A Piece of the Pie Chart: Feminist Robotics

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ABSTRACT

This paper analyzes the robotic gallery installation *A Piece of the Pie Chart*. The project addresses gender inequity in the tech world. It consists of a computer workstation and a food robot. The food robot puts pie charts onto edible, pre-baked pies. They depict the gender gap in technical environments. Visitors use the robot to create pies. Pictures of the pies are disseminated via Twitter, and the physical pies are mailed to the places where the data originated. In the following text, the author disassembles the machine in the context of feminist theory, feminist technology research, visualization, and political robotics.

How the Project Works

In the exhibition, the machine as well as a computer with keyboard and mouse are displayed on a pedestal with vacuum cleaners suspended from the ceiling (Figure 1, Figure 2). Hoses from the vacuum cleaners reach down to the surface of the pedestal, where they are attached to robot arms. Exhibition visitors interact with the machine mainly through the computer interface (Figure 3). They start by browsing and eventually selecting a pie. The pies depict statistics such as gender ratios in the graduating classes of Swiss tech universities, in IT teams within public administration, and among the management of the largest public IT companies in Switzerland. Once visitors have decided on a pie depicting a gender ratio, the screen shows them how to place a pre-baked pie into the machine. Some of these pies are stacked next to the machine, ready to be used. When the machine has verified that the pie has been correctly placed, a linear actuator pushes the pie onto a conveyor belt, where a heat gun heats up the chocolate covering of the pie until the chocolate is soft and sticky. The pie is then transported to one of the robotic arms. The robotic arm guides a hose to the paper pie chart that the visitor has previously chosen.

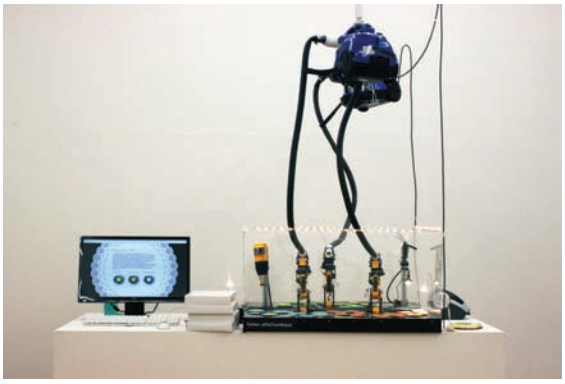

Figure 1. The installation *A Piece of the Pie Chart* in a lighted setting. Dimensions: 200cm x 83 cm x 300cm. © 2013 Annina Rüst.

Once the robot arm has reached the diagram selected by the user, it places the hose over the pie chart. When the hose is placed over the diagram, the vacuum cleaner is automatically switched on. While the vacuum cleaner is on, the diagram sticks to the hose. The arm that holds the hose then places the pie chart onto the warm chocolate surface of the pie. Once this has happened, the vacuum cleaner is switched off and it releases the pie chart. The conveyor transports the thus decorated pie under a webcam where it is photographed and the picture posted on Twitter (Figure 4). After that, the pie can be removed from the machine by the visitor. The visitor then packages and mails the pie to the place where the data originated.

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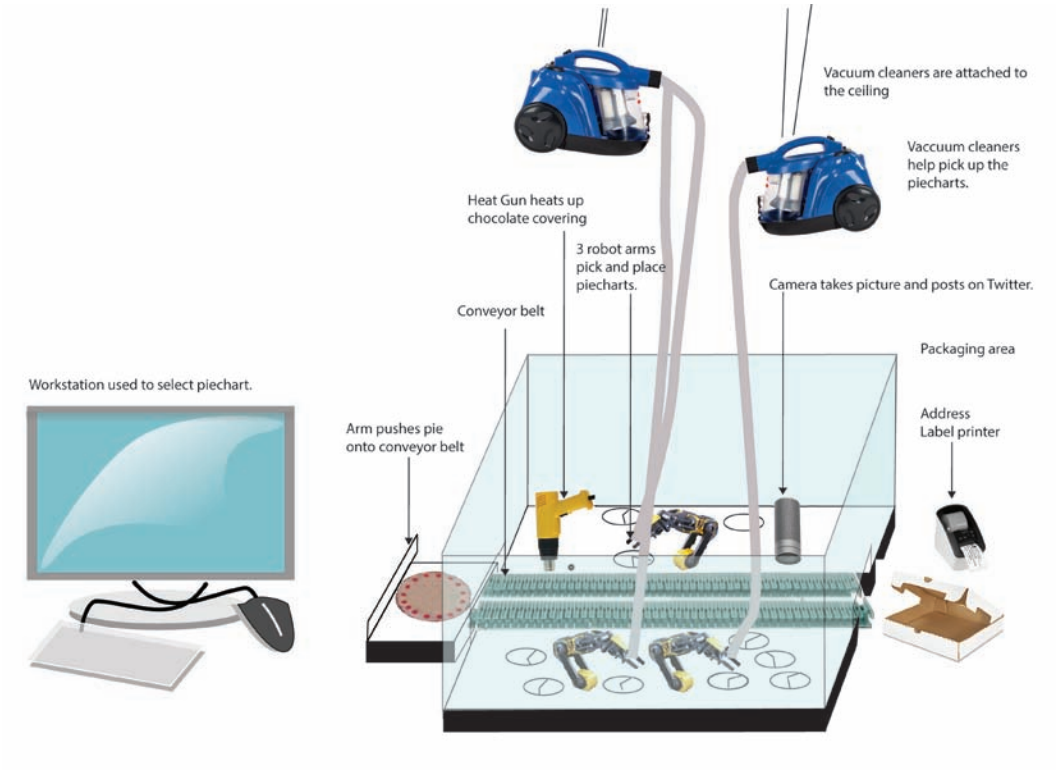

Figure 2. A diagram of the project. © 2013 Annina Rüst.

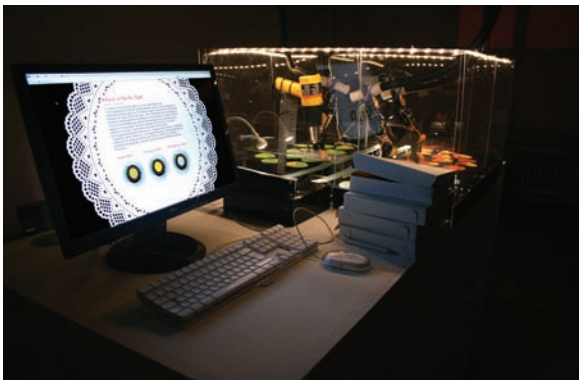

Figure 3. The project as it was presented at Stadtgalerie Bern in Switzerland (in a darkened room). Dimensions: 200cm x 83 cm x 300cm. © 2013 Annina Rüst.

Feminist Technology

The following is a statement on feminist technology, providing a theoretical framework for the project. As a feminist technologist, I am working towards making gender equity a reality. I am motivated by the conviction that humans as well as technology are shapeable and can thus be changed. However, this is not commonly accepted, especially when it comes to the question of what causes the gender gap in tech workplaces. Feminist theorist Donna Haraway writes in *Simians, Cyborgs, and Women: The Reinvention of Nature*: "A constant dimension of primate studies has been the naturalization of human history; that is, making human nature the *raw material* rather than the *product* of history" [1]. The tendency that Haraway found in evolutionary biology, to see human nature as something that shapes history and not the other way around, is also pervasive in psychology research into the lack of women in tech occupations. Some psychologists explain the gender gap in technical spaces by saying that women are not interested in pursuing technical careers for various reasons relating to statistical personality differences between the sexes [2, 3]. This stands in contrast to studies from other social science disciplines that say that women are kept back by adverse cultures within tech spaces [4, 5]. The latter set of researchers sees the culture rather than statistical differences between the sexes as the factor that shapes women's disinterest in tech. From my own experience, and as somebody who wants to make tech more inclusive, I find the cultural explanation more convincing, productive, and instructive. I do not view statistical gender differences as separate from the culture where they were created. The gender gap in

Figure 4. A screen shot of the project's Twitter feed. © 2013 Annina Rüst.

technology is therefore an expression of a culture, and this culture can be changed.

Even before personal computers became widely available, feminist technology scholar Cynthia Cockburn asserted: "Technology is a medium of power" [6]. In her 1988 book *Machinery of Dominance*, Cockburn traced the division of labor and the gendering of technology creation from the Stone Age [7] to emerging technologies of the 1980s. She found that a historically established division of labor along gender lines is not "natural" but arbitrary. One example that shows the arbitrariness of gender-divided labor is the period after World War II, when women, who were skilled workers in the technology industry throughout the war, were expected to either retire to domesticity or accept less skilled work. Cockburn writes: "Women found themselves addressed by an intense ideology of 'femininity' and 'domesticity'" [8]. Cockburn studied high-tech workplaces in clothing manufacture, medical imaging, and mail order. She concludes that women had merely operator and executor roles, while the creator jobs were largely reserved for men [9]. Not much has changed since the 1980s: many of Cockburn's findings are echoed in *The Athena Factor*, an extensive study conducted by the *Harvard Business Review* 20 years later in various STEM (science, technology, engineering, math) workplaces. Like Cockburn, the authors of *The Athena Factor* found that women did not get equal access to creator roles [10] and that many found the path to promotion difficult to navigate [11].

The gender gap in tech workplaces has a direct influence on what products are being made. Researchers at the Michelle R. Clayman Institute for Gender Research at Stanford University have found that venture capitalists feel more comfortable funding tech startups founded by men over those founded by women: "Gender of the entrepreneur influences evaluations most when the person, rather than the venture, is the target of evaluation" [12]. Entrepreneurs with technical degrees were rated similarly regardless of gender, while male entrepreneurs without technical degree had an advantage over female entrepreneurs of the same category. This bias towards ventures proposed by men does not make sense in terms of innovation. A study conducted by the National Center for Women and Information Technology (NCWIT) found that IT patents by teams of male and female inventors have higher citation rates than IT patents by all-male teams of inventors [13]. Diversity is important to innovation, yet women are still kept back by prejudices against their ability to create and innovate.

The above research in feminist science and technology studies provides a theoretical frame for my practical work. Technology and the social sphere are not separate entities but interconnected processes as the above examples show. They also show that the gender gap in the tech world is something that can and should be changed, because women and other minorities are needed to accelerate the next tech revolution with their contributions. In the following paragraphs, I will explain how I translate theory into practice.

Translating Data into Object and Action

There are various data sets on gender in technology. For the version of the project that was exhibited in Switzerland, I used part of a data set on computer science graduation rates at public universities made available through the interactive database of the Swiss Statistics Office (Bundesamt für Statistik) [14]. I also manually gathered data from the websites of the largest public IT companies as well as from IT departments within the public sector. Just by looking at the data, I could learn that women were generally underrepresented in tech at all stages of their career. One university, the University of Neuchatel, had graduated no female computer scientists in 2012. Other universities like the University of Basel and the University of Bern had just one female Computer Science graduate in 2012. In public administration, I found that the number of women in IT departments varies but is far from gender parity. I also looked at the management of public tech companies and found that it was similarly male-dominated as the management of comparable public companies in Switzerland.

Looking at quantitative data is interesting. However I find that just translating this data into a graph, chart, or other 2D imagery is not enough. In *A Piece of the Pie Chart*, I combine visualization of gender data in the tech workplace with action. Mapping gender data onto edible pies adds material representation to gender statistics. The pies are a multisensory symbol explaining how women fare in the tech industry. They show that women receive a small share of what technology work has to offer. This data mapping style adds urgency to the technofeminist cause: it is not a data visualization to be passively consumed. What comes out of the machine is an object along with instructions to mail it to the place where the data originated. It asks people to take action and gives them directions for mailing or tweeting the pies.

A study has found that gender is a contentious topic in the tech world [15]. I therefore chose a "sweet," humorous, seemingly non-threatening form of protest using pies. The University of Fribourg, which received a pie through Twitter during the exhibition in Switzerland, disseminated the image of "their" pie [16] to their followers even though the gender ratio in their 2012 class of computer science graduates is not impressive.

To those receiving the pie tweets, like the University of Fribourg, it might not be obvious that the pies are decorated by a robot. But the robotic part is important. The robot performs for the audience in the exhibition. Performative feminist activist art using data visualization is not without precedent: starting in 1985, the Guerilla Girls protested the lack of female representation in the art world. As part of their project, the group visualized gender statistics in a humorous, performative way, wearing gorilla masks against personal repercussions [17]. In my project, I borrow their playful style of data presentation. However, as a female artist-technologist, I chose robotics as the performative element representing me and, by extension, other women within the context of tech work.

Repurposing (Gendered) Pre-Fab Kits to Create Feminist Technology for Adults

To build the installation, I repurposed robotics kits from VEX [18] and OWI [19] Robotics, as well as household appliances such as vacuum cleaners and a heat gun. The VEX and OWI Robotics kits are designed for people who want to re-create robotics clichés such as a tank-like all-terrain vehicle, an android, or an autonomous vehicle. I repurposed a tank construction kit to create a conveyor belt. I modified OWI robotic arms to work in conjunction with vacuum cleaners to create a mechanism that moves the paper diagrams onto the pies. Household appliances such as vacuum cleaners are similar to the VEX and OWI robotics kits in that they envision a clearly defined set of use-cases. My machine is a mashup of technologies and household items, a mix of traditionally masculine robotics with traditionally female household

technologies (baking, vacuuming). Theorists like Judy Wajcman have pointed out that technologies invented for the home are seen to have less significance in the scope of the history of technology [20]. My machine pays tribute to the invisible labor of female inventors of household appliances and the products of household labor (the pies) by pairing them with robotic hardware. By eliminating unnecessary boundaries between different types of technologies, new forms of robots can be created.

This is a subject area that is typically investigated in the context of education. An example is the research of the Lifelong Kindergarten Group at the MIT Media Lab. Their research into after-school activities dealing with robotics showed that these activities tend to attract more boys than girls [21]. The robotics activities during after-school activities were found to be oriented towards traditional robotics tasks, such as building a car, and encouraged building robots for competition rather than exhibition. As designers of creative technology, the researchers from the Lifelong Kindergarten Group proceeded to build successful kits [22] targeted at other forms of play, such as crafting and narrative play, to attract a broader range of children. Building on the efforts of the Lifelong Kindergarten Group, consumers today can buy several very well-designed technology kits for kids that do not reproduce technology clichés [23, 24]. There has been a change in the culture of learning technology for children (and others who enjoy playing with electronics). However, a similar cultural change in the technology working world of grown-ups is needed as well. Judy Wajcman writes in *Feminism Confronts Technology*:

> Official plans to rectify the under-representation of women in engineering often proceed as though the problem were simply a lack of self-confidence in women. But male dominance of technology has in large part been secured by the active exclusion of women from areas of technological work [25].

More recently, researchers have found that, as female technologists progress beyond the classroom and into the work world, they tend to like the experience less and less [26]. In fact, a large percentage of women in tech tend to drop out mid-career [27]. These women initially had a keen interest in technology, but later encountered a hostile macho culture in the workplace that had the effect of keeping them from seeing a clear career path, leaving them "stuck" and "stalled" in their career [28].

Just like the Lifelong Kindergarten Group, I would like to expand culturally established ideas of what technology is supposed to be and who the creators of such technology should be. Rather than constructing a kit for kids, I have constructed a machine dealing with objects and data for adults to interact with. The social transformation that is underway on the educational level has to happen on the adult level as well, so that the children who grow up playing with well-designed technology-learning toys will not be expected to assimilate into a tech culture that may not be inclusive of their diversity. As Cynthia Cockburn writes in *Machinery of Dominance*, "It is not legitimate to simply urge women forward without considering what waits for them on the other side of the door of equal opportunity" [29].

Political Robotic Art

The preceding sections of this paper have focused on the project in the context of technofeminist thought as well as gender and technology. In this section, I consider the project in the context of political robotic art.

At various points in history, humans have created machines with a political message. One historical political automaton is *Tipu's Tiger* [30], an 18th-century life-sized machine made for

Tipu, Sultan of the Kingdom of Mysore, India. It depicts a tiger in the process of devouring a European man in uniform. The automaton has a hand crank that sets a wind organ in motion. The wind organ imitates the cries of the soldier and the growling of the tiger, while the soldier's arm moves back and forth in agony. Ironically, the object is now housed in the Victoria and Albert Museum in London.

More recently, the Institute of Applied Autonomy created various, obviously political, robots in an effort that they call "Contestational Robotics" [31]. The robots they created are *GraffitiWriter* and *Pamphleteer*. Both robots are designed for activist information dissemination. *Pamphleteer* distributes pamphlets while *Graffitiwriter* surreptitiously writes messages on streets. These technologies speak about the perils that human activists face in their work. A similar political robotics project is Natalie Jeremijenko's *Feral Robotic Dogs* [32]. She modified robotic toy dogs and outfitted them to detect environmental hazards. Another example is Chris Csikszentmihalyi's *Afghan Explorer* [33], a robotic reporter that reports back from war zones where reporting by humans is not possible.

What these robots have in common with *A Piece of the Pie Chart* is that they make politics and political action poetic. The main goal is not to respond to a technical challenge or accomplish a repetitive task in order to replace human drudgery. Rather, they address political issues using robotics as a medium and extend the capabilities of a machine beyond pragmatic use-cases.

Conclusion

I have made a case for understanding technology as a mirror of the values of the society that produces it, and for understanding society as a mirror of the technology it uses. Similarly, I see *A Piece of the Pie Chart* as a mirror of myself, the female tech producer. The machine is a miniature version of an automatized assembly line, a symbol of the industrial revolution, a period in time where tremendous social and technical transformation happened. In my factory-style setup, I produce not just pies but an audience that will take action towards making technology a more diverse discipline in order to transform tech culture.

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