An Inconvenient Studio

Mahesh Senagala
Ball State University

Joshua Vermillion
Ball State University

ABSTRACT

The authors propose that technologically empowered design innovations, able to confront the many global challenges faced presently and in the future, require new pedagogical and organizational strategies in the design studio. The paper describes a novel approach to conducting An Inconvenient Studio and the unique learning experience that led to original active and reactive inventions. Situated technologies / physical computing played a central role in enabling An Inconvenient Studio. Five projects that came out of the studio will be briefly described: Legobotics, Bloom, Twist, Arcus Animus, and Morpholuminescence.

1 INTRODUCTION

The prospects of climate change loom over the horizon of our generation (Pachuari and Reisinger 2007). The daunting task of reigning in risk factors for cataclysmic climate change requires that we think outside the silos of education, pedagogy, and knowledge creation and embrace innovation through design (Mau 2007). In spring 2009, a studio was conducted at Ball State University with an aim to innovate through active strategies in environmental design (in distinction to passive design), digital technologies, robotics, interactive architecture, and collaborative design approaches that challenge conventional models of studio education. Known by many names (interactive architecture, responsive architecture, smart environments, intelligent buildings, situated technologies, and robotic architecture), these new technologies hold tremendous promise for the future of architecture (Cook et al. 2005; Guin et al. 1986).

The studio was given an opportunity to self-organize and operate around a self-defined mission and brand, as well as a set of advanced technologies and design topics. Inconveniently, no preconceived design projects were given to the students. No deadlines were provided. Instead, a vertical studio consisting of thirteen graduate and undergraduate students and two instructors was turned into an entrepreneurial think tank (inconvenient studio 2009), with an organizational structure that evolved through practical as well as academic needs. The students were asked to come up with projects and project time lines through collective dialog, exploration, and consensus, as well as to develop and choose roles for themselves for tasks such as direction, fundraising, archiving and recording work, and public relations. The studio needed to be an agile and adaptive organization to maximize its reliance on the collective intelligence—identifying problems through research and developing proposed solutions through design. As an organization, the studio was allowed to consider failure and conflict as inherent conditions of any system. Instead of handling them top-down, the studio was permitted to go through the natural cycles of learning from failure and conflict resolution as part of the learning process.

2 SELF-ORGANIZING STUDIO WITHOUT BOUNDARIES

The studio established no firm boundaries that would fiercely distinguish institutional interiority from non-institutional exteriority. Hence, the studio has functioned as a network without boundaries, expanding the reach of the institution and embracing the larger world into the fold of knowledge creation. In this sense, the group was seen as an organizational structure as a collective possessing a "design intelligence," which is enabled by communication, information, and design technologies to innovate, not only architectural projects, but the architecture of ideas, processes, techniques, and materials (Speaks 2002). Managing the complexities of a holistic process for designing that fosters team-oriented and multidisciplinary design innovation in a complexly connected world requires that academia and design firms embrace new technologies and organizational experiments (Steele 2006; Erdman et al. 2006). All members of the think tank were encouraged to leverage ideas, people, and learning from anywhere in the world through their individual networks. The studio benefited from many alignments with multidisciplinary and external collaborators, as portions of this "inconvenient" studio were taught in collaboration with the BSU Institute for Digital Fabrication, CASE Design, University of Waterloo, and Pratt Institute.

3 PROJECTS

3.1 LEGOBOTICS

Initial knowledge building began through structured play exercises—brief open-ended provocations were provided, followed by making and testing, and finally, "playful" demonstrations of the "works-in-progress"—all in very quick fashion. At the beginning, in the spirit of iterative prototyping, experimenting, and failing, the studio was tasked to explore the creation of prototypes, or "Legobots," that could behave according to a small set of stimuli and rules. LEGO NXT kits were useful for developing these prototypes quickly—the kits have pre-designed connection systems and are easily assembled, modular, re-configurable, and packaged with sensors, microcontrollers, and actuators that are all driven with a visual programming interface. Failures were abundant as the students quickly found the limitations of these kits. For instance, the sensing ranges for light, sound, and proximity had to first be discovered, and then carefully controlled by adjusting the physical location and direction of the sensors, as well as by calibrating and fine-tuning the programming.

In these cases, physical prototyping proved to be the critical method driving the design and innovation process. Most, if not all, of the design changes and development occurred through the building, testing, and modifying of full-working prototypes.

3.2 BLOOM

One such project, titled "Bloom," sought to blur the distinction between canopy and enclosure with the opening and closing of lightweight petals that hovered overhead (fig. 1). Crafted from steam-bent wood and rice paper, the petals contracted to define a small, intimate space within an otherwise open atrium by sensing human occupation, while interpreting sound levels. As a prototype, it served its purpose well by engaging the academic audience (from architecture and related disciplines) physically, but also engaging the audience's imaginations. "Bloom" was critiqued by the studio and attending academic audience not as a final product, but rather as a snapshot within a larger work-in-progress.

Figure 1 Bloom Prototype (Students: Brandon Hoopingarner, Paul Konwinski, Brianna Newton)

Figure 2 Twist Prototype (Students: Elizabeth Boone, Adam Buente, Kyle Perry)

3.3 TWIST

A different project used custom-made drive belts to twist stretched-cloth panels in patterns (fig. 2). This project attached to a linear expanse of windows and sensed passers-by in an adjacent hallway, twisting and opening sequences of panels to reveal sunlight and views to the surrounding campus. The project consisted of a modular, expandable kit comprised of parts that were laser cut from acrylic. All connections were achieved without traditional hardware, underscoring the importance of tolerances and details. This modular, "plug-in" design and assembly logic were key to testing and improving the installation's performance. Sets of components formed modular assembly systems such as the framing systems, stretching systems, pivoting systems, twisting systems, etc. If one of these systems failed to perform, particular system components could be redesigned and fabricated quickly, while ready-made to plug back into the larger whole. This partitioning of functions and systems made it possible to adapt particular component designs with minimal interference or a redesign of the entire prototype.

Figure 3 Arcus Animus Prototype, the physical result of a workshop led by Philip Beesley, University of Waterloo

3.4 ARCUS ANIMUS

The next studio project, named "Arcus Animus," was a hanging installation composed of several layered mesh works, consisting of acrylic, bamboo, and mylar components (fig. 3). The installation reacted to human occupation, as interpreted by arrayed proximity sensors. These physical reactions consisted of "shaking" movements, actuated pneumatically using solenoid valves and custom air muscles. The workshop accelerated the students' learning and application of many technical skills related to digital fabrication, electronics, and microcontroller programming. Beyond this, the students learned a great deal about teamwork and group dynamics, particularly as all of the work occurred over a short, accelerated time line, necessitating the efficient delegation of many overlapping tasks. Philip Beesley from the University of Waterloo led the workshop and project, with most of the installation designed and planned in advance.

3.5 MORPHOLUMINESCENCE

Following the Arcus Animus workshop, a few small student teams developed entrepreneurial projects to apply their new skills. One such project, titled Morpholuminescence, was developed as a submission to a student lighting-design competition (fig. 4). The competition brief asked for lighting proposals for retail fitting rooms. The students interpreted the lighting scheme from a traditional three-point studio photography lighting setup to highlight the subject when modeling in front of a mirror. Proximity sensors track the posture of the human subject to control the hinged triangular petals and variably tuned lighting. When the fitting room is unoccupied, the petals drop, revealing variable RGB LED lighting, highlighting the fitting room area with bright colors. When activated, the petals begin to close to form a faceted but continuous acrylic light surface, while the color and intensity of the fitting room lighting changes—brighter for the task of changing clothes, and then optimized for highlighting the human subject in front of a mirror.

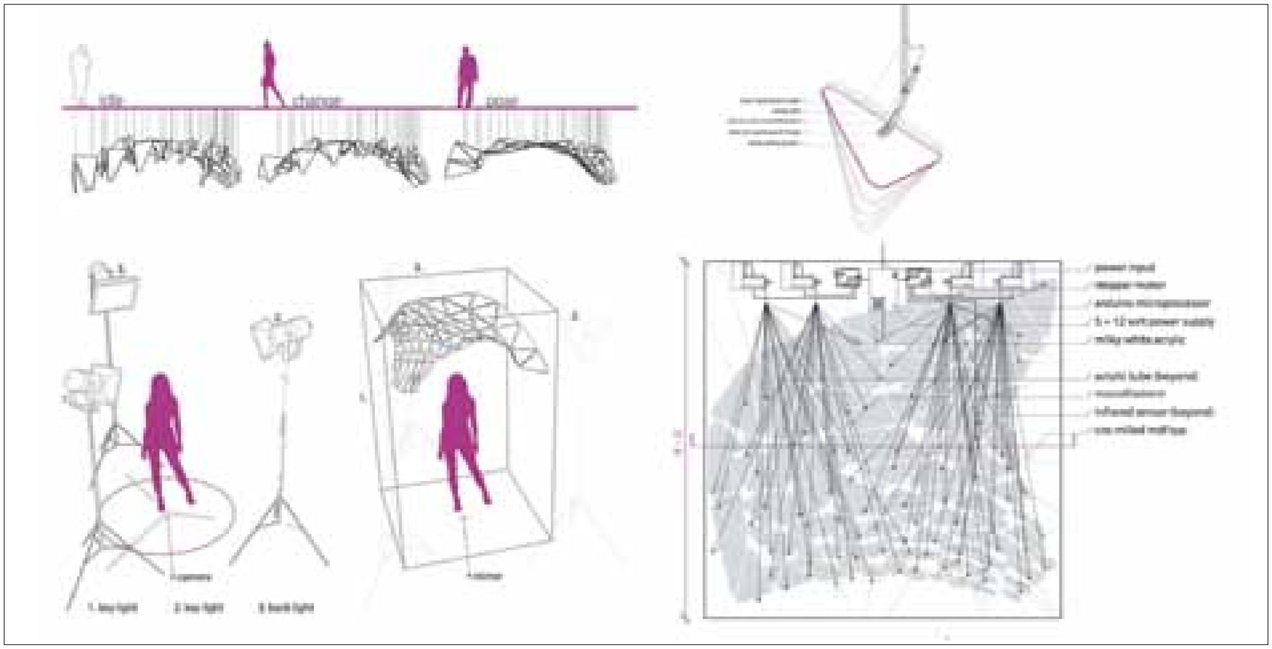

Figure 4
Morpholuminescence Design Scheme (Students: Elizabeth Boone, Adam Buente, Kyle Perry)

ACKNOWLEDGMENTS

THE AUTHORS WISH TO ACKNOWLEDGE THE STUDENTS FROM AN INCONVENIENT STUDIO: DEEPAK BANIYA, ELIZABETH BOONE, ERIC BROCKMEYER, ADAM BUENTE, LUKE CHRISTEN, BRANDON HOOPINGARNER, BRAD HORN, PAUL KONWINSKI, YEVGE MONAKHOV, BRIANNA NEWTON, KYLE PERRY, AND DAISY WINKLER. ADDITIONALLY, PHILIP BEESLEY (UNIVERSITY OF WATERLOO / PBA), DAVID FANO (CASE DESIGN), BRAD ROTHENBERG (PRATT INSTITUTE), AND STEVE SANDERSON (CASE DESIGN) FOR THEIR INVALUABLE CONTRIBUTIONS AND EFFORTS IN CONDUCTING WORKSHOPS.

REFERENCES

COOK, DIANE J, AND S. K. DAS, ET AL. (2005). SMART ENVIRONMENTS: TECHNOLOGY, PROTOCOLS, AND APPLICATIONS. HOBOKEN: WILEY.

ERDMAN, D., M. GOW, U. KARLSSON, AND C. PERRY. (2006). PARALLEL PROCESSING: DESIGN/PRACTICE. IN AD 76: COLLECTIVE INTELLIGENCE IN DESIGN, EDS. C. HIGHT AND C. PERRY. NO. 5 (SEPT/OCT 2006): 80–87.

GOUIN, M. D., AND T. B. CROSS. (1986). INTELLIGENT BUILDINGS: STRATEGIES FOR TECHNOLOGY AND ARCHITECTURE. HOMEWOOD, IL: DOW JONES-IRWIN.

MAU, B. (2007). MASSIVE CHANGE. NEW YORK: PHAIDON PRESS.

PACHAURI, R. K., AND A. REISINGER. (EDS.) (2007). CLIMATE CHANGE SYNTHESIS REPORT, INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE.

SPEAKS, M. (2002). DESIGN INTELLIGENCE. PART 1: INTRODUCTION. IN A+U 387. DECEMBER 2002.

STEELE, B. (2006). THE AADRL: DESIGN, COLLABORATION AND CONVERGENCE. IN AD 76: COLLECTIVE INTELLIGENCE IN DESIGN, EDS. C. HIGHT AND C. PERRY. NO. 5 (SEPT/OCT 2006): 58–63.