

Reenvisioning Everyday Architecture: Experiments in Visual Mapping and Hybrid Media

Submission for 2023 ACSA Creative Achievement Award

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The work by thirteen students in Aki Ishida's Thesis Concentration Area examines and reenvision the architecture of everyday, including housing, clinics, schools, and more. As the landscapes of domestic life, remote work, healthcare, and other social norms shift, how does architecture respond? Using the immersive visual/audio environment of the Cube at the Moss Arts Center as a means for design inquiry, the students will present animations on the 360-degree cyclorama and models mapped with digital images and videos.



Reenvisioning Everyday Architecture: Experiments in Visual Mapping and Hybrid Media

As the landscapes of domestic life, remote work, healthcare, and other social norms shift, how does architecture respond? Through architectural ethnography and augmented reality, a group of 13 thesis students at Virginia Tech uncovered opportunities for reenvisioning everyday architecture from the perspective of its inhabitants. As an alternative to the tradition of independently advised thesis year, our B.Arch program in 2021/22 introduced Thesis Concentration Areas, a cohort of students who broadly shared interest in a faculty's research, in which each student would identify and develop their own thesis. Our group began with a focus on relations between the built environment and human health, and applied design research methods I had used in transdisciplinary healthcare design projects, including ethnography, full-scale mockups, and augmented reality (Fig. 1, 2).

During the fall semester, the students focused on representation and mapping of spatial conditions



Fig. 1 Using full-scale mockup with projection mapping to bodystorm interactions at patient's bedside



Fig. 2 Using projected images and videos to mockup a nurses station at full scale

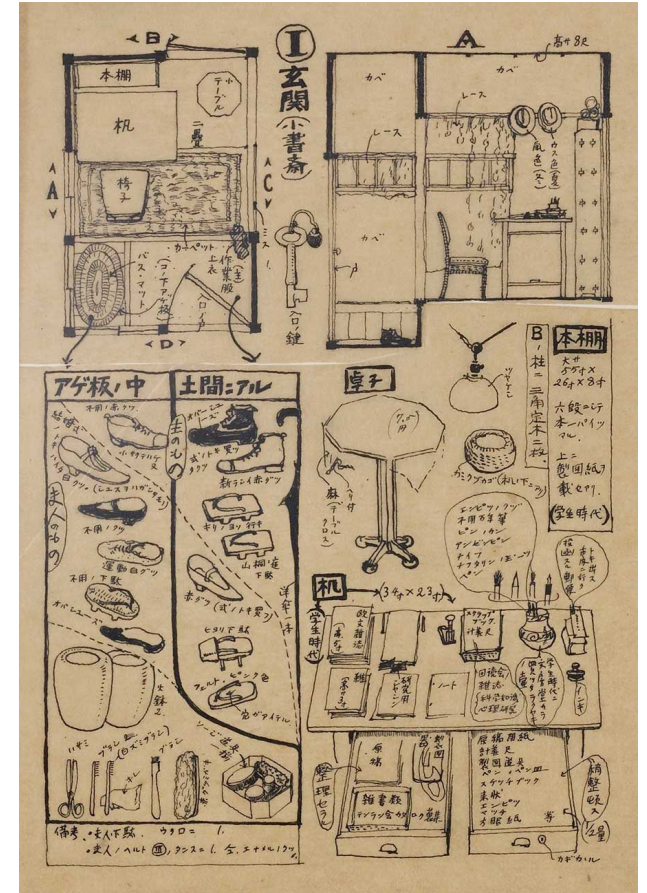


Fig. 3 Domestic interior by Kon Wajiro in *Modernology* (1930)

by observing everyday spaces. We expanded on the traditions of ethnographic drawings by architects such as Kon Wajiro, who documented changes in cityscape and people as Japan modernized during the interwar years (Fig. 3), and Atelier Bow Wow, who published drawings of "accidental" buildings and urban conditions in *Pet Architecture* and *Made in Tokyo*. We incorporated new methodologies to begin to question the colonial roots of anthropological ethnography. This effort to reexamine and redirect ethnographic studies parallels a movement by anthropologists to include the subjects in the knowledge-production process (Fig. 4), and continues with further intentionality in my current cohort of 2022/23.

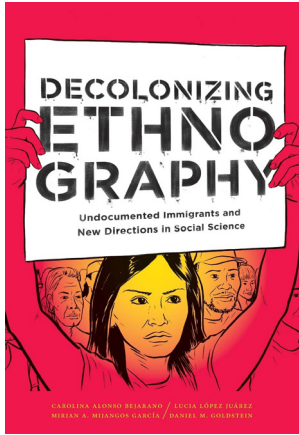


Fig. 4 *Decolonizing Ethnography* by Alonso Bejarano, et al. (2019)

projection on the cyclorama (Fig. 6), a set of 360-degree cylindrical screens with immersive sounds. We learned from examples by computer scientists who reimaged Office of the Future where all surfaces in an office space could become a digital display, innovators in medicine that train surgeons to operate on human bodies using augmented reality, and artists such as Krzysztof Wodiczko and Doug Aitkin (Fig. 7) who project videos and photographs on buildings as a form of narrative, protest, and provocation.

The technique of mapping physical models with projected images and videos blurs the distinctions between virtual and real, and digital and physical.

Methodologies adapted from healthcare design provided the means to critically observe the spaces they encounter every day. They enabled us to imagine what is not visible but heard, and what is suggested but not obvious. These immersive model environments, combined with ethnography, facilitated imagination of what is possible—or new realities—in everyday architecture.



Fig. 7 *Song 1* by Doug Aitken at the Hirshhorn Museum (2012)

The students made drawings to visualize a complex array of interactions between people, technology, built environment, and information by augmenting orthographic drawings with 3D scans, time-lapse images, and animations as means to capture actions and spatial relations that our eyes might miss. In late Fall, each student identified their own site and program, which included housing, schools, clinics, and infrastructures, that enabled further investigation of the thesis that emerged from their studies. In early Spring, the group held an exhibit in Virginia Tech's Cube (Fig. 3), blackbox theater designed for augmented environment experimentations, to explore with projection mapping on physical models (Fig. 5) and video

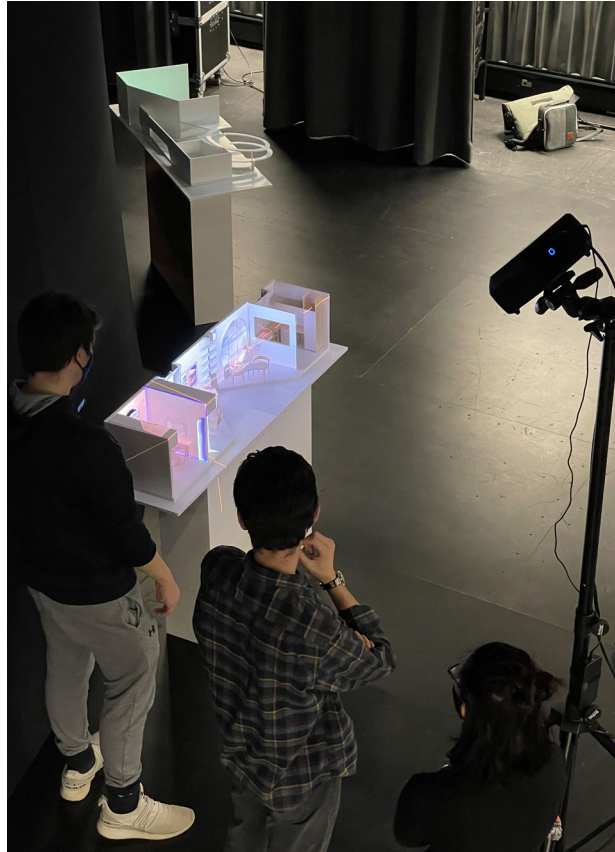


Fig. 5 Projection mapping on a foamcore model at the New Realities exhibit in *Cube* (2022)



Fig. 6 Animations on Cyclorama at the New Realities exhibit in *Cube* (2022)

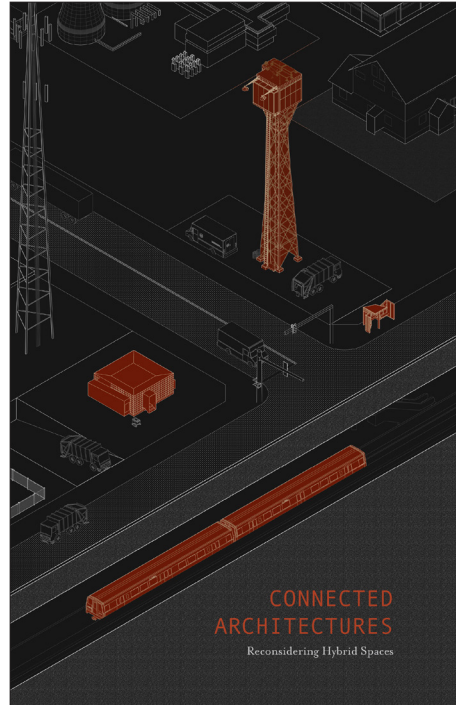
Poster design on cover: Joon Kang

Connected Architectures: Reconsidering Hybrid Spaces

Kaitlyn Mueller, B.Arch 2022

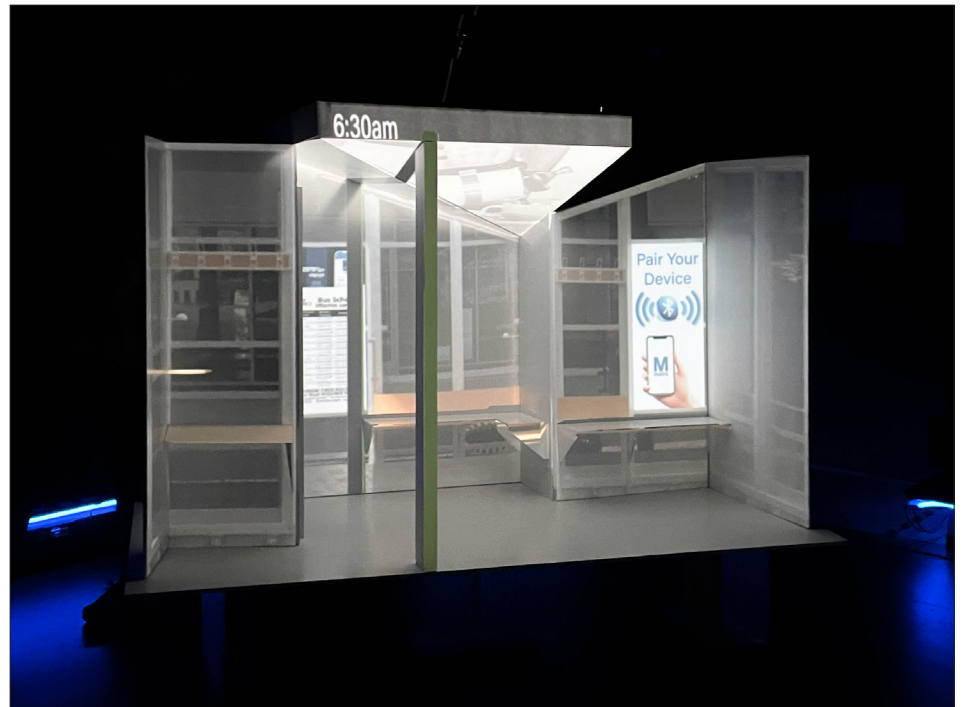
In our digital age, we have developed a strong reliance on our use of the internet. This has proliferated into the creation of a virtual society and culture at a global scale. Critics, such as Karl Marx and the Situationists commented on society's growing fascination with product consumption during the 1950s onward and advocated for people to understand their reality. Today, the form of consumption that has captivated society with product consumption during the 1950s onward and advocated for people to understand their reality. Today, the form of consumption that has captivated society has shifted from products to virtual media. As technology has progressed, people have begun to primarily consume digital media and entertainment, spending most of their time viewing screens. In many ways, this technological development has enabled a wider global community and an ability for people to connect instantaneously. Despite the benefits, this new mode of social participation is addictive, distracting, and con-trived, intensifying the same consumer/user obsession with "unreality" that was critiqued in the former century.

Architecture has remained passive as our modes of consumption and social interaction have changed. Both the physical and virtual spheres have logics of consumption and social interaction. This thesis questions how our built environment responds to our relationship with the virtual sphere, as well as how it responds to the intersections between the virtual and physical. The virtual and physical spheres are inextricably interconnected and both develop our social networks. However, hyper-consumption of media via the internet is very quickly changing how we socialize and interact with each other and with space and place.



Above: Cover of Kaitlyn Mueller's thesis book
Subsequent images: excerpts from her book



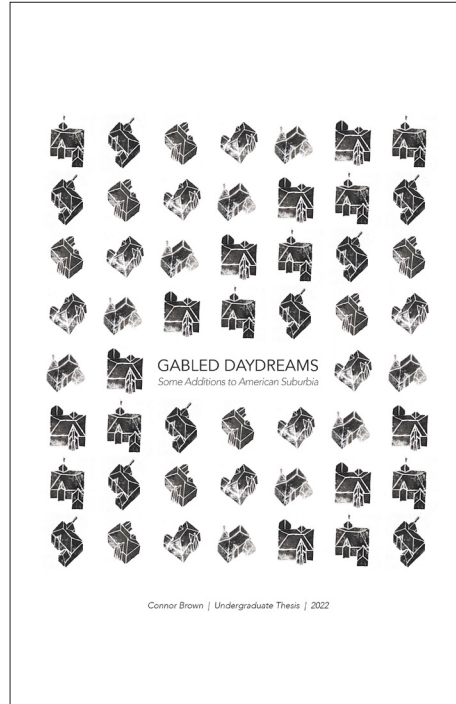


Gabled Daydreams: Some Additions to American Suburbia

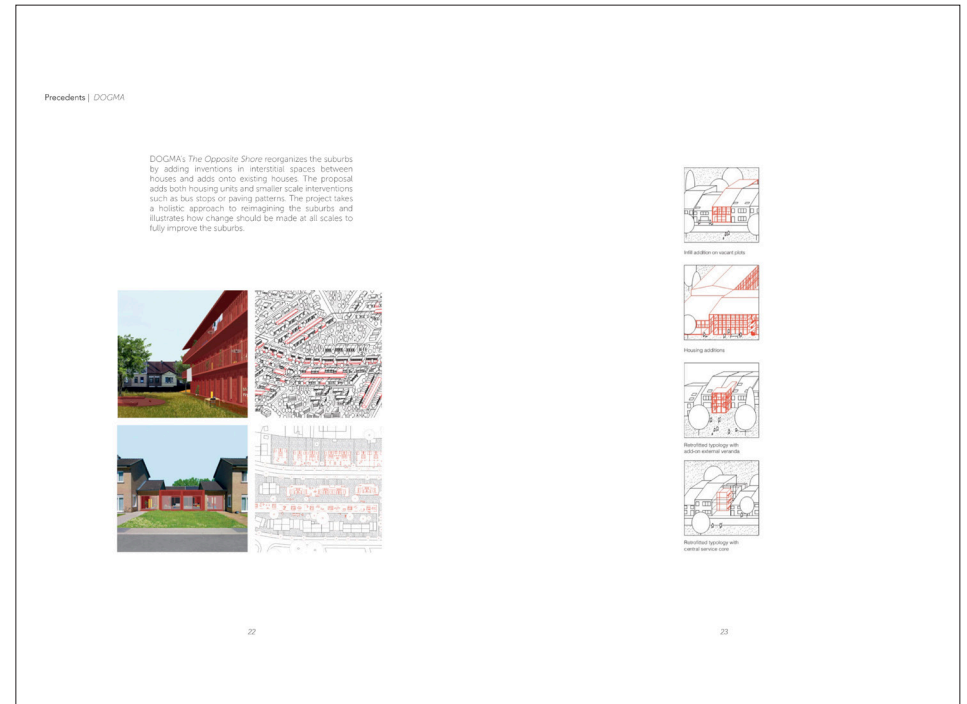
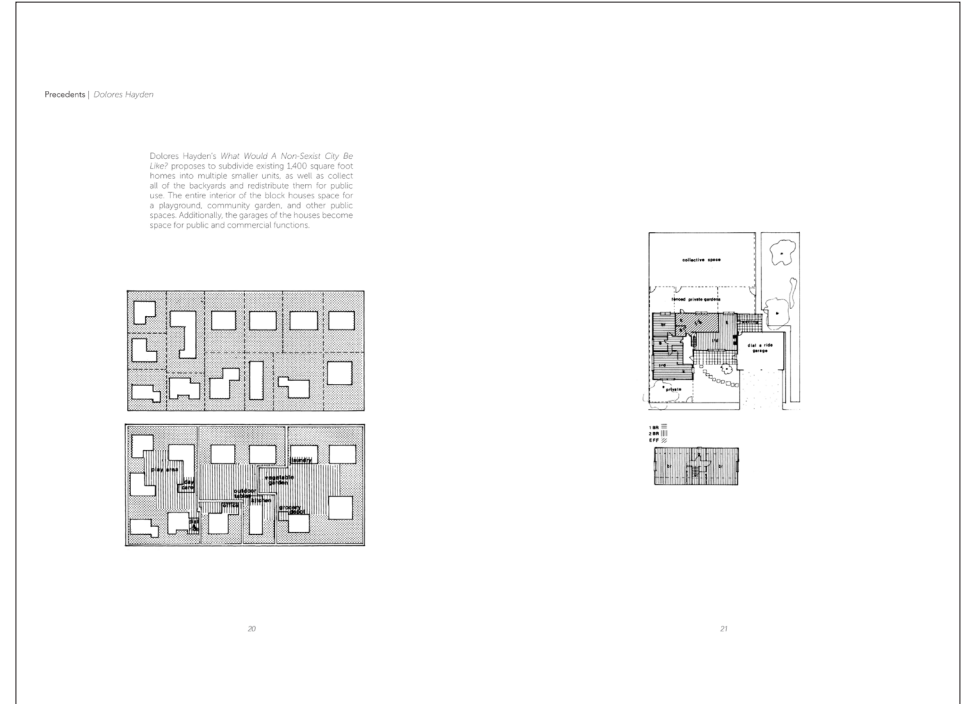
Connor T. Brown, B.Arch 2022

Suburbia today has proven to be a wasteful model of living. Growing since the start of their mass production in the 1950's to accommodate the post-war population surge, suburbia has created an automobile reliance and encouraged mass consumption through individualized dwellings. Historically the suburbs have been seen as a "lost cause" but new developments like Seaside, Florida and Radburn, New Jersey attempted to remediate these issues by building entirely new neighborhoods with a focus on walkability and sense of community. While the goals of these neighborhoods were successful, they rely on further sprawl and fail to address the existing suburban landscape which prevails throughout the United States.

This thesis aims to intervene into an existing suburban subdivision, constructing new interventions to increase the density of dwellings while incorporating commercial and communal space within walking distance of the home. This includes grocery markets, pharmacies, child-care services, laundry facilities and co-working spaces. How can these services and ideals be incorporated into the existing suburban landscape, to avoid additional resource waste and further sprawl, rather than proposing an entirely new model of living. What architectural elements and ideas can be extracted from single family suburban homes, typically overlooked as having architectural merit, and be elevated to create more dynamic spaces to encourage interactions that are missing in typical suburban neighborhoods. Using an existing suburb in Dallas, Texas, the retrofitted suburb reflects its context and takes advantage of the climate, making a walkable neighborhood feasible year-round.



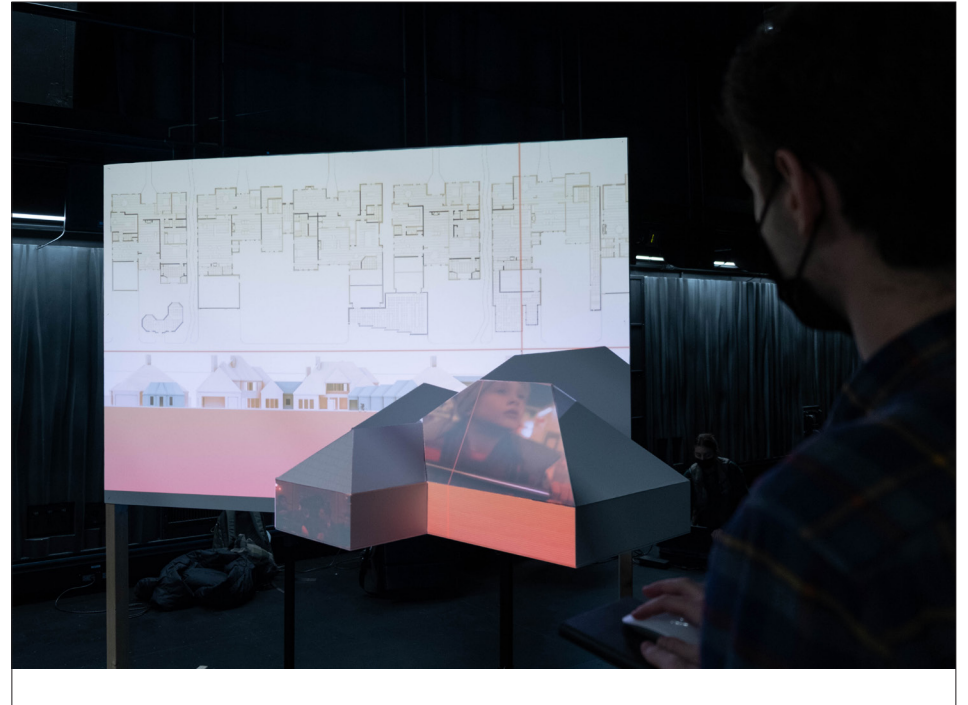
Above: Cover of Connor Brown's thesis book
Subsequent images: excerpts from his book



Process | Addition Types



formal stages of addition types, Sterling, VA



Site | Plan with Additions

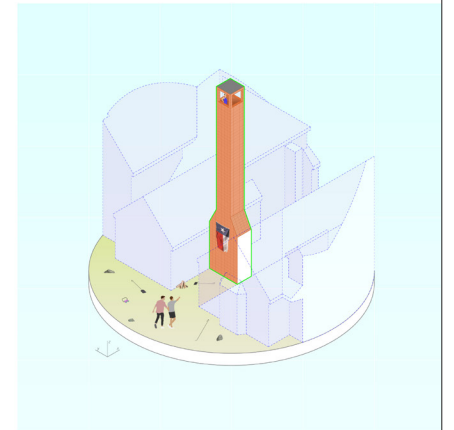
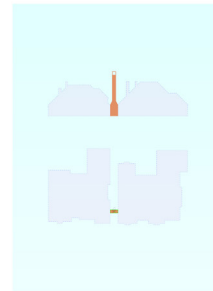


Additions | Observation Chimney

The observation chimney references the prevalence of chimneys in the neighborhood despite being located in a subtropical climate which makes chimneys unnecessary. The observation chimney attempts to be equally frivolous, scaling up to human size and accommodating a spiral stair inside which leads to a lighthouse-like platform on the top. The chimney allows for unfamiliar views of the suburban landscape, placing the viewer above the roof lines of the houses. It brings an awareness to one's surroundings and reveals the absurdity of the dense suburb. Additionally, it is a voyeuristic piece of architecture which allows for views of all parts of the neighborhood. The chimney is meant to be a public space for suburbanites as well as visitors.



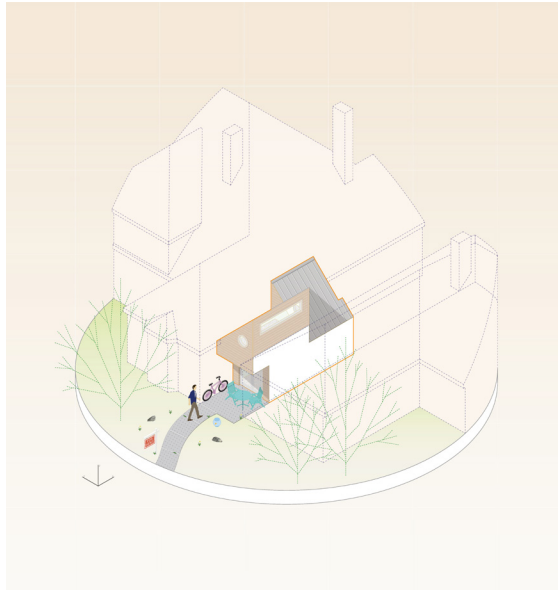
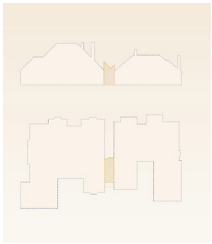
The two of them wandered toward the chimney and down. They had climbed it and surveyed the neighborhood as they had seen from above. They both thought it would be thing to prohibit at the same time.



chimney fits in between two houses

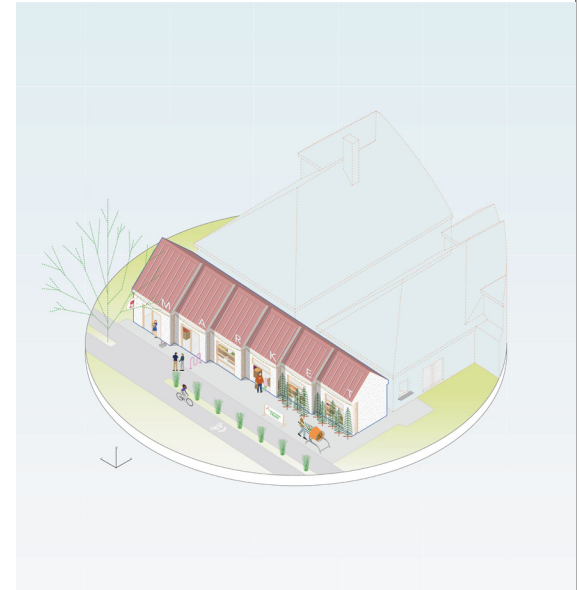
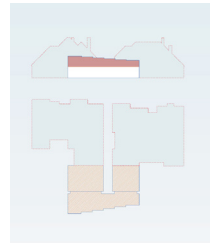
GUEST HOUSE

The guesthouse connects two houses to each other, sliding into the narrow eight-foot spaces between two houses. The guest house consists of a small kitchenette and living area with a loft above for the bed. The guest house utilizes the bathroom of the existing house adjacent to it and it also has a small covered outdoor patio space. It is used as a temporary dwelling for visitors to the neighborhood functioning as an Airbnb. The form of the guesthouse references the roofs of the adjacent houses in order to access light and ventilation. The guest house references Accessory Dwelling Units, popular for providing more affordable housing and increasing density of residential areas. The building seeks to be an ADU of sorts, though rather than existing a separate structure, it combines two existing houses.



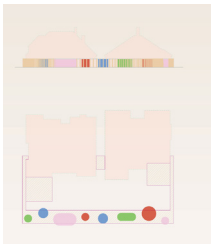
MARKET

The grocery market connects former garage spaces and adds onto them in the former driveways to create a large space for selling locally grown produce and other grocery essentials. The form of the market takes on the form of garage bays with its articulated plan and uses glass garage doors to create an indoor/outdoor space. The stepping back of the plan makes space on the exterior of a public plaza to sell plants, flowers or Christmas trees in the winter. The interior space remains unfinished further referencing the garage with concrete floors, plywood ceilings and exposed beams. The exterior material facade material is similar to Terrazzo, with shredded bits of old vinyl siding cast into boards, forming a rainscreen on the exterior of the building.



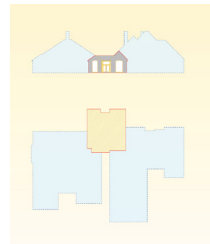
DAYCARE

The daycare can be read as an enlarged fence where two halves of the fence are pulled apart so the fence becomes an occupiable wall. It combines two backyards to create the main play space for the children. The two homeowners would covown the daycare and serve as the main caretakers of the children. A gradient in the density of boards allows views through the fence into the backyard beyond. Inside of the fence is an outdoor pavilion with smaller round playrooms for indoor play. The fence referencing the existing privacy fences on the site but seeks to be more transparent while still protecting the children's play space.



CO-WORK

The co-working space connects two home offices, providing three additional rooms in front of the houses to create a larger work space. The space provides workspace for the changing work culture, with more people working from home by providing space for these people to still work collaboratively and have an office-like environment. The social interactions that occur in a traditional office are facilitated through different types of workspace like lounge seating, individual desks, or conference tables. The co-work space utilizes the existing rooflines of the houses it is attached to, and the space between is infilled with a sawtooth roof, bringing daylight into the workspace. The existing windows of the homes are converted into doorways to allow access to the new rooms created and connect the spaces while still providing some level of privacy. On the exterior of the new rooms, existing window types are enlarged and become oversized to allow more light to enter and provide views out. The facade material is a thin brick veneer which is revealed in sections to reference the non-structural brick found throughout the neighborhood.

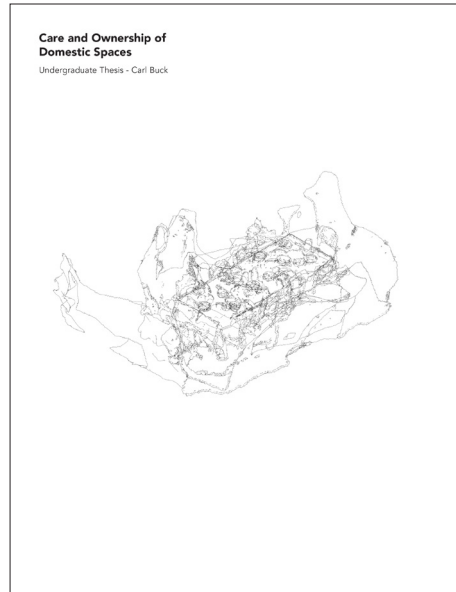


Care and Ownership of Domestic Spaces

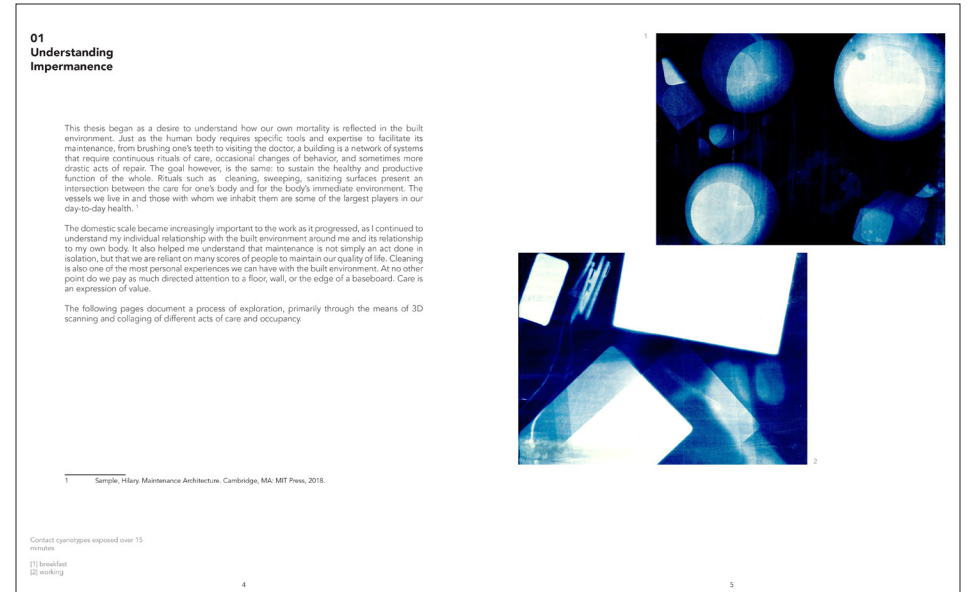
Carl Buck, B.Arch 2022

Architecture's relationship to maintenance indicates an understanding of its own mortality. Maintenance serves as a means of both preserving a building in a chosen moment in time, while also acknowledging its need for care. While ownership is typically privatized, the act or ability to care can suggest a feeling of ownership. In institutional buildings, maintenance is professionalized, out of necessities of scale. However, at the domestic level, the owner becomes the default caretaker, often creating a gap between the individual's agency and the building's needs. In both settings, this labor is frequently undervalued or unseen.

Designers have a responsibility to understand the lifespan of the objects they create, as well as to plan for their eventual end. This requires the architect to design with renewal in mind, and for the structure's need for care to be effectively communicated. The occupants' physical interaction when performing maintenance and the distribution of their efforts are key concerns. This thesis seeks a renegotiation of the building's labor and resources, adapting existing building stock to bridge the gap between domestic and institutional care. The typology of the boarding house serves as a means to explore the relationships between ownership, care, and the distribution of domestic labor.



Above: Cover of Carl Buck's thesis book
Subsequent images: excerpts from his book



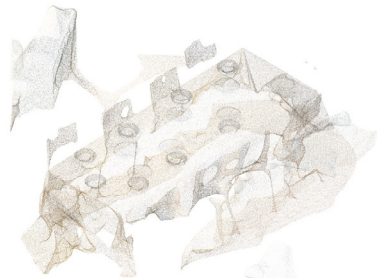
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2



3



4



5



Group dinner scanned over the course of two hours

- [1] After Dinner
- [2] Mid Dinner
- [3] Table Set
- [4] Table and Chairs
- [5] Four Layers Merged

8

9

27.5 Months:
Average Rent Duration

10.5 Years:
Average Time Spent Living
in a House

25 Years:
Deck Planks, Linoleum Floor, OSB Panel, Flooring
Underlayment, Fiber Cement Roofing, Fiber Cement Trim,
Underground PVC Piping

50 Years:
Kitchen Cabinets, Modified Acrylic Sink, Concrete Floor,
Engineered Wood Floor, Vinyl Floor, Baseboard System,
Slate Roofing, Fiber Cement Fascia/Soffits, Copper Gutter

72.6 Years:
Average Human Lifespan

80 Years:
Poured Foundation,
Concrete Block Foundation,
Wall Panel, Brick Siding, Vinyl Siding



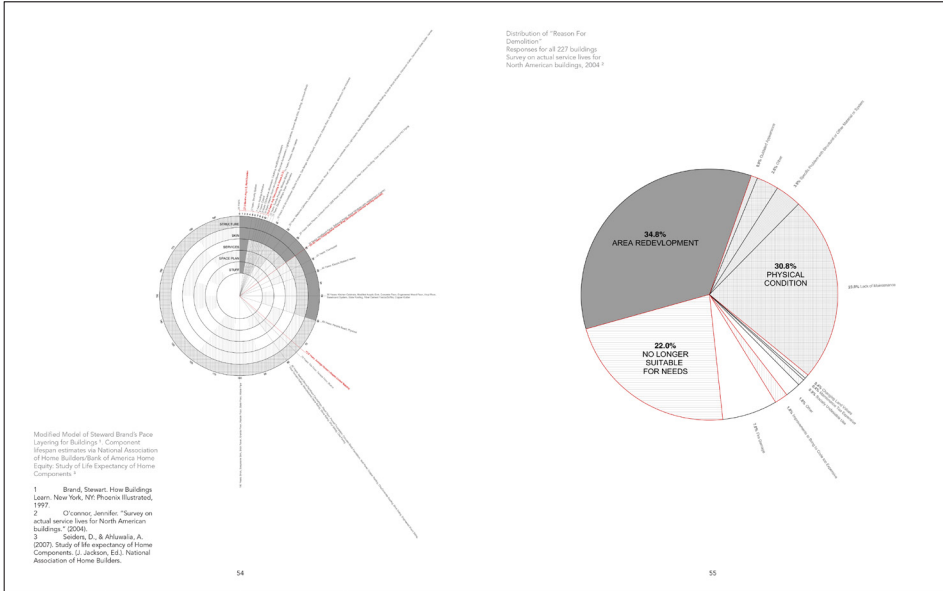
Care and Ownership of Domestic Spaces

Below are a series of 3D scanned collages completed for an exhibition of Aki Ishida's Thesis Concentration Area in the Moose Arts Center titled "New Realities: Reenvisioning Everyday Architecture". The film that accompanies these images explores the relationship between human occupancy and building component lifespans by dissecting the interior of my own apartment at 903 Giles Rd and arranging the individual components according to their projected lifespans. The composition was inspired by vanitas paintings that contrast earthly wealth with symbols of mortality (see previous page).



- (1) Bathroom
- (2) Kitchen
- (3) Laundry Room
- (4) Bedroom
- (5) Front Steps





Collective Kitchen

The centralized kitchen of the boarding house is intended to function either as a series of three kitchenettes that can be used by multiple individuals, or as a workstation that can provide food to a larger group of residents. The three workstations are positioned to allow for verbal and visual coordination between users and accommodate a collective style of working. Ample prep space is also provided to allow for a greater number of individuals to participate. The goal of this arrangement is to encourage the sharing of this work, while still giving individuals the option to cook by themselves if they wish.

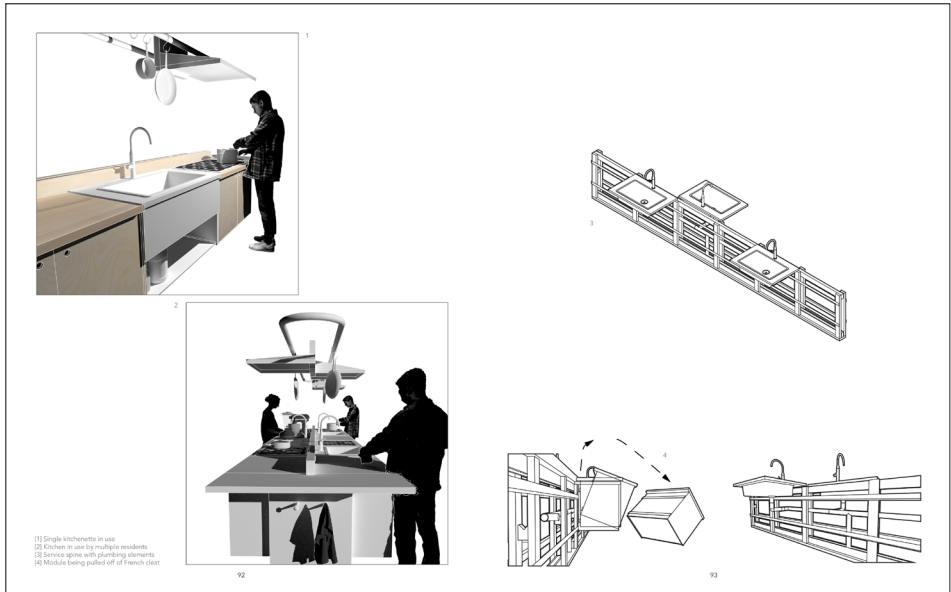
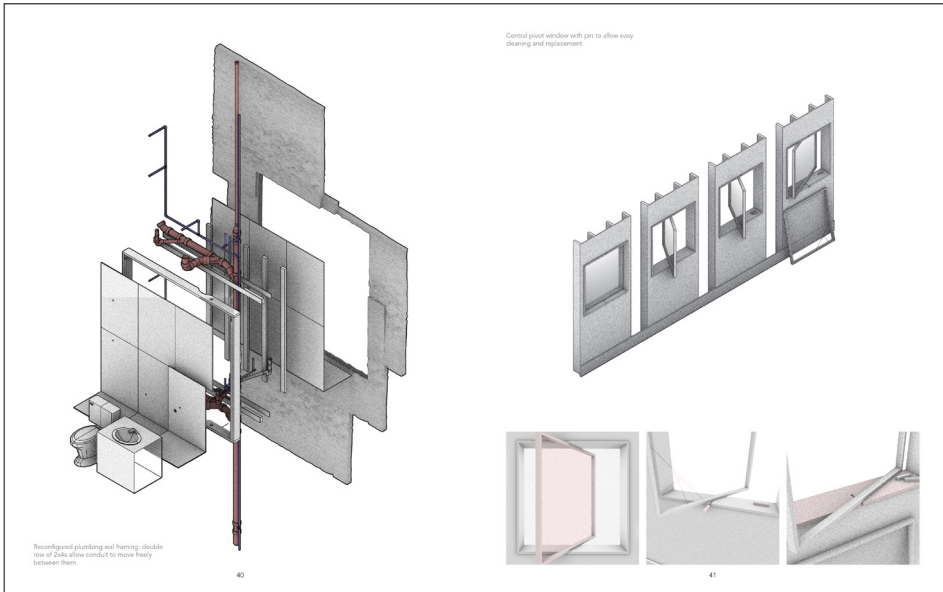
All parts of the kitchen are based on a 36"x24" butcher block counter module with built-in storage. These counter sections are mounted to a spine containing all electrical and plumbing fixtures. French cleat attachments allow these units to be lifted off of the spine for maintenance or upgrades of individual elements or to access the plumbing conduit.

There is a large gap under the cabinets to facilitate easier sweeping. Food storage is centralized in the preexisting 10'x12' fridge and a large pantry.

- 1) Cooking Space
- 2) Prep Space
- 3) Demountable Modules

90

91



This paper written on the work with this thesis studio will be presented at *2022 International Conference for Design Communication for Experimental Traditions* at Auburn University on October 7, 2022

Projection Mapped Architectural Models: Experiencing multiple times and places at once

Aki Ishida | Virginia Tech School of Architecture

Keywords: projection mapping, augmented reality, narrative, design pedagogy

Introduction

How might architects expand their modes of representation and possibilities for architectural narrative and criticism by combining two media that are familiar to architects: digital projections and physical models? By projecting digital stills and videos on surfaces of a physical architectural model, one can, for instance, conjure past memories of a place, and imagine what might occur there in the future. This paper examines historical background, then the outcomes, criticisms, and possibilities of using projection mapping to study temporal, mutable facets of architecture.

In a three-week charrette culminating in an exhibit in a black box theater, a group of thirteen undergraduate architecture thesis students at Virginia Tech School of Architecture experimented with applications of projection mapping in architecture design process. The students projected photographs, rendered images, and videos onto surfaces of plywood and foamcore models. By overlaying digital images with physical architectural models, the students combined two narrative representation modes to create an immersive environment that enabled viewers to experience multiple places, times, or narratives simultaneously. Additionally, by studying the work of computer scientists in Augmented Reality (AR) and artists who project images on buildings, possibilities emerge for architects to engage projection mapped models in their design processes.

Projection mapping in entertainment and theater

Projection mapping is a technique in which, with a projector, digital images or videos are mapped onto a 3-D object, often irregularly shaped and non-flat, turning it into a display surface. Entertainment and theater industries began to develop this technology in the late 1960s to create immersive experiences. An early example of a film projected onto a non-flat surface dates back to 1969, when Disneyland showcased singing busts in a haunted house. In the *Grim Grinning Ghosts*, 16-mm

headshot films of five signing men were projected on to five sculpted busts, simulating an appearance of ghostly, singing heads.¹ Broadway theaters have also adapted projection mapping in stage set design. Previously, plays that span multiple locations and times required elaborate pullies and moving stage sets to transition between scenes. Instead, projecting images and videos onto three-dimensional props enable scenes to shift in seconds. In the musical *Anastasia*, the set designers incorporated projection mapped images to move the story setting from a Polish countryside to a bridge surrounded by cherry blossoms in Paris.² Using this technique, the scene transitions fluidly from one location or time to another, both on the stage and in the audience's imagination.

Projection mapping and augmented reality

More recently, projection mapping has been applied in the field of Augmented Reality (AR) to combine the physical world with the virtual. In 1998, a group of computer scientists,



Fig. 1 Augmented Reality in The Office of the Future by Raskar, Welsh, and Chen



Fig. 2 Hiroshima Projection (1999) by Krzysztof Wodiczko

including Ramesh Raskar, Greg Welch, and Wei-Chao Chen at the University of North Carolina, published the paper “The Office of the Future: A Unified Approach to Image-Based Modeling and Spatially Immersive Displays,”³ speculating on an office of the future in which any existing surface or object, such as a desk, curtains, or walls, could be seamlessly turned into a display (Fig. 1). Instead of looking into a monitor or a TV screen, all surfaces in the room could become a “telecollaboration” display to enable a fully immersive, mixed reality meeting at the office. The following year, Raskar published “Table-Top Spatially-Augmented Reality: Bringing Physical Models to Life with Projected Imagery,”⁴ which describes “Spatial Augmented Reality” (SAR) that combines physical models with digital images projected on them. Whereas in Virtual Reality, the viewer sees rendered images of an object or space, in SAR, physical objects are enhanced—or augmented—with computer generated images. Different textures, colors, or patterns could be projected onto a white model of a building. The viewer is seeing a hybrid model, where the shapes of the physical model can be both seen and touched, and simultaneously augmented with digital photos, videos, or high-resolution rendering. Some AR, including the popular mobile game *Pokémon Go* which brought AR to



Fig. 3 *SONG 1* (2012) by Doug Aitkin

mass audience in 2016, uses a tablet or a phone to play. In the game, players traverse the physical world using a digital map, in search for digital Pokémon characters that appear on the screen. In SAR, since the viewer is in the physical environment of the model, a headset or a tablet is not necessary, and multiple people can simultaneously see the model and share the experience.⁵

Projection mapping in visual arts

Contemporary artists have projected videos onto buildings and monuments to create immersive narratives, often as acts of criticism and protest. Starting in the 1980s, the Polish artist Krzysztof Wodiczko projected politically charged images onto works of architecture and public monuments to critically reflect on collective memory of a place. In his 1999 *Hiroshima Projection* (Fig. 2), for example, he projected photographs of atomic bomb survivors' hands on the river in front of the Atomic Bomb Dome, one of a few structures that survived the blast. The projections accompanied recorded voices of 14 survivors telling their stories.⁶ The juxtaposition of their hands, voices, and the river, in which many victims jumped in and died, stirred emotions and created an event that became a place of both healing and protest. In the 2014 *Homeless Projections*:

Place des Arts, he projected large, intimate portraits of those who frequent downtown Montreal—the homeless, immigrants, and veterans—on the tiered building faces of the civic theater Théâtre Maisonneuve, accompanied by recorded voices of these marginalized people.

Similarly, the American artist Doug Aitkin is known for his architectural scale projection of curated images and videos, challenging the interactions between performance and environment. In contrast to Wodiczko's, Aitkin's images are often of people and places in everyday lives. In his *Sleepwalkers* (2007) at the Museum of Modern Art in New York, footages of five individuals going about their routines of waking up, eating, going to work, and sleeping were projected onto the facades of five building. At the Hirshhorn Museum's audio-visual installation *SONG 1* (2012), eleven high-definition projectors mapped videos seamlessly onto the cylindrical concrete Brutalist building, while the speakers played covers of the 1934 song "I Only Have Eyes for You" (Fig. 3). The show began at sunset as the daylight transitioned to darkness and lasted until midnight. As *The Atlantic* notes, the videos play scenes that occur in the dark, and the light that appears is nearly always human-made light, not the sunlight—a motel

neon sign, flame of a match, or florescent illumination from a corner store at night.⁷ Aitkin says his choices of images and building location on the Mall are not politically motivated.⁸ Rather, he refocuses attention to everyday places that everyone knows intimately—parking lots, malls, corridors. He does this by carefully linking the content of the videos to the site of the artwork. For instance, when a performer in the video sings "All the stars are out tonight," they gesture upwards towards the sky above the Hirshhorn; the digital scenes on the concrete walls become merged with the real world unfolding on the National Mall.

The work by the Virginia Tech architecture thesis studio builds on projection mapping's ability to merge the real with the virtual, and to trigger sentiments through juxtaposition of images with physical structures. The outcome of the studio suggests, as intimated in the work of both Aitkin and Wodiczko, possibilities for the augmented architectural models to provoke and critique, and not to simply simulate the built structure or convey information.

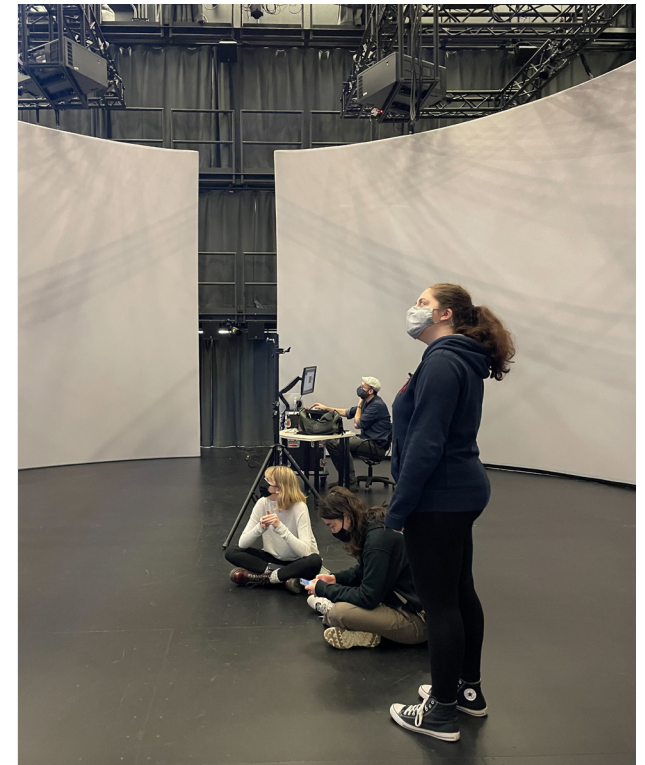


Fig. 4 The Cube at Virginia Tech

Projection mapping for architecture design studio

A group of 13 Bachelor of Architecture thesis students at Virginia Tech developed their year-long thesis in Aki Ishida's Thesis Concentration Area. While each student independently developed their own thesis, they shared a collective thread of inquiry reflected in the exhibit title, which they named *New Realities: Reenvisioning Everyday Architecture*. They exhibited the work in Virginia Tech's *Cube*, a 50-ft by 40-ft Blackbox theater with a 32-ft high ceiling designed for augmented environment experimentations combining in-person and virtual interactions (Fig. 4). The exhibit combined two different types of media. Seven students created videos that were shown on the cyclorama, a 16-ft tall cylindrical screen for panoramic projections. The other six students exhibited projection mapped models.

With the guidance of David Franusich, a creative technologist from Virginia Tech's Institute for Creativity, Arts and Technology (ICAT), the six students learned how to map images and videos onto surfaces of a model using the software TouchDesigner. TouchDesigner is a visual programming software (as opposed to code programming that uses text) used by designers, artists, and musicians for interactive multimedia, including immersive VR experience, User Interface, and interactive sculptures. Franusich demonstrated and taught the basic skills in about an hour, and each student experimented with the content of the projected media and the scale of the model. The students built a portion of their building at anywhere between half-scale to 1/8" to a foot scale out of 3/16" and 1/2" thick foamcore, or painted plywood in one case. A standard Epson High-Definition projector, a type normally used in seminar rooms, was connected to each student's



Fig. 6 Projection mapped model of a bus stop built at half scale. Kaitlyn Mueller.

laptop to project multiple images or videos onto the model. The distance between the projector and the model impacts the definition of the pictures seen on the model. There were also some challenges in mounting the projector where people would not obstruct the light or accidentally knock it. The exhibit was attended by 196 people from the School of Architecture + Design (the capacity was limited due to pandemic restrictions) from 10am to 5pm on February 16, 2022.

Three examples from the exhibit *New Realities: Reenvisioning Everyday Architecture*

One student Kaitlyn Mueller in her thesis "Connecting Architectures: Reconsidering Hybrid Spaces" examined a bus stop, which is a structure of routine. She imagined possibilities for bus stops to be a destination, not only a means to an end. In her words, "[my project] is a space that could foster a hybrid method of communication between commuters, and is designed for optimum flexibility, equipped for in-person and virtual socialization, in an attempt to elevate everyday waiting experiences." Projecting onto a half scale model of a bus stop (Fig. 5, 6), videos and stills mapped onto surfaces of the model suggested ways in which a person waiting for a bus could connect their phone to the walls and ceilings to watch entertainment, find seats to have a conversation, or play games with others who are in remote locations. By mapping videos of different scenarios on foamcore surfaces, she suggested how the shelter may be occupied by different people at different times of the day, and how they could both physically and digitally interact with the built structure. Through this installation, she questioned "how our built environment responds to our relationship with the virtual sphere, as well as how it responds to the intersections between the virtual and physical."

Another student, Sahar Khoury, studied how a collective housing for people with dementia could adapt along with the progressive stages of the illness. She wrote, "People with dementia generally prefer to stay in one's own home. In response, a melding of domestic care, assisted living, and healthcare can serve as a solution, preventing displacement as



Fig. 5 Projection mapped model of a bus stop, showing 6:30am and 8:30am scenes. Kaitlyn Mueller.

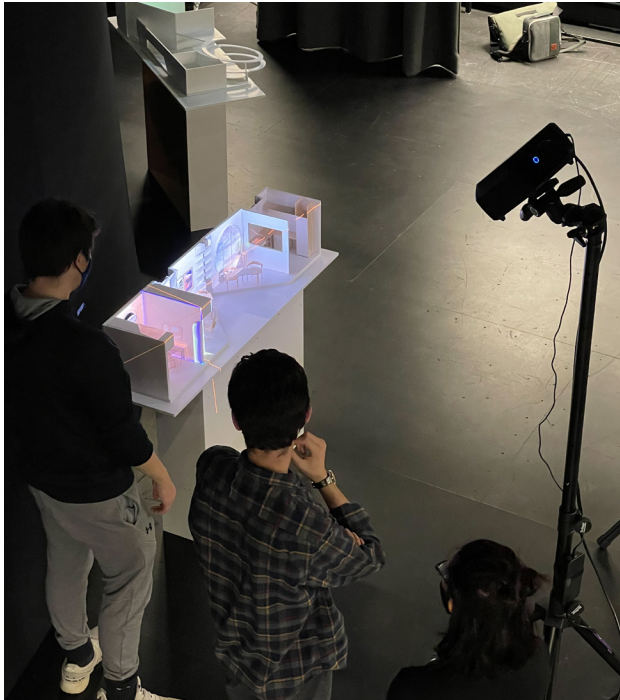


Fig. 7 Projection mapped model of an apartment for a man with dementia. Images being calibrated. Sahar Khoury.

the loss of memories and spatial perception cause additional confusion. An adaptive housing model may accommodate the needs of a person throughout the progression of the condition and allow for the resident to remain living independently for as long as possible.” She studied this through the design of an apartment for a former ship captain who now has dementia (Fig. 7). She experimented with projecting on the interior walls of the apartment a series of photographs from the patient’s past. Digital images were combined with physical architectural elements that trigger the patient’s memory and assist in activating their cognitive abilities. Architectural elements such as a ship’s porthole for a window and a collection of photos projected onto the walls trigger memories from his past working on a cargo ship (Fig. 8). Combining digital projections and physical architectural elements, the interior juxtaposed the past with the present to remind him of his identity. In place of printed photos displayed in wooden frames, immersing the person in videos and photos at one-to-one human scale, and having the images appear and disappear through the day, or through the varying stages of their illness, may assist in activating their memories and living more independently.

In another example, Connor Brown, in his thesis “Gabled Daydreams: Some Additions to American Suburbia,” investigated how we might reimagine uses of existing suburban neighborhoods. Motivated by Dolores Hayden’s provocation in her essay “What Would a Non-Sexist City Be Like?” (1980) to subdivide a 1400-SF suburban home into three smaller units, as well as contemporary housing projects by firms such as DOGMA, Brown proposed to increase density, decrease dependency on automobiles, and add communal spaces and services, such as daycare and grocery stores within walking distance from homes. For the exhibit, he curated a series of excerpts from films that take place in the suburbs, such as *Home Alone*, and projected them onto an 1/2” to a foot scale white

foamcore model of a McMansion (Fig. 9). Plans and sections of his proposed buildings were also woven into multiple videos projected onto the house model like a dynamic digital collage. With precise mapping capabilities of TouchDesigner, different video clips could be played simultaneously on individual roof planes and walls of the house.

Reflections, limitations, potential

In the 1999 paper, Raskar et al. suggests architectural applications of the hybrid physical/graphic model SAR. They write that an architect could project on table a map of an urban plan, in place of plans printed on paper, or a physical site model. SAR can also be used, they said, to show how a building



Fig.8 Projection mapped model of an apartment for a man with dementia. Projected photos from his past serve as a reminder of his identify. Sahar Khoury.



Fig. 9 Film footages and materials mapped onto roof and wall surfaces of a white McMansion model. Connor Brown.

might look with different finishes by projecting different colors or textures onto a white model, or to help the client see what the building might look at nighttime, or on a sunny day. The paper also suggests that projections could reveal internal systems of a building, such as plumbing pipes, electrical wiring, and other hidden infrastructures. Combining digital and physical models can serve the practice purpose of conveying information more clearly and accessibly to clients and the public, and it can do much more for designers. In all three students' examples showed that mapping moving or still images on surfaces of a model enables more intimate, precise juxtaposition of a narrative on a specific place within the model, and convey temporality of built environment—a substantial contrast to static prints pinned on a wall, or slides in a PowerPoint presentation. These hybrid models can also provoke, critique, and serve as a form of activism, as shown in Wodiczko's work, or elicit emotions as in Aitkin's.

While projection mapping expands possibilities as both a design and pedagogical tool, it also presents some practical limitation. The model must be seen in a dark space for the images to be visible. This is not dissimilar to darkening the room for slide presentations to be visible, and limits the spaces

in which a model can be presented and discussed. Students must also have access to HD projectors, which may not be readily available. The idea of projecting on a large-scale object, such as a building or infrastructure outdoors, is intriguing, but brightness and fidelity at this scale would require powerful, specialized projectors that must be safeguarded against theft and natural elements. For these reasons, the ability to hold public presentations outdoors faces some limitations for student projects, although with appropriate resources, full-scale mockups placed outdoors and projected with images present further potential for simulation, provocation, and public discourse.

In his 1997 essay "Tarzans in the Media Forest," Toyo Ito wrote that humans are now provided with two types of bodies: "the real body which is linked with the real world by the fluids flowing inside it, and a virtual body linked with the world by the flow of electrons."⁹ Already in the early 1990s, in the exhibit *Visions of Japan* (1991-92) in London, Arata Isozaki and Toyo Ito showed images of neon-lit night streets of Kabukicho district in Tokyo displayed on 44 seamlessly connected floor-to-ceiling screens, accompanied by recordings of sounds from the streets playing on 16 channel speakers in the gallery (Fig. 10). Ito wrote that humans are surrounded by air of technology and questioned whether our bodies may already be robotized like androids.¹⁰ If we live in cities, buildings, and bodies that increasingly combine the physical and the digital, the physical model mapped with the digital is an apt medium for architectural design. In fact, if our cities have been immersed in electrons and our bodies are breathing air of technology, architects should have incorporated video mapping in their design process decades ago.

The technique of mapping physical models with projected images and videos blurs the distinctions between virtual and real, and digital and physical. It enables us to imagine what is



Fig. 10 Exhibit *Visions of Japan* (1999) at Victoria & Albert Museum

not visible but heard, and what is suggested but not obvious. These immersive model environments facilitate imagination of what is possible—or new realities—in everyday architecture.

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Notes

¹ "The Illustrated History of Projection Mapping," Projection Mapping Central, accessed <https://projection-mapping.org/the-history-of-projection-mapping/>.

² Ashely Lee, "Projection design is reinventing theater, and not just Broadway. National tours too," *Los Angeles Times*, October 5, 2012, <https://www.latimes.com/entertainment-arts/story/2019-10-05/projection-design-theater-national-tours>.

³ Ramesh Raskar, et al., "The office of the future: A unified approach to image-based modeling and spatially immersive displays," *Proceedings of the 25th Annual Conference on Computer Graphics and Interactive Techniques* (1998): 179-188.

⁴ Ramesh Raskar, Greg Welch, and Wei-Chao Chen, "Table-top spatially-augmented reality: bringing physical models to life with projected imagery," *Proceedings 2nd IEEE and ACM International Workshop on Augmented Reality* (1999): 64-71, doi: 10.1109/IWAR.1999.803807.

⁵ Raskar, 1999.

⁶ "Hiroshima," Krzysztof Wodiczko, accessed <https://www.krzysztofwodiczko.com/public-projections/#/new-gallery-4/>.

⁷ Esther Yi, "When a Museum's Exterior Becomes a Canvas for Video Art," *Atlantic*, March 27, 2012, <https://www.theatlantic.com/entertainment/archive/2012/03/when-a-museums-exterior-becomes-a-canvas-for-video-art/255125/>

⁸ Ibid.

⁹ Toyo Ito, "Tarzans in the Media Forest," in *Tarzans in the Media Forest* (London: Architectural Association, 2011), 120

¹⁰ Toyo Ito, "Architecture in Simulated City," *el Croquis: Toyo Ito 71* (Madrid: el Croquis, 1995): 6-15.