# Augmented Bubbles

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Today, as a paradigm shift, head-mounted displays (HMD) are being reintroduced as mixed reality (MR) instruments. MR allows designers to interact with and experience the physical and virtual world simultaneously in an immersive environment. In a 1995 essay, "The Vision of Virtual Reality", Biocca, Kim, and Levy argued that the "essential copy" and "physical transcendence" were important drivers in the generation of mixed realities. They described the search for the "essential copy" as seeking a "means to fool the senses—a display that provides a perfect illusory deception," while "physical transcendence" is rooted in an "ancient desire for escape from the confines of the physical world, [to] free the mind from the 'prison' of a body" (Biocca, Kim, and Levy 1995, 7). This theoretical foundation, with the latest technology, has inspired us to explore the relationship between the separator and the physical space, the perception of action, time, space, and the physical body.

"Augmented Bubbles" is an installation that expands on computation and mixed reality work produced at the University of Cincinnati, School of Architecture and Interior Design. A digitally fabricated component is juxtaposed using the Microsoft HoloLens near-eye light-field display with its animated holographic simulation. Through sensory perception and the motor response of users, the HMD helps one perform sensorimotor and cognitive activities in a mixed reality world.

Initially, the project began as an exploration of patterns and structures in conjunction with the tendencies and behaviors of a material, in this case, flat sheets of matte polypropylene. Inspiration was drawn from two seemingly different yet intertwined sources: Islamic geometries and soap bubbles. The basis of any polygonal geometric pattern, no matter the complexity, can always be broken down into a series of triangles. Within these triangles lies an inherent logic by which they are organized and give rigidity to the assembly. This same concept is explained at length in Self-made Tapestry: Pattern Formation in Nature by Philip Ball (1999). Ball uses the underlying structure of bubbles and honeycombs to describe how geometries found in nature arise from an innate desire for equilibrium. Three site dependent armatures define the aggregation and modulation of the base unit in CATIA's Sheetmetal Workbench. This platform allowed us to simulate the folding process of flat sheet materials. Parameters relative to weight, strength, and translucency were incorporated. Following, the location of connection holes was automated. Nylon arrowhead rivets were used wherever faces overlapped and zip-ties were employed wherever a hinge joint occurred. The fabrication and construction process expanded on the notion of skin and structure in architecture.

In the end, the digital bubble was reconstructed using the marching- cube algorithm. Free from the "essential copy" mindset, the new model is a symbolic simulation of reality. With the intention of blurring the real and the virtual, the model was eventually animated and further manipulated using Autodesk Maya and Unity. The virtual animation was controlled by the user's gesture and voice. Through the HoloLens spectator system and its semi-transparent "optical see-through" screen, the students combined computer-generated images with a view of the real world.

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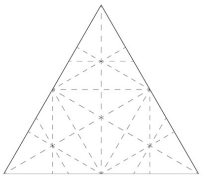


Figure 1: Base Unit.

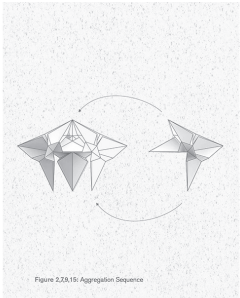


Figure 2,7,9,15: Aggregation Sequence

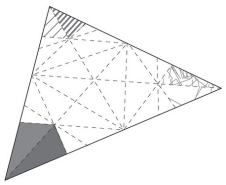


Figure 3,5,12,17: Folding.

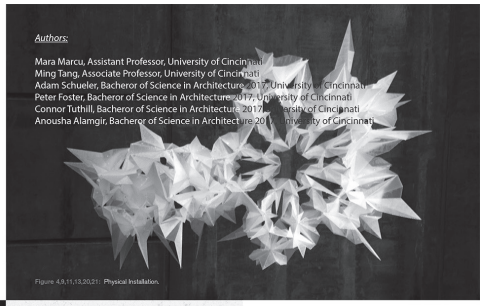
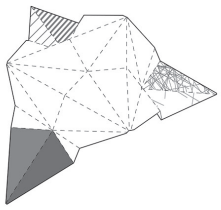


Figure 4,9,11,13,20,21: Physical Installation.



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# AUGMENTED BUBBLES

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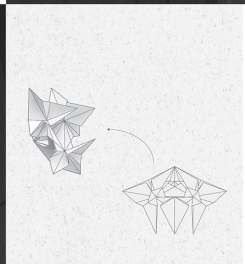

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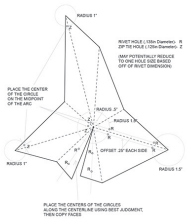
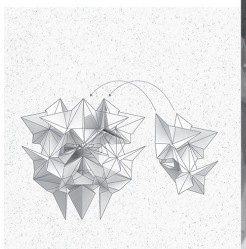



Figure 7: Unfolding/Fabrication: Modulated variant with connection hinges.



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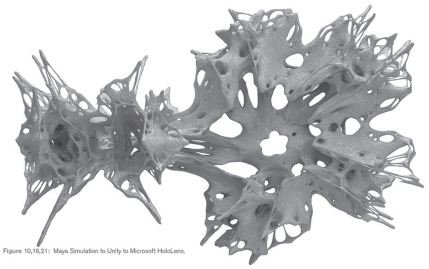

Figure 10,18,21: Maya Simulation to Unity to Microsoft HoloLens.

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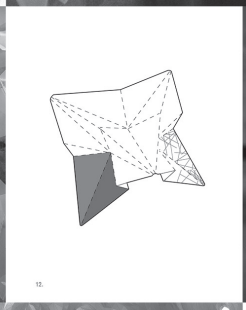

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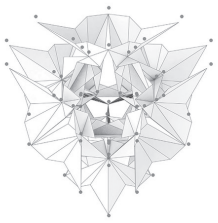
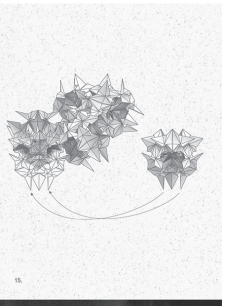


Figure 14: Power Copy: Tertiary Armature with input points



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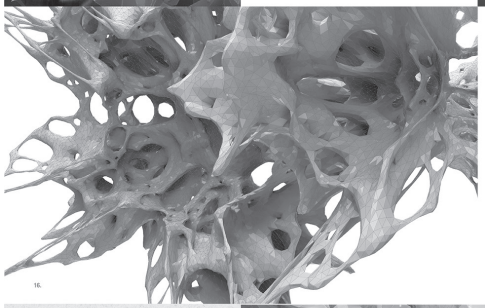

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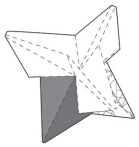

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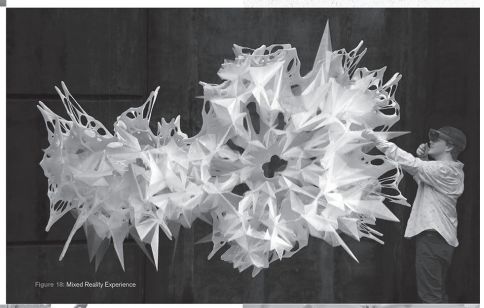


Figure 18: Mixed Reality Experience

Figure 19: Plan.

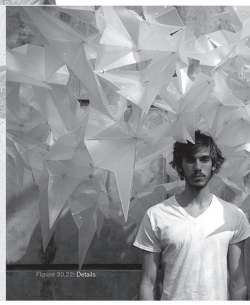
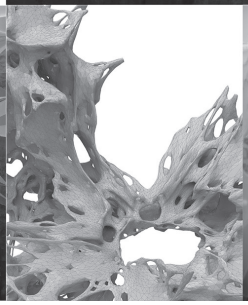


Figure 20,23: Details

folding process of flat sheet materials. Parameters relative to weight, strength, and translucency were incorporated. Following, the location of connection holes was automated. Nylon arrowhead rivets were used wherever faces overlapped and zip-ties were employed whenever a hinge joint occurred. Digital fabrication and construction process expanded on the notion of skin and structure in architecture.

In the end, the digital bubble was reconstructed using the marching-cube algorithm. Free from the "essential copy" mindset, the new model is a symbolic simulation of reality. With the intention of blurring



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*References*

1. *Biocca, F., Levy, M. (1995). Communication in the age of virtual reality. New Jersey: Lawrence Erlbaum Associate.*
2. *Philip Ball, Self-made Tapestry: Pattern Formation in Nature, Oxford University Press, 1999, 16-36.*