The Voice of the Polyrhetor: Physical Computing and the (e-)Literature of Things

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Sustaining a deep engagement with the machines we use has long been assumed to be fundamental to what we do as authors and scholars. In technical communication and writing studies, the term "digital literacy" is frequently used to signify the process of learning how to "read" (and occasionally write) digital texts. A growing cohort of digital humanists asserts that both writing and coding are crucial components. For practitioners of electronic literature, it is the process of what N. Katherine Hayles calls "concealing and revealing" (54) that guides our work with platforms, authoring systems, and code. Matt Kirschenbaum, for example, argues that "the distinction between what's on the screen (or page) and what lies beneath is beginning to disappear, as computer languages seep into the visible, legible spaces in which we read" ("Hello Worlds"). Cathy Davidson suggests that "[d]igital literacy means not rote learning but experimentation, process, creativity, not just technology but multimedia imagination, expression–and principles too" ("Digital Literacy"). And Ian Bogost has argued for what he calls "procedural literacy" (32) in which we learn not only how to code, but also learn how the disciplinary nature of code itself encourages structured thinking and facilitates an understanding of the world as a series of interrelated systems.

One question we might like to ask in the pursuit of procedural literacy is how far we can extend what it means "to write." Jody Shipka, for example,

warns of the conflation of "multimodality" (composition processes that cross multiple tactile, visual, and oral media) with the more traditionally understood electronic "multimedia," arguing that digital composition often substitutes one "narrow range of practices" (5), such as writing, for another, such as hypertext, while undermining the "complex relationship between writing and other modes of representation" that might include the spatial, oral, and haptic (12). Thus, if we are to realize the full promise of Bogost's call for procedural literacy, we might like to consider the proposition that working with technology to promote digital literacy should go beyond the manipulation of digital objects using software, and even beyond the manipulation of software itself.

One fruitful series of digital literacy practices involves looking not just at the surfaces and screens of the computer as a writing tool, but looking inside and under the hood. This field, known as "humanities physical computing," or "critical making," emphasizes the role of student and scholar as builder and maker, as well as critic. Thus, "writing the machine" includes learning how to assemble it from the ground up, and understanding its physical components, how they connect, and how they function. In this chapter, I'll look at the role of physical computing (that is, the practice of creating electronic objects and circuits using microprocessors, servos, and other small pieces of electronics) as a potential component in "digital literacy" practices, and suggest that studying physical computing can offer us insights into the way communication is moving from the screen to a much more complex world of 3D electronic objects. These objects, I'll suggest, expose the innards of writing as a practice that is embedded much more deeply in layers of encoding and staging than we might initially think, and offer a fertile space for the creation of an electronic literature of Things.

Rhetoricians are by their training fond of an apposite piece of classical terminology, so let's find something to suit. If one can speak of "discursive" or "rhetorical engineering" when discussing the composition of technical writing, the appropriate term for the compositional processes involved in physical computing might be "skenic engineering." The *skene* in classical Greek theater was the building behind the main stage area (the proscenium) where props and materials (and actors) were kept in waiting for use in productions; sometimes for dramatic purposes action happened "off-stage" in the skene area. Such a model rings intuitively true with writing, in which we draw upon historical references, metaphors, and argumentative turns. But because of its origins in the physical spaces of the theater, the term *skene* also calls to mind the "stage-setting" intent of physical computing, and the productive potential of a space from which electronic items and objects might be drawn or manipulated in fruitful ways and multiple combinations.

To show you the potential range of skenic engineering, let's look at examples of a couple of historical "writing machines," which employ physical technologies in very different ways.

Machine #1: The Futurama

In 1939, visitors to the New York World's Fair were introduced to the Futurama diorama exhibit: a "ride into the future" built by industrial designer Norman Bel Geddes for General Motors. Geddes' model of 1960s America, at over 35,000 square feet and housed in the Fair's GM Pavilion, was a showcase for futuristic design with its streamlined, unornamented walls and sweeping highway-like entrance. The "Futurama ride" was the highlight of the Fair, attracting up to 28,000 people a day over the two-year duration of the exhibit.

The Futurama exhibit employed the genre of the ride, which was popular in other amusement parks at the fair: visitors were seated in a "carry-go-round" consisting of 552 plush blue mohair chairs that moved slowly around the sides of the diorama as simulated night fell and the sun rose again. The carry-go-round or "mobilounge" was "… a combination conveyor-elevator-escalator," designed by Westinghouse Elevator Company, with a piped-in soundtrack generated by the Polyrhetor, an audio soundtrack delivery device created by Electrical Research Products, Inc. The winged easy chairs, upholstered in blue mohair fabric, were six-feet high "to suggest a private, traveling opera box" (Geddes, "For Release"). The chairs' "wings" were designed to limit the spectator's view to the front. According to Bel Geddes' description,

> The spectator is seated in a comfortable chair on the conveyor platform and is moved through semi-darkness while a quiet authoritative voice at his shoulder explains what he is about to see …. It will be viewed through a continuous window directly before him and the voice at his shoulder will personally bring to his attention and describe to him the various features and points of interest which he is to see.
>
> ("Description")

The "quiet authoritative voice" Bel Geddes referred to consisted of a recorded voice issuing from a sound-box in each pair of chairs. The soundtrack, which was triggered as each set of chairs rolled over predetermined points in the ride, was controlled and coordinated by a centralized machine called "the Polyrhetor." This machine, also known as the "spectator sound system," and "Twenty-Tons-of-Voice," delivered guided narration (voiced by Edgar Barrier of Orson Welles' Mercury Theater) to the 552 armchairs carrying visitors through the ride.

The Polyrhetor contained 150 individual amplifiers, each playing a part of the guided tour through the exhibit. Because magnetic tape was in the early stages of development, the machine relied on motion picture film as a medium on which to record the audio guide. A contemporary image caption reads: "This huge automaton, machined to a precision rivaling the world's

great telescopes, serves as a corps of 150 'private guides' to visitors. […] 150 equally spaced photoelectric cell devices scan a motion picture film at the same time throughout its length [to give] visitors a perfectly synchronized description of the treats awaiting the motorist of the future" (GM Heritage Center).

When I first started writing about the Futurama ride many years ago I was primarily interested in it only for the message it was conveying: that the highways of the future were coming, that they would unite the pastoral natural world with technological convenience and speed, and that the landscape would be rationalized into a productive, pleasant, driving experience (Burgess and Hamming 2015). And certainly, the ride achieved this successfully: the designer Norman Bel Geddes would be a key voice in postwar thinking about American superhighways. But over time it became clear that what was most interesting about the ride was not the diorama, with its "half-million buildings and houses – thousands of miles of multi-lane highways – [and] more than a million trees" (*Highways and Horizons*). But what kept me coming back was the giant Polyrhetor machine, with its film canisters (without vision) and its radio star voice (without radio). I started thinking about the Polyrhetor as a kind of throwback to oral culture in the midst of literate culture.

Of all the components of the Futurama ride, the Polyrhetor device is particularly interesting because of the way it speaks to us. It straddles the communications divide between orality and literacy: where orality is characterized by Ong, McLuhan, and others as an aural, enveloping exchange featuring spoken word and shared experience, while literacy consists of the organization of information in the visual register, encouraging distance and discipline of the eye. On the one hand, the Futurama ride was a shared, "oral" experience. Edgar Barrier's recorded voice spoke to each person, customized to their position above the diorama, while the intimacy of the ride was magnified by soft chairs and dim lighting. People emerged from the ride bearing a pin ("I have seen the future") proclaiming their participation in a shared experience. The Polyrhetor's voice, chosen by designers for its smooth, authoritative, but comforting tone, provided guidance via the trusted medium of a radio professional's familiar-sounding narration.

On the other hand, though, the couches with their wing-backed dividers separated travelers from each other, and the distance from the diorama separated each viewer from the landscape. Rather than walking through an exhibition hallway, the visitors were placed above the diorama. There were no customized movements: once you were on the ride, there was no getting off. The voice was prerecorded and did not talk back. Indeed, the picture the diorama presented of the future was of a rationalized network across the landscape, the individual vehicles encouraging an atomistic vision of transportation.

Thus, even while the Polyrhetor provided the comfort and individual attention of the oral tradition, it disciplined its visitors into accepting what John Brinckerhoff Jackson would later call the "new odology", saying

> We do not always give credit to how the motorized American – commuter, tourist, truck driver – has accepted the new odology, how docile we have been in complying with the scientific definition of the highway as a managed, authoritarian system of steady, uninterrupted flow for economic benefits.
>
> (192)

In short, the Futurama ride was a persuasive space, with the ride itself mirroring the physical pathways of the highways being traced onto the landscape, while the Polyrhetor provided the narrative scaffolding.

Machine #2: The Universal Turing Machine

Let's step back out for a moment, and look at a skenic machine from another perspective. At the same time as the Polyrhetor and the Futurama were being conceived and staged with the help of industrial designers and engineers for the purpose of selling cars, the British mathematician Alan Turing was publishing *On Computable Numbers* (1936), in which he posited a thought experiment we know popularly as "the Turing machine."

The Turing machine features a tape of infinite length and a probe head. The tape is fed through the machine. The probe head can read and write to the tape: ones and zeroes or some analog. The tape can move back and forth, being marked and remarked to carry out computations and data processing. An "action table" contained mathematical instructions for processing the tape. A key feature of a Turing machine was that it consisted of what he called "discrete states"—for example, the number of switches turned on and off. Given enough space, a complete description of every single state in the machine could be stored. The machine could thus be described completely using a limited symbolic set.

The most significant version of the Turing machine is the universal Turing machine (UTM), which can be *programmed to behave like other Turing machines* by feeding in instructions through the tape. This means that in order to get the UTM to do something different, you just need to feed it new instructions on the tape, rather than building another machine. This was a radical new idea, coming out of Turing's realization that you didn't need to know what the physical build of a machine was; all you needed to know was its informational state at any particular point. By 1950, after having the chance to work on the earliest computers, Turing was able to state with confidence that "digital computers … can mimic any discrete state machine" (441).

Reading and Writing Machines

You would think that there is a world between these two machines, the Futurama exhibit and the machine in Turing's brain. But they have one thing in common: they're both reading and writing machines. In fact, if we want to get a little fanciful, the Futurama ride starts to look eerily like a physical manifestation of a Turing machine: the Polyrhetor and chair triggering mechanism is the probe head. The people are fed in like a ribbon. This gives us a picture of a kind of human Turing tape passing through a massive capitalist programming machine. The Polyrhetor and the Futurama ride between them created a specific context for "programming" humans: in addition to literally "reading" the script from film canisters, the Polyrhetor provides a "reading" of the landscape and "writes" on the visitors by impressing the story on them. The Futurama exhibit is, thus, both a computer and a kind of giant book to be read, built on the skenic technologies of the Polyrhetor's sensors and film voice recordings.

The idea of these kinds of large-scale technologies as reading and writing machines enables us to think about the relationship between technology and written artifacts—for example, books—with some fruitful results. First, is a book more like a UTM—infinitely programmable, regardless of form—or more like a Polyrhetor—preprogrammed specific to its circumstances? Let's map it out:

- The purpose of a Turing machine was that there only needed to be one machine, which could simulate all other machines through programming. Nothing was single-purpose any more.
- A book could be thought of as a Turing machine in the sense that the machine is programmable—the technology of the book remains stable while the programming changes.
- Nominally, the Polyrhetor is the same; its "voice" is recorded and stored.
- But at the same time, the Polyrhetor is a single-use system reliant on other parts of the Futurama—for example, the sensor system that triggered parts of the audio track as chairs passed through the ride. The Polyrhetor was created in order to provide context for one specific text: the diorama. It wasn't portable, and used technologies that were quickly outdated (in particular, film as an audio device).

The Polyrhetor and the Turing machine thus offer us two boundary scenarios for what it means to read and write. On one end of the spectrum, the Futurama ride employs tools drawn from the theater, film, and engineering. It is a profoundly physical experience that makes very little use of textual elements beyond the occasional sign. On the other end, Turing's discrete

state machines are reliant exclusively on encoding and decoding: the primary function of text. Both are thus simulation machines, but in different ways. The Turing machine simulates the literate environment, encoding and recoding. The Polyrhetor simulates the place-and-time-bound environment, guiding, persuading, enveloping. Between these two machines lies a fruitful space for creative play: between material and virtual, presence and absence, speaking and writing.

An (e-)Literature of Things

Once we start thinking about reading and writing environments as potential sites for designing, staging, and engineering digital texts, many new modalities open up for electronic literature. Physical computing, with its easy access to hobbyist-level electronic components, offers us some interesting alternative directions in the creation of digital texts that respond to light, sound, movement, or the press of a button. And skenic engineering—the "staging" of code and material objects to create specific effects—can help us to create interesting literary artifacts that emphasize, like artists' books, exploration and idiosyncracy, rather than rationalism and regularity.

To create a skenic literary object, let us consider the process of electronic staging. Much work being done in physical computing right now is concerned with the non-"writing" parts of the Polyrhetor experience. As Carla Diana notes, "we're entering a time when sound, light and movement are equally important parts of the creative palette. Everyday objects whose expressive elements have long been static will now glow, sing, vibrate and change position at the drop of a hat" ("Talking, Walking Objects"). We're surrounded by such objects: our Google Nests regulate our HVAC systems. Our cars are stuffed to bursting with sensors. Our refrigerators are internet-connected. Our home networks are doling out local IP addresses to our televisions, set-top boxes. The Amazon one-click button is a physical button you can use to re-order laundry detergent. The Internet of Things is in our homes, eating our electricity.

In the midst of this cacophony of movable screens, motion-detectable bodies and electronic signals, the idea of using an IoT network to produce *actual text*—physical, printed pieces of paper with static marks on them—seems quaint. And yet I'm fascinated by the process of using IoT-era technologies (manufactured hardware object, microprocessors, communication networks, commercial and open-source APIs) to produce such old-fashioned literary artifacts. As we've already established, the Polyrhetor was a kind of reading/writing machine in the sense that like a Turing machine, the Polyrhetor "writes" its narrative onto us. Thus, my plan was to stage a skenic machine that would produce writing: an electronic

literary device embedded in the Internet of Things. But unlike the Turing machine, which is purely concerned with symbols, the Futurama ride and the Polyrhetor drew upon the strengths of the oral and physical environment: the coming together of people into the same space. We still value the face-to-face experience, the closeness of flesh, the shared temporary habitat. And so, my skenic object would need to embrace both the near and the far: electronic, distant writing and physical, face-to-face writing.

The inspiration to create such an object began for me when I saw a tiny thermal printer show up in an online store for electronics. It was a small, somewhat clunky version of the many different types of thermal receipt printers that are used ubiquitously to document the moment we swipe our credit cards or pass over paper notes in exchange for food, services, and objects. It wasn't internet-connected, but various tutorial links promised me that I could hook it up to an Arduino or Raspberry Pi, and use those components to connect to the internet. Most importantly, though, the continuous paper scrolling out of the printer feed reminded me of the Turing machine tape and the human "tape" passing through the Futurama ride.

Receipt printers themselves are interesting little producers of everyday text. A receipt is what David Levy so evocatively calls "a witness" (7)—it is an object that is generated on the spot as proof of a transaction in a place and time. It stands in for a person, testifying to an interaction. In my first attempt to create a little skenic object, which I called "MashBOT," I wanted to mess with the perception that a piece of writing can either be local (produced as a kind of one-time event, like the Polyrhetor) or global (produced in a broadcast environment built for replication and repetition, like the encodings and decodings of the Turing machine), oral or literate—but not both. Thus, MashBOT was created as a writing machine that did two things: produce a piece of writing posted to that great global writing space, Twitter, while simultaneously crafting an unique, local physical copy, printed out on a little thermal printer paired with an Arduino microcontroller.

MashBOT writes love notes, generated using Markov chains and a very simple corpus of quotes from Bruno Latour's *Aramis* and Roland Barthes' *A Lover's Discourse: Fragments*. Interacting with the project can be done in two ways: by going to the Twitter handle @mashomatic and reading the generated tweets from anywhere, or entering the physical space where MashBOT is exhibited, waiting for the "ready" light to turn green, and pressing a tiny button, which prints a copy of the latest tweet queued up on the printer. In the process, the human "reader" crosses repeatedly between the generality of computing and the physical particularity of that embedded moment in which the button is pressed. The tweet is the same, but it can be torn or cut from the stream of "receipts" slowly being produced by the printer, placed in the pocket, and taken away like a little talisman of the written word. The technology is simultaneously broadcast and narrowcast: the love notes are broadcast by Twitter, but the note that appears on the

printer is narrowcast for the person in front of it. The snippet of Markov-generated literature twins, duplicates: the same note appears online (in many places at once) and on paper (in one place).

None of this would be possible without staging principles that make use of connectivity and another nice old rhetorical borrowing, *dispositio* (arrangement). Taking as his model a typical Parisian day, Latour suggests that a comprehensive sociology must account for not merely separate people and things, but the ways they are wired together through multiple control and observation technologies: traffic lights, cameras, and so forth: "sensors, counters, radio signals, computers, listings, formulae, scales, circuit-breakers, servo-mechanisms need to be added in; it is these that permit the link to be made between one place and another, distant, one … You can't make a social structure without this compilation work" (240). The *skene* of MashBOT is bound up in this "compilation work"—the hooking together of multiple technologies, from Twitter, to backend server scripting, to Arduino coding and assembly, all the way to the moment the user presses the button to print the text. Python scripts hook together the Twitter API with text-generating scripts; my fingers assemble the delicate components into a configuration on the breadboard that will allow a flow of bits and electrons to become an inscription on thermal paper.

Of course, all literature is the result of a transaction or collaboration between multiple actors and actants—with the book acting as a physical index of the wide network of "publishing" as a means of conveying meaning. Historically, it seems that literature relies on, or leverages, this transparency to make claims about the universality of "the literary." With few exceptions (such as the artist's book), we are meant to look through books, not at them. Twitter does likewise, by making the act of tweeting and reading tweets as seamless as possible. We look straight through the browser window as though it does not exist. An e-literature of Things upends this process by introducing physical technologies into the equation, so that they are less "transparent" than the disappearing book or browser window. These objects exist to remind us that "literariness" is not universal, or virtual, but the result of a mess of interactions with materiality: the body, the object, the manufacturing process that produced that object, the specific physical circumstances in which one interacts with the object.

Finally, Latour suggests the deep wrong-headedness of a sociological model that "imagined that at root we were monkeys to which had been added by a simple prosthesis, buildings, computers, formulae or steam engines. … objects are not means, but rather mediators-just as all other actants are. They do not transmit our force faithfully, any more then we are faithful messengers of theirs" (240). MashBOT is an example of this unfaithfulness. At the time of this writing, he's been tweeting for about eighteen months, and he occasionally gets a retweet. But not all are from humans—indeed, some are from other Twitterbots, triggering on a word that MashBOT

has generated and using it to produce their own response. This is the true moment of conception for my version of the giant Polyrhetor—my desktop machine of "many voices"—as an example of the (e-)literature of Things.

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