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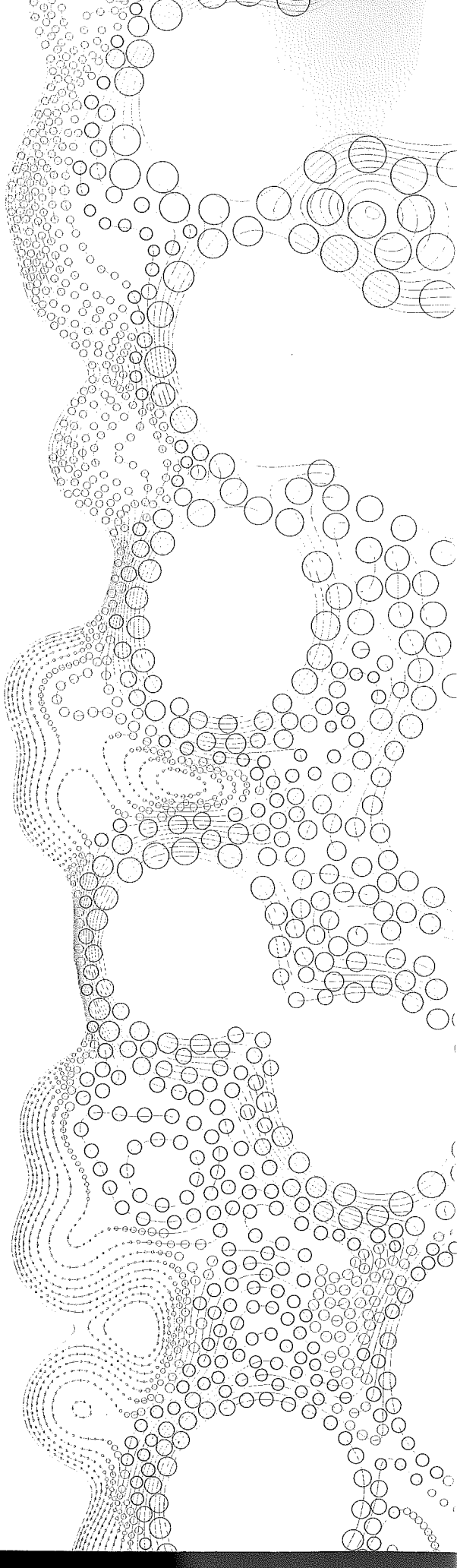
PROCEEDINGS OF THE 31ST ANNUAL CONFERENCE OF THE ASSOCIATION FOR COMPUTER AIDED DESIGN IN ARCHITECTURE (ACADIA)

Edited by Joshua M. Taron, Vera Parlac, Branko Kolarevic, and Jason S. Johnson



INTEGRATION THROUGH COMPUTATION: PROCEEDINGS OF THE 31ST ANNUAL CONFERENCE OF THE ASSOCIATION FOR COMPUTER AIDED DESIGN IN ARCHITECTURE (ACADIA) 2011

Joshua M. Taron, Vera Parlac, Branko Kolarevic, and Jason S. Johnson, editors

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Arduino Microcontrollers and The Queen's Hamlet

UTILITARIAN AND HEDONIZED DIY PRACTICES IN CONTEMPORARY ELECTRONIC CULTURE

Garnet Hertz
Concept Lab

"Integration Through Computation" is a concept I'm a bit uncomfortable with, especially since a key theme of my work is poking fun at computer technology. I am primarily a contemporary artist who builds projects that are innovative yet disruptive, advanced yet backward, or graceful yet kludged. Examples include a mobile robot driven by a live Madagascan cockroach – a vehicle designed with a special virtual reality system for the insect to help it actually drive **(Figure 1)** – and a sit-down arcade video game cabinet from the 1980s that is converted into a real vehicle that can drive down the street.[1] In these projects, I invert and play with ideas of biomimetics, cybernetics, artificial intelligence, computer games, virtual reality and augmented reality. Contradiction is an integral part of my process, and advanced computer technologies are often the thing I'm simultaneously loving and hating.

Despite my twisted affair with computation, I work as a Research Scientist in Computer Science at the University of California Irvine – although I think of myself more as a hands-on bricoleur or hacker than a scientist that systematically accumulates data. This bias toward applied technologies is considerably influenced by spending time growing up on a farm in Clemenceau, Saskatchewan: a town of ten people according to the 2006 Canadian Census.[2] Although I only spent part of my childhood there, rural technologies sparked my love of innovations scraped up out of material necessity: modifying a motor with a coat hanger, building a go-kart out of a tricycle and a lawnmower engine **(Figure 2)**, or trying to weld together some form of chimeric farm equipment to save time and make money. Farmers are usually experts at building things themselves, fixing things themselves, and doing-it-themselves, which is very useful if the town you're living in has less than a dozen people.

My family sold the farm when I was in elementary school and we lived full time in the city of Saskatoon where my father taught Mechanical Engineering at the University of Saskatchewan. Although the environment changed, my father's research in vehicle fuel efficiency seemed like advanced farm hacking: the labs were filled with students modifying Briggs & Stratton engines and hacksawing apart bicycles to create ultra-lightweight frames for high efficiency research vehicles **(Figure 3)**. Farmyard bricolage wasn't too far from the truth: the University of Saskatchewan served a large population of students that had grown up in small towns similar to Clemenceau.

In this paper, I will pull together concepts of utility-driven do-it-yourself (DIY) culture and pleasure-oriented DIY practice to investigate a significant trend in contemporary computing culture, the "maker" movement, typified by an interest in building personalized and handmade electronic devices with sensors, motors and lights, usually controlled by microcontrollers like the Arduino. My argument is that maker culture has been co-opted by consumer hobby culture, but this is not necessarily detrimental because it provides an important outlet for personal exploration, increases an understanding of how electronic media actually works and assists individuals to be actors in a culture that is increasingly complex, technological and digitized.

Utilitarian DIY

To carve out a few terms, I'd first like to highlight the do-it-yourself tasks done primarily out of functional necessity, not enjoyment. Utilitarian DIY – like fixing a broken rearview mirror on a car with duct tape – isn't motivated by the satisfaction of craftsmanship or creative self-empowerment: it's a fix to get something repaired when resources and money are limited. Repairs, chores and kludges are motivated by this sort of functional necessity, often cobbling together whatever materials are immediately available. Although pride can be taken in this sort of work, the joy of building or fixing the object isn't as important as its functional value.

Utility is at the core of a significant portion of the DIY practice that my great grandparents and their rural peers undertook as prairie homesteaders in the late Victorian era: building houses out of sod, making soap out of tallow and lye, or patching clothes with scraps of fabric.[3] It sounds contrived to even call this work "DIY": self-sufficiency skills are simply a mode of survival when few other options exist.

Hedonized DIY

Rachel Maines describes the inverse of utility-oriented production as hedonized production: when the usefulness or the significance of the product is overshadowed by the pleasure of producing it.[4] Maines tracks the transition of how utilitarian chores have shifted into leisurely tasks over time, like gardening, hunting, cooking, needlework, home mechanics and brewing. A lack of material hardship assists in do-it-yourself tasks becoming enjoyable hobbies: in times of prosperity and leisure, chores shift into artisanal crafts.

Marie Antoinette's *Hameau de la reine,* (The Queen's Hamlet) **(Figure 4)** is a popular example of a hedonized farm experience built at Versailles between 1783 and 1787.[5] The Hamlet was a sanitized farm retreat where the Queen sought refuge in peasant life, with tasks including milking carefully cleaned cows in fine porcelain buckets that were painted to appear as if they were constructed of wood. The Queen's tasks were an attempt to escape palace formality and reconnect with rural life, perhaps similar to how contemporary camping in a tent is used by many as a reconnection to living outdoors.

Maker Culture and the Hedonized Arduino

The Arduino is a small and inexpensive computer that fits in the palm of your hand and is used to sense things in the world – like temperature, distance, switches, or information from a PC. It is also used to control things in the world, like motors, displays, lights, sound devices and other electronic objects **(Figure 5)**.[6] It is a microcontroller platform that does what several similar platforms have done in the past, but it's clearly the poster child of microcontrollers in contemporary electronic DIY culture.[7] The Arduino has popularized physical computing, robotic objects, and interactive environments into the wider hobby community, and has helped make electronic prototyping a trendy leisurely pastime. It's fashionable enough that I've seen many students purchase the Arduino without any particular project or application in mind: owning an Arduino is like an authentic form of identification that you belong to the open source hardware movement and the contemporary electronic DIY community.

To extend Maines' concept, the Arduino is a hedonized technology, enabled by a reduction of microcontroller prices and a surplus of code and consumer electronics to experiment with.

Arduino's synecdochical symbolization of the electronic DIY movement isn't a negative thing: as a fashionable accessory of nerd culture, the Arduino is useful in its role of re-introducing some of the basics of homebrew computing that predated the personal computer.[8] But unlike the path of the personal computer, working with the Arduino is usually focused on the physicality of computing: projects often don't use a standard keyboard, mouse and monitor. Instead, sensors like thermometers or ultrasonic rangefinders are coupled to motors, speakers or lights, with a focus on creating unique and interactive objects, not easy to use general purpose computers. Arduino projects can include retrofitting an antique telephone with the functionality of Skype, or building a coffee table that has a glowing top that changes colors depending on the local weather forecast.[9] The Arduino in maker culture is a bit like a small Briggs & Stratton gasoline engine on a farm that can be adapted to operate a go-kart, an auger, a water pump or a lawnmower: it is a flexible component that can power an array of devices. In some ways, it has brought computing to

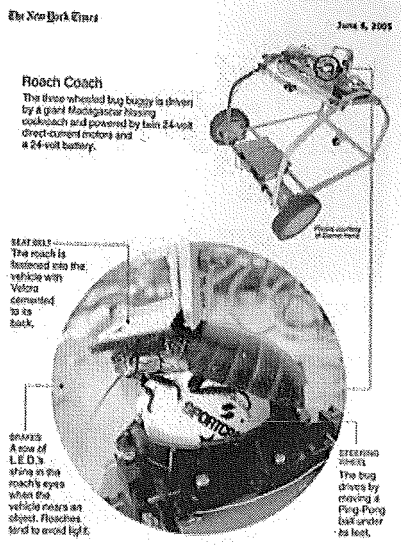


Fig. 1

Fig. 2

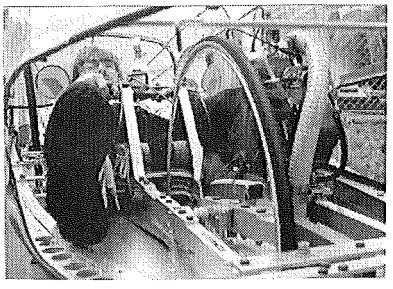


Fig. 3

Figure 1. *The Cockroach Controlled Mobile Robot (Version 1), as described by the New York Times on June 6th 2006*

Figure 2. *Farmyard in Clemenceau, Saskatchewan, with remnants of a go-kart (in foreground) built from tricycle parts and originally powered by a small Briggs & Stratton lawnmower engine*

Figure 3. *Student at University of Saskatchewan lays in high efficiency research vehicle with a modified Briggs & Stratton engine, 1982*

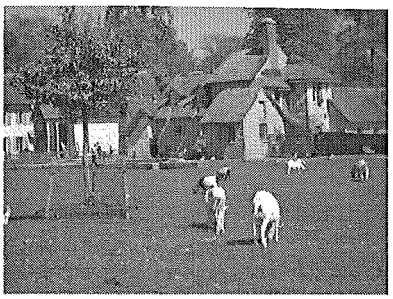


Fig. 4

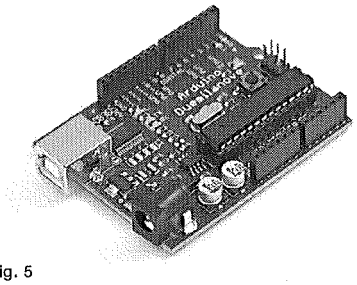


Fig. 5

Figure 4. *Photograph of the Queen's Hamlet at Versailles by Chris Waits in 2011 (CC BY 2.0)*

Figure 5. *The Arduino open-source single-board microcontroller, Duemilanove model (2009)*

tinkerers and tinkerers to computing, and has popularized physical computing to a new generation of individuals.

Maker culture has been considerably sculpted by O'Reilly Media through its popular Make magazine that has been in print since 2005.[10] The magazine is a revival of publications like Popular Mechanics which began at the turn of the 20th Century, fueled by a rising enthusiasm for technology. Popular Mechanics expanded through the mid-20th Century with the rising middle class and evolved into a periodical that primarily featured compilations of interesting hobby projects for fathers and sons to do on leisurely weekends.[11] It was not a utilitarian survivalist guide nor a craft manual, but an encouragement for individuals to express themselves through creativity and a knowledge of how technologies work. Similarly, Make magazine has continued the trajectory of Popular Mechanics in the 1950s and ported it over into the field of microcontrollers.

Arduino and the Age of Remix

The Arduino has become popular due to many factors, including its ability to easily interface with ordinary household objects, digital devices and computer code. Chronologically, digital media has moved from a speculative opportunity in the 1990s, became widely adopted as a consumer commodity in the 2000s, and is now in continual renewal and surplus. As a result, topics like reuse, remixing, and sampling have become increasingly commonplace. The Arduino has leveraged its strength as a hardware remix tool and has been rewarded with its ability to interface with and reconfigure everyday electronic devices.

Opening the Black Boxes of Throwaway Culture

Mark Frauenfelder, Editor-in-Chief of Make magazine, links the rise of DIY culture with a dissatisfaction with consumer culture, living authentically, and the Japanese concept of wabi-sabi: the beauty found in an object's imperfections.[12] Frauenfelder provides a valuable description of contemporary DIY culture in relationship to a throwaway consumerism, but there are additional issues that deserve articulation beyond counter-consumerism and the personal satisfaction of doing something the hard way.

A key value of contemporary electronic DIY culture is in how it challenges the "black box" mindset that most users have when using consumer electronics and computing devices. The inner workings of digital culture is increasingly concealed as a result of the development of newer generations of technologies. Products are built out of existing components, and in the process the components fade from being contemplated objects into the background of punctualized infrastructure.[13] In contrast to open source systems that strive to have a transparent interior, blackboxed technologies are only understood on the surface of how they function: an electronic toy makes a sound when a button is pressed or a computer printer outputs a document when requested. This blackboxing is a requirement of technological advancement: a computer system, for example, is almost incomprehensible if continually thought of as millions of transistors, circuits and technical components.

A black box is a system that is not technically understood or accessed, and as a result obsolete or broken black boxes are often unusable. They are often proprietary products, and once the desired functionality of the device stops working it is often unfixable and inaccessible for modification by most individuals. Unlike a household lamp which can be fitted with replacement light bulbs, many consumer electronic devices have no user-serviceable parts, and the technology is discarded after it breaks. The depunctualization, or breaking apart the device into its components, is difficult due to the highly specialized engineering and manufacturing processes used in the design of the artifact.

Part of Frauenfelder's concept of living authentically through DIY can be expanded as an opening and exploring of the black boxes of digital culture. The Arduino plays an important role as a gateway into understanding the foundations of electronics, microcontrollers and code. These building blocks of digital culture are not just part of our leisure: they are the core of a culture that is increasingly described, managed and interfaced with electronically.

Conclusion

Make magazine can be criticized in a similar manner to Marie Antoinette's constructed Hamlet: they both over-emphasize leisure and do not critically engage with DIY culture. Similarly, the Arduino has been popularized to a wide hobby audience and in the process has transitioned into what Maines terms a hedonizing technology: a pleasure-oriented hobby culture.

In comparison to The Queen's Hamlet, however, the Arduino is conceivably more legitimate because it educates individuals in how to rip open and comprehend a core aspect of contemporary life: the black box of digital culture. The Arduino and contemporary DIY culture have the potential to bring together the physical world with digital media, empowering individuals and designers to navigate across different disciplinary territories to create processes, techniques, and objects that are simultaneously new and reminiscent of our DIY past.

Engaging only with maker culture as a hobby practice is selling it short: its low-level interface with technology provides an important outlet for personal exploration, it increases an understanding of how electronic media actually works, and it assists individuals to be actors in a culture that is increasingly complex, technological and digitized. Opening and tinkering with the black box is not enough: a critical making that combines engaged thought with technical construction is our path into meaningful personal, social and civic engagement.[14]

Acknowledgements

Special thanks to Amelia Guimarin and Christopher Guevara for feedback on this paper.

Notes

1. See http://conceptlab.com/roachbot/ for information about Cockroach Controlled Mobile Robot project and http://conceptlab.com/outrun/ for details on OutRun, the arcade game concept car.

2. Statistics Canada. 2007. Population and dwelling counts, for Canada, provinces and territories, and designated places, 2006 and 2001 censuses - 100% data (table). Population and Dwelling Count Highlight Tables. 2006 Census. Statistics Canada Catalogue no. 97-550-XWE2006002. Ottawa. Released March 13, 2007. http://www12.statcan.ca/english/census06/data/popdwell/Table.cfm?T=1302&SR=1&S=1&O=A&RPP=9999&PR=47&CMA=0 (accessed July 29, 2011)

3. For a compilation of traditional homesteader skills, see Back To Basics: How to Learn and Enjoy Our Traditional Skills (The Reader's Digest Association, 1981).

4. Rachel Maines, Hedonizing Technologies: Paths to Pleasure in Hobbies and Leisure (Johns Hopkins University Press, 2009).

5. For information on the Queen's Hamlet, see the official website at http://en.chateauversailles.fr/discover-the-estate/le-domaine-de-marie-antoinette/the-queen-hamlet/the-queens-hamlet.

6. For more information on the Arduino, see http://www.arduino.cc/

7. Similar platforms to the Arduino include high level devices like the NiQ EZ/IO, Beehive ADB I/O, Infusion Systems's I-Cubed or low-level microcontrollers like the Microchip PIC, Atmel, or AVR chips.

8. For information on the Homebrew Computer Club, an early Silicon Valley computing DIY group that is credited with sparking the personal computer revolution, see John Markoff, What the Dormouse Said: How the Sixties Counterculture Shaped the Personal Computer Industry (Penguin, 2005).

9. See Andrew Lewis's Vintage VoIP article in Make Volume 25 (O'Reilly Media, 2011) for a description of how to convert a classic 1930s retro telephone into a Skype phone.

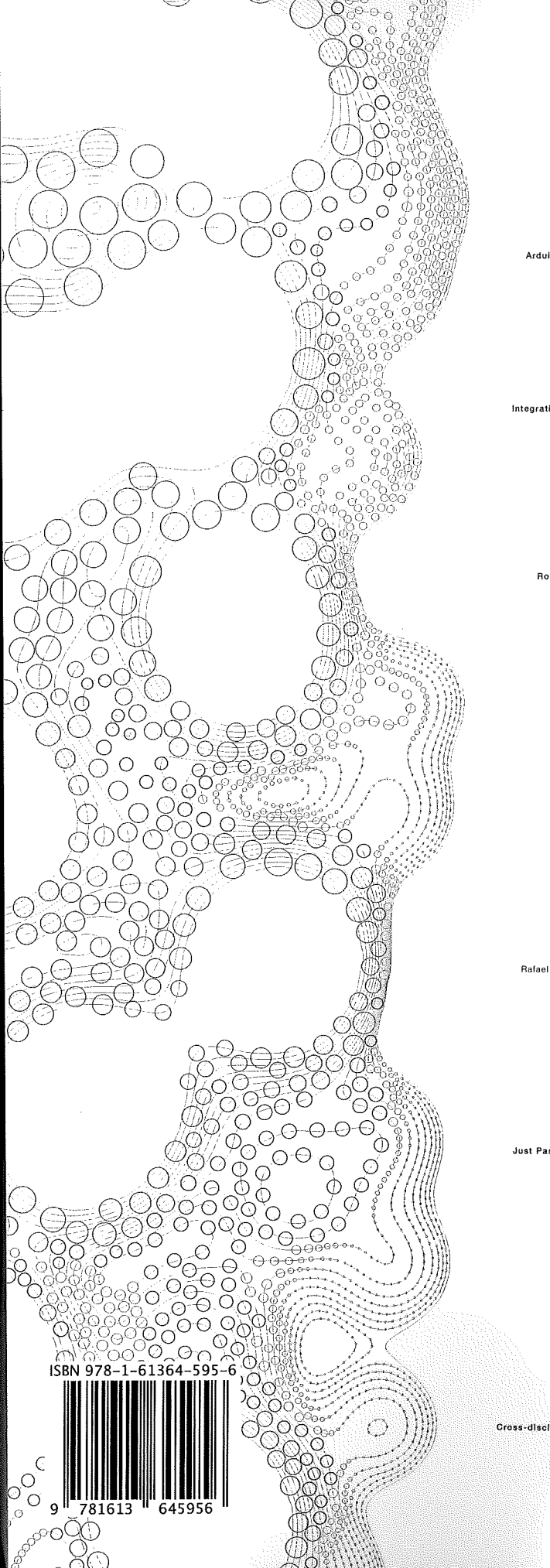
10. Make: Technology on Your Time (O'Reilly Media, since 2005).

11. For example, see Popular Mechanics, "Make it Yourself: 900 Things to Make and Do" (Popular Mechanics, 1927).

12. Mark Frauenfelder, "*Made by Hand: Searching for Meaning in a Throwaway World*" (Portfolio, 2010).

13. Punctualization refers to a concept in Actor-Network Theory to describe when components are brought together into a single complex system that can be used as a single object. For more information, see Bruno Latour, Pandora's Hope: Essays on the Reality of Science Studies, Harvard University Press, 1999.

14. Matt Ratto, "Critical Making: Conceptual and Material Studies in Technology and Social Life," The Information Society, 27, no. 4 (2011): 252-260.



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