RCADE Project

Talk – 21 April 2017

*Extruding Logic*

Hello, I’m Kyle Bickoff, I’m PhD candidate in English Literature at the University of Maryland, and will be reading my paper *Extruding Logic* here today.

[SLIDE 2] Let me start by telling you a few things about our object, the 3D printer we chose—it’s made by a company called Monoprice, and goes by the unmemorable name – the 13860 Maker Select 3d Printer V2. Monoprice is an American company that resells electronics, and rebrands electronic products under its own proprietary label. Our printer may announce itself with its generic title, but it is actually a fork [SLIDE 3] of the [Prusa i3 printer](http://www.prusaprinters.org/prusa-i3/)—an open source design that emerged from the RepRap project—a University of Bath funded initiative with an open design and making use of a free software license [SLIDE 4].[[1]](#footnote-1) Why have we chosen to work with Monoprice’s proprietary version of this printer design? What sort of components is our device composed of? What logics are embedded into our printer? And, how do these components and the design choices influence our understandings of ourselves as *printers* and as *actors* in the larger 3D printing economies? These are a few of the questions I hope to speak to here today.

[SLIDE 5] Monoprice is just one company among a vast array of businesses producing generic consumer electronics. Our printer’s clear origins from the Prusa project speak to the knowledges embedded in the machine—[SLIDE 6] the Prusa project emphasized the value of designing a printer that could reproduce a significant portion of its own parts—those components including the build-plate, component housings, structural supports for the printer, and nearly any other component that need not be of flexible rubber or of a cast metal origin. Thus, such a printer could reproduce components for other printers on-site in perpetuity, the kind of work that embodies a certain hobbyist or *diy* ethic.[[2]](#footnote-2)

So, if the knowledge origins of the supply chain for our printer start with the ideas begun at the RepRap and Prusa stages—the material origins can be traced to a private sector company—[SLIDE 7] Wanhao, which produces its components, cheaply, in the city of Jinhua, China.[[3]](#footnote-3) I was able to find some images and see the very facilities and space in which our printer was built. [SLIDE 8 AND SLIDE 9] – Here are a couple of maps for context in both the urban and global settings. After production, the Wanhao printer is then sold directly to the American company, Monoprice, with new firmware, and re-labelled and rebranded for Monoprice under Monoprice’s “IIIP” brand label. [SLIDE 10] There are few markings on the machine itself to indicate that it’s rebranded and produced by another company—one notable exception of a residual ‘Wanhao’ trace was found when a member of our group printed some of the sample models. This model, named The Wanhao Bot – shown by the image from our instructional manual, was meant to be a robot, but instead turned out to be an elephant—and a glow in the dark one at that.

At this point, we begin to understand our Monoprice printer in a broader context—it is part of a much larger industry and economy that **only** begins at the University of Bath’s RepRap project. The economy I describe both privatizes the public knowledge from RepRap and converts the open-source software into proprietary software. When I say proprietary, I mean privately-owned and restricted software that is difficult or impossible to modify, and where the source code is not made accessible to consumers. Our machine itself – while materially a 3D printer – also serves as a device that redirects the state provided-funds for a project like RepRap and diverts these resources, in the end, to furthering wealth-aggregation in the private sector. The printer itself is engaged in both material production and wealth redistribution and requisition. Indeed, this printer is by no means an exception, but typically the rule in the industrty—our printer’s production history, if nothing else, forces us to address the roots of its material, labor, and knowledge-based origins. So, when we consider the origin of our approximately $300 printer against Makerbot’s top of the line Replicator+‘s selling price of $2,500, we can start to see the labor our printer depends on—the low-cost physical labor of production in Jinhua, China, the open-source software designed with the support of public university funding, and the hidden costs of transportation, importation, and **of course** the final cut for Amazon—before it reaches us, the consumers.

I’d like to look a bit more closely at the material components of these printers as well—in particular, I’m interested in some of the intentionality that is embedded into these technologies. These ‘logics’ that are a part of our 3D printer are by no means new—they are reincarnated from their previous forms. [SLIDE 11] Friedrich Kittler tell us that “A medium is a medium is a medium… To transfer messages from one medium to another always involve[s] reshaping them to conform to new standards and materials” (Discourse Networks 1800/1900, 265). Kittler, here, attempts to describe how media transposes its form as it is incarnated in different technologies. Specifically, Kittler is describing what Jay David Bolter and Richard Grusin later term, remediation.[[4]](#footnote-4) Kittler furthers his explanation, refuting the notion that media are “translated” across technological eras, instead describing them as “transposing” themselves and “reshaping” themselves to meet the affordances of the technology.

[SLIDE 12] Our printer in many ways embodies these notions of transposition and remediation. I’d like to look at the hardware of our machine—for example, visually our machine’s build is far more revealing of its internal components and construction than, for example, the bestselling Makerbot is. From the outside, you can see that the X, Y, and Z axes reveal themselves during normal operation. Our extruder is positioned clearly, and in a way where its components are easy to work on, disassemble, repair, and reassemble. The raw material, our PLA spool, is prominently housed in a functional location *top and center* (literally), not concealed in an enclosed rear compartment.

But what I’m MOST interested in in our machine is its internal components. [SLIDE 13] While we were interested in *making* things with our printer, I think we were just as interested in, if not more interested, in tinkering and unmaking the thing. When we opened up our sealed, black box unit—and about 25 screws later, we saw our circuit boards—one board is devoted to power distribution and the other devoted to computation. We examined each of our components: our power connections, as well as the access points for the individual control cables for each of the X, Y, and Z axes all became clear and comprehensible (relatively!) before our eyes. You’ll also see that on the logic controller for the printer, our board was inscribed with a link to a website. [SLIDE 14] This website links off not only to a Reprap link, but also to resources like a github repository. [SLIDE 15] While our own machine may have its intellectual flaws through its proprietary branding and custom firmware, one of its greatest strengths is its ability to be modified—[SLIDE 16] and these schematics reveal that openness. [SLIDE 17] [SLIDE 18] While our machine’s origins are partially concealed, and commodify some of the open-source ideas on which it was built, it still retains some of this open layout. The instructional manual makes no mentions of these external resources, but built into the logic board itself is the original logic of our machine’s design—the support for open source software and for community modification. Moreover, while not *advertised* as a *feature* of the printer, the components may still themselves reveal their design, and can be further studied by engaging with the tools provided by the community and its resources, which opens the door to far more elaborate tinkering and modification of the system.

While the Prusa 3D printer variant and fork may be the most prevalent in common 3d printer designs, perhaps the single best known printer brand is the Makerbot company. [SLIDE 19] Makerbot, itself, was founded in 2009—but in just two years, in 2011, a major venture capital group in Boulder, Colorado—the Foundry Group—invested $10million into the company. In another 2 years, by 2013, a publicly traded company, Stratasys, acquired Makerbot for about $400 million dollars, integrating it into its larger corporation, one worth over $2billion dollars. So, I mean to show, 3d printing is indeed big money and not just a hobbyist’s realm. At the same time, we can trace the Makerbot’s design alongside private investment. At Makerbot’s advent—before its private equity infusion, it built open machines like the Cupcake CNC and Thing-O-Matic, which revealed their internal components. But, after the 2011 cash infusion, the next machine was the Replicator, which literally became a BLACK BOX. The machine’s software remained open, but the machine’s design began to conceal its internal components. Around the time of the Makerbot’s acquisition by Stratasys, the Makerbot Replicator 2 and later Makerbot+ turned towards entirely proprietary components. In a blog post on the Makerbot website, one of the original creators, Bre Pettis, describes that they would be shifting from an open-source approach to a proprietary mode of the developing the physical components of the machine AND the Graphical user interface—in a 3D printer, that means everything. Pettis describes the company’s motivation—they want to prevent ‘cloning’ of their technology—Pettis’ exact words are [QUOTE], “it allows us to clearly speak one of the unspoken rules of open source hardware. Specifically the one that states that “cloning ain’t cool.”[[5]](#footnote-5) [ENDQUOTE] So, in following one of the ‘unspoken open-source rules,’ the company decided to no longer remain open-source and to use entirely proprietary physical components and software. Cool, right? More recently, the company has further concealed the internal components of their next generation of machines and has even filed for some patents for community developed modifications to their machine that were posted online…

Earlier, I mentioned the term “blackbox.” [SLIDE 20] It’s a term in media theory used early on by Norbert Weiner in his seminal text, *Cybernetics*. It also used in very current understandings of media, for example in Greg Siegel’s *Forensic Media* or Frank Pasquale’s *The Blackbox Society*. The Black box, is quite literally an apparatus into which information is entered and out of which information is received—but in the space of the black box, Norbert Weiner tells us, [QUOTE] “we do not … have any information of the structure by which th[e] operation is performed.” Weiner is saying that we cannot understand the message when its concealed within such a space. The same sorts of operations occur across our media infrastructures—when we cede control and agency over the algorithms of the black box itself, our own knowledge and agency is therefore reduced (Pasquale, 3). While Weiner discussed this concept from a more technical standpoint in computing, Pasquale—among others—applies it to financial institutions, search engine companies, and surveillance record usage (5-6). In our 3D printing machines, we see this same embedded logic—that of the blackbox. [SLIDE 21] By physically sealing the machine, by encouraging proprietary and costly plastic filament, by using specialty spool sizes, by locking down their software, complicating home repair, and encouraging the purchase of costly Makerbot branded warranty and repair plans—Makerbot and similar companies can charge more for their machines and components, while at the same time restricting users’ agency over their machines. 3D printing, in this light, starts to resemble one of its predecessors and now peers—the inkjet printer market—which sells relatively affordable printers, but extremely costly inkjet cartridges. The machines are often completely irreparable, and the companies retain more agency over user’s machines than the users themselves have.

To conclude—our own 3D printer has its flaws, and it is certainly part of a larger economy of globalized production, commodification of publicly funded knowledge, and neoliberal redistribution of public funds. But, our model’s design still remains partially open, even if it does not explicitly declare itself as such and perhaps tries to hide this ancestry. While platforms like Makerbot continue to lock down additional facets of their machines, ours remains technically open; still, our machine remains a part of an industry that seems to not only reinforce, but perhaps accelerate the neoliberal shift. Despite all of this, Hobbyists and tinkerers have created online communities and have developed and documented a huge variety of modifications—these communities have sprung up both around the Wanhao i3, which is our printer’s true identity,[[6]](#footnote-6) as well as some around the Monoprice Maker Select variant.[[7]](#footnote-7) These communities, as well as some of nonmaterial concerns are subjects that my peers will now take the chance to speak to in far greater depth. [SLIDE 22] Thank you!

 See Also:

<http://hackaday.com/2016/09/14/wanhao-duplicator-i3-should-put-an-end-to-cheapest-printer-kickstarters/>

<https://www.youtube.com/watch?v=U8xLzfm675A>

<http://josefprusa.cz/open-hardware-meaning/>

<https://github.com/reprappro/melzi/blob/master/melzi-board.png>

<https://github.com/reprappro/melzi/blob/master/melzi.png>

1. ([http://reprap.org/wiki/RepRapGPLLicence)](http://reprap.org/wiki/RepRapGPLLicence%29). [↑](#footnote-ref-1)
2. (SHOW: [http://reprap.org/wiki/File:Josefprusa.jpg)](http://reprap.org/wiki/File%3AJosefprusa.jpg%29) [↑](#footnote-ref-2)
3. ([http://www.wanhao3dprinter.com/dy/3.html)](http://www.wanhao3dprinter.com/dy/3.html%29) [↑](#footnote-ref-3)
4. ([https://mitpress.mit.edu/books/remediation)](https://mitpress.mit.edu/books/remediation%29); <http://www.digitalhumanities.org/dhq/vol/6/1/000110/000110.html>) [↑](#footnote-ref-4)
5. ([https://www.makerbot.com/media-center/2012/09/24/lets-try-that-again)](https://www.makerbot.com/media-center/2012/09/24/lets-try-that-again%29) [↑](#footnote-ref-5)
6. ([http://3dprinterwiki.info/wiki/wanhao-duplicator-i3/)](http://3dprinterwiki.info/wiki/wanhao-duplicator-i3/%29) [↑](#footnote-ref-6)
7. ([https://www.reddit.com/r/3Dprinting/comments/52qk56/monoprice\_maker\_select\_v2\_purchased\_things\_to/)](https://www.reddit.com/r/3Dprinting/comments/52qk56/monoprice_maker_select_v2_purchased_things_to/%29) [↑](#footnote-ref-7)