemaking. In her article "Towards a Diffuse House", Anna Puigjaner states that the growing digital sphere has turned "the entirety of the built environment into an endless domestic landscape, one defined less by buildings or public spaces and more by objects and technologies" [1]. Situating an experimental practice in this vast digital sphere, we are aware that physical bodies occupying one actual space at a time but simultaneously existing in–and being connected to–many others through cameras, networks, and screens has become the most iconic reality of the modern city. During recent years, such multiplicity of presence has spurred a cultural shift much more drastically than any has come before. The pivots from situated towards remoteness in social and professional lives urge new definitions of architectural boundary, techno-aesthetics, domesticity, and public space. Designing with webcams, inhabitable screens, domestic archetypes, and daily life activities, the installation reimagines cityscapes as interactive fictions of its citizens from within their personal proximities in the gallery. It invites public engagements when examining the world around publics and individuals through an immersive environment. The project questions what existing architecture and digital media could offer in their radically transformed relationships with social mechanism, humanity, and wellbeing. The paper outlines the conceptual approach, the technical framework, and the spatial strategies of the installation.

Keywords

Interactive Installation, Computational Drawing, Projection Mapping.

Introduction

In her book Public Intimacy, Giuliana Bruno states that "in the modern era space could no longer be conceived as static and continuous" and with cultural mobilization through new means of transportation and communication, our visual terrain became disjointed, split, fragmented, multiplied, mobile, transient, and unstable [2]. Contemporary daily life can no longer be associated only with a singular or a series of domestic and public spaces, rather, it roots in the reality where physical bodies occupying one actual space at a time but simultaneously existing in—and being connected to—many others through cameras, networks, and screens. We have built quite sophisticated awareness of such iconic reality since the last century in public realms, from visual signals captured by surveillance cameras to personal data detected and fed into the intelligent machine networks. Such multi presence of humans—largely bound to what Trevor Paglen describes as "invisible world of machine-to-machine visual culture" —has been normally imperceptible to oneself and detached from the conventional built forms [3].

Figure 1 Installation close-up view: interactive webcam mechanism with small digital monitor (foreground) and projection chamber with hybrid physical and virtual material effects. Photograph by the author.

However, during recent years, the pivot from situated towards remoteness in one's personal and professional lives not only accelerated the wide adoption of digital technologies for communication, but also urged new definitions of architectural boundary, techno-aesthetics, domesticity, and public space. The invisible machine-to-machine infrastructure has been foregrounded more visually than ever, the presence of which has populated overwhelmingly in domestic spaces. One's personal spaces increasingly became the limited areas in front of a webcam, presented through teleconferencing grids on digital monitors in many others' spaces at once. Consequently, personal spaces—traditionally as areas defined by walls or barriers within reachable proximities—are thus perceived as networks of framed camera views. Their static spatial outlines dissolve into fuzzy

boundaries that dynamically recompose themselves at virtual distances in real time. The connectivity disassociated with geographic locations signifies not only the dynamic and the fragmentated cinematic nature of the contemporary architectural experience, but moreover, the paradox of the non-related, contextless physical spaces and the necessity of their existence in the real world.

Primarily built upon capturing, transmitting, displaying, and interacting with visual signals, *Interior Cities* is a multimedia interactive installation that explores such hybrid conditions (Figure 1&2). Through the fusion of geometric and temporal parameters in constructing computational drawing instruments and the hybridization of physical and virtual material effects, it embraces the real-time and the fuzzy edge—an underlying architype that engages the desire of connecting, exchanging, and relocating through new image landscapes.

Figure 2 Installation views. Photograph by the author.

THE WEBCAM AND THE SHARED SCREEN

Interior Cities borrows concepts of the "webcam" and the "screen sharing" on teleconferencing platforms to manifest the intimacy between media and architecture that is projected onto social relations. The design of the installation explores the visual, mechanical, and algorithmic transformations of cameras and images to interrogate physical boundaries of isolated personal spaces and the shared public. Using emerging media technology with real-time webcam captures, the project constructs imaginary cityscapes interactively which visitors could step into; and transforms architectural objects and surfaces into displays and interfaces following two conceptual considerations elaborated in the following sessions.

Webcams as cultural objects for interactive drawing

The project explores webcam as not only a device for seeing but also a drawing machine. When it comes to the camera as an optical device, the capacity of hardware integration has drastically changed the notion of seeing. From Eadweard Muybridge's multi-lens apparatus for scientific uses, to depth sensors embedded in personal devices– the instrumented visual world evolves on a daily basis before we could take notice. Webcam for video streaming and network communications, on the other hand– operating separately from advanced hardware– often relates to low-res imagery, glitches, low-bandwidth delays, and most of the time bears concerns of compromised personal privacy. A front camera on a laptop nowadays is typically blocked by the user with masking tape of various colors or sticky notes at hand, which has become a normal addition to the device. The project designs with such cultural phenomenon of the webcam. Ordinary action sequences around the webcam such as peeling off the tape from the lens, adjusting lights, moving hands between those objects while getting ready for video calls, recur frequently these days for work-from-home needs and beyond. These types of activities around the webcam serve as main generators of visual inputs and are to be reassembled into surreal scenarios and translated into dynamic illusory textures overlaid onto existing built forms interactively. Visual narratives are thus created in motion by overlapping two types of camera spaces: one evidenced in photos captured at various locations in the city, and the other dynamically related to participants (Figure 2).

Networking media with inhabitable screens

The installation setup explores visual media in telecommunications in relationship to architectural spaces. Pioneered by Stan VanDerBeek's *Movie-Drome* during the 1960s, such investigation relates participants and the built environment beyond physical boundaries, and builds architecture as experience machines through integrated circuits, computers, and satellite networks [4]. Similarly, Diller Scofidio's installations *Para-site* (1989) and *Jump Cuts* (1996) employs information network that links remote sites of circulation, where the form, the arrangement, and the content of digital screens break the bound spatial relations [5]. Or as in iCinema's *T_Visionarium* (2003), viewers are "enabled to capture, transpose and recompose global televisual data" to construct interactively cinematic narratives [6]. Moreover,

with the capacity of stepping into the virtual world and experiencing media through hardware and software, architecture enclosures– as described in the mixed reality film project *FREESTYLE – Architectural Adventures in Mass Media* (2020) – shift from functional purposes to styles and textures that affect "how we structure our social and individual values in physical and virtual space" [7].

Designing with remote visual, spatial, and social relations, the installation invites a series of viewing activities blurred between shared screen and shared space. Sensitizing spectators with animated imagery and choreographed body movements around various networked displays, viewing chambers, and soft forms, the viewing experience is to be configured spatially, where screens are to be looked into and interacted with.

Physical setup

Installation Overview

Interior Cities is an immersive environment that integrates the interactive camera devices and the inhabitable screens using technologies including animation, projection mapping, and computational drawing. The installation consists of two 10'x10'x10' structures. Situated in an elongated atrium space, each structure assembles a customized suspended webcam mechanism in a spherical form, and a

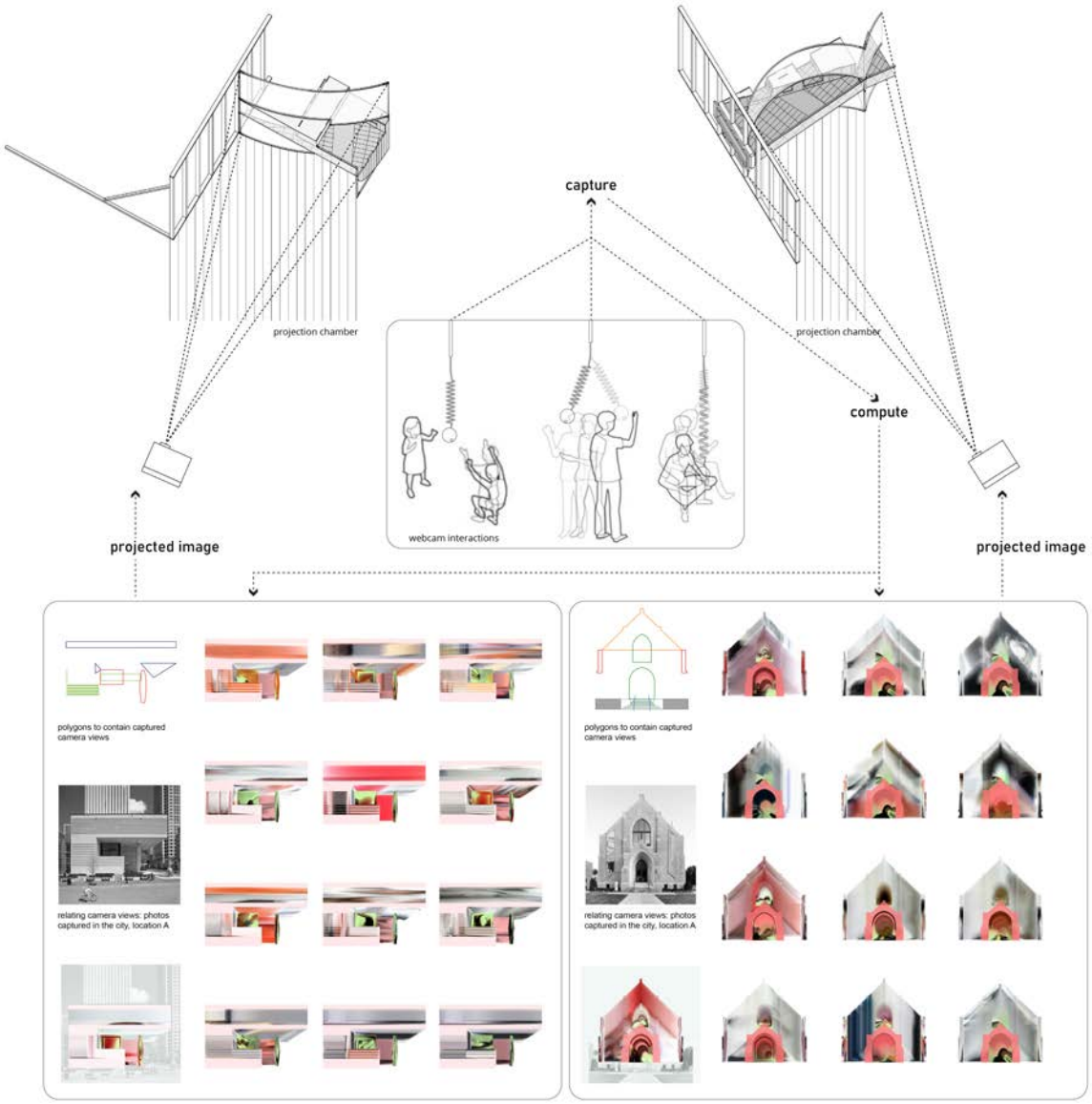

Figure 3 Physical setup of capturing, computing, and projecting visual signals. The webcam, drawing with masking tape, sticky notes, hand gestures, and artificial lights using a customized script, results in illusory patterns appearing in motion over the existing built forms. Image courtesy the author.

projection chamber. As one moves around and physically interacts with the webcams, computed visual signals produce virtual material textures, and are then projected onto the three-dimensionally configured screens.

The forms of the chambers are generated by abstractly translating existing built forms of two selected locations within the city into spatial hybrids of translucent surfaces and opaque materials with color patterns, offering a sense of familiarity with urban contexts remotely, while allowing various opportunities for viewing, interacting, and inhabiting the recomposed imagery in 3D.

Huggable webcam spheres as real time drawing instruments

Using webcams as instruments for drawing, the installation practices optical and image transformations with computational techniques. These drawing machines establish an analytical relationship between camera apparatus and pixel arrays, in order to draw, to transform and to aggregate autonomously the visual signals captured by webcams. Multi-lens camera, high speed photography, bullet time camera, and so on—analogue mechanisms for capturing, editing, and analyzing motion sequences are translated into computational logics following geometric and temporal orders. More specifically, real-time video captures are stored temporarily, and still frames selected at certain intervals from the constantly updating sequences are outputted onto layered polygon shapes with remapped UV coordinates (Figure 3). The webcam mechanisms are designed as huggable spheres, inviting visitors to get close, to look into, to swing them around, to pet them, or to talk to each other around them (Figure 4). As input devices of the interactive system, activities around these playful objects result in constant changes in the camera views. Fictional forms emerged autonomously from the overlay of the current and the successive series of stored prior frames. Blocks of color appear as distorted doors and openings; objects partially blocking the lens creates wall textures; hands waving close to the camera fluctuates the digital canvas with hues of reds. Visual order is created from rearranged relations or reassigned properties of pixels arrays from the video feed. These real time drawings are instruments of image and time, a digital reassemblage of Dan Graham's *Present Continuous Past*(s) (1974) [8] while abstractly translating the mirror walls, video recorder, 8-second delayed video display in Graham's installation into coordinates of digital frames, scaling factors, frame counts, RGBA values, etc. as variables in the computer scripts.

2D and 3D color patterns for the shared perception

The installation employs vibrant geometric patterns as part of the physical setup through which subtle movements in the captured scenes can be easily registered in the drawing scripts. And as a result, video captures in motion can be effectively translated into interactive textures. Thus, virtual material effects produced through the camera drawing instruments inform the physical material logics such as color, contrast, density of textures and so on. 2D and 3D line patterns overlay with color panels and the floor surface. The contrast between lines and the surface background colors were optimized for camera drawing scripts. Ultimately, the installation is a 3D line drawing designed for the shared perception of human and the camera. The physical material and virtual imagery together blur the edge of spaces defined by architectural surfaces, where animations are coauthored by human in motion and the camera movements (Figure 5).

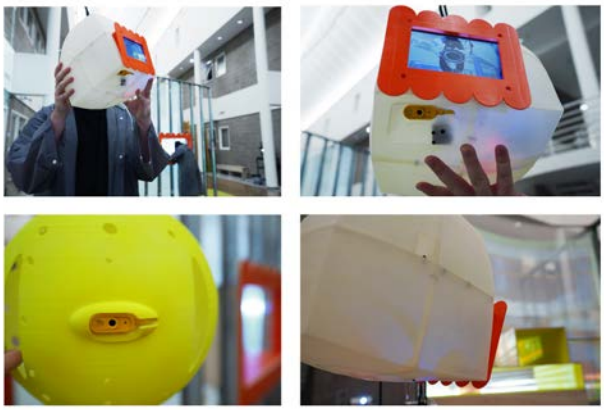

Figure 4 Two webcam mechanisms designed as suspended spheres, inviting playful interaction from the visitors. Photographs by the author.

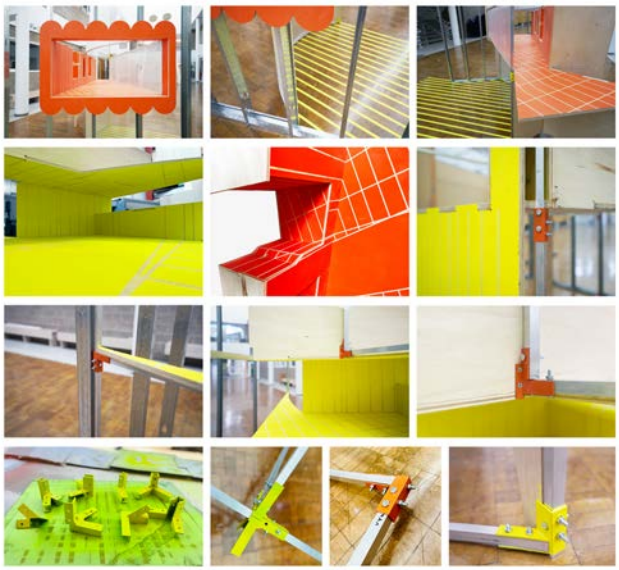

Figure 5 Customized patterns and 3D printed brackets for optimizing fabrication workflow and color schemes with line patterns to produce hybrid material effects in motion through webcam drawing script for the shared perception of human and machine. Photograph by the author.

Interactive projections

Visual signals captured by two webcams are computed through Processing, the outputs of which are then imported into TouchDesigner for additional visual effects and

projection mapping setups. Animated visuals are projected onto– and through– the ten-foot-tall translucent fabric, transforming the space into a virtual cityscape with cameras and displays. One might encounter a stored moment of his or her ephemeral past presence while moving around the spatial "displays", inhabiting the stitched, overlaid, delayed, or nested dualities of the present and the past(s), the spatial

Figure 6 Installation view. Photograph by the author.

and temporal, the actual and perceptual depth (Figure 6&7).

Conclusion

The installation offers a playful examination of the image culture, place, digital materiality, and the built environment with the everyday technologies. By exploring methods of projecting, compositing, and perceiving images and materials, it experiments with camera inputs to trigger visual, spatial, and social effects. The installation invites participations through extending beyond typical ways one might interact with webcams and screens in daily life activities. Movements, distortions, light fluctuations, delays, and misalignments are a few attributes that lead to creative discoveries among visitors. Forms of camera spheres and the captured real-time imagery displayed on a 5.5-inch monitor as part of one of the spheres, for instance, resulted in reactions such as dancing around, taking selfies, capturing one self's mirrored figures in the small screen, rotating the sphere and looking for lens alignments, and so on, which were then manifested in the projected media. In the era of remote communications and telepresence, *Interior Cities* explores digital devices and hybrid media as cultural practice, where forms of immersion offer a sense of connectivity and care. It builds upon constructing moving images that relate human body movements and architecture. Hybridity and complexity of spaces are experienced through rhythm, speed, and sequence of the computed webcam inputs, where inhabitable forms emerge as part of the delay, the glitch, the fast-forward, or the slow-mo. The webcam and the shared screen thus are both a technological device for seeing and agencies that actively alters the perception of space, through which we could rethink communication technologies and architectures of the everyday.

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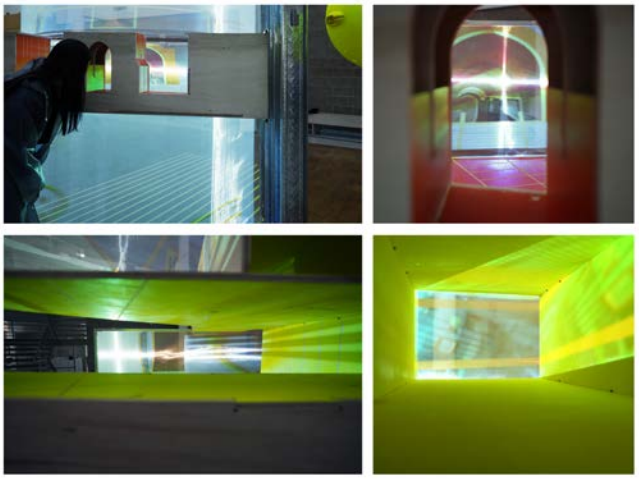

Figure 7 Framed views of the interactive projections. Photographs by the author.

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Author Biography

Catty Dan Zhang is an associate professor of architecture at University of Tennessee Knoxville, and the founder of Temporary Office—award-winning design practice exploring architecture and digital technology through the production of exhibitions, objects, drawings, animations, installations, buildings, and writings. Her work experiments with the multiplicity of techniques and mediums, translating ordinary objects into performative and synergistic systems to visualize and to modulate ephemeral forms. Zhang was a finalist of the Harvard GSD's Wheelwright Prize in 2018 and 2021. She was awarded the first prize in the Pamphlet Architecture 37 competition and is the author of the most recent volume in the *Pamphlet Architecture* series titled "Active Atmospheres: On Instruments and Protocols for Medium Hybrids and Architectural Voids" (Steven Holl Foundation & Station Hill Press, 2023).