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Cultural Robotics: on the Intersections of Identity and Autonomy in People and Machines

Robótica cultural: sobre las imbricaciones entre la identidad y la autonomía en personas y máquinas

Audrey Bennett & Ron Eglash
Rensselaer Polytechnic Institute
bennett@rpi.edu - eglash@rpi.edu

Abstract

In this paper, we introduce the phrase "cultural robotics" to refer to the interdisciplinary analysis of autonomous machines and their mutual construction with society: as culture constructs robots, they are (re)constructing us. The objects we study range from industrial manufacturing devices to socially-intelligent robots (SIRs), and our disciplinary frameworks include humanities-oriented approaches –cultural anthropology and graphic design in particular—as well as cybernetics and computational sciences. We will examine the cultural significance of two SIRs portrayed in pop culture, analyze the socio-technical history of autonomous devices such as the master-slave circuit, and explore the ways in which such observations might contribute to efforts such as participatory design (discussed here in terms of Bennett's "interactive aesthetics"). We conclude with a recent case study in which racial identity and robot design had direct intersections. Like Haraway and Latour, we aim to prevent either technocentric or human-centric perspectives from dominating the analysis. It is our hope that more democratic and sustainable ways of designing and using robots can emerge from this view of hybridity and co-evolution between social and technical worlds.

Keywords

History of autonomous devices, interactive aesthetics, socially-intelligent robots.

Resumen

En este artículo utilizamos el término “robótica cultural” para aludir al análisis interdisciplinar de máquinas autónomas y el modo que se construyen conjuntamente con la sociedad, en el sentido que la cultura construye robots y estos nos reconstruyen. Las temáticas que abordamos van desde la fabricación industrial de artefactos a los robots socialmente inteligentes o interactivos. Nuestro marco teórico se circunscribe a la antropología cultural y principalmente al diseño gráfico además de la cibernética y las ciencias computacionales. El texto incluye un análisis del significado cultural de dos robots socialmente interactivos o autónomos (socially-intelligent robots – SIR) con un cierto acervo en la cultura popular. Asimismo analizamos la historia tecno-social de dispositivos autónomos como el circuito biestable “maestro-esclavo”, y exploramos el modo en que este tipo de apreciaciones puede contribuir en el desarrollo de diseños participativos (a los que aludiremos a partir del concepto “estética interactiva” acuñado por Bennett). Concluimos con un estudio de caso reciente que muestra imbricaciones evidentes entre la identidad racial y el diseño de robots. Al igual que Haraway y Latour, sugerimos alejarnos de determinismos tecnocéntricos o humanistas, con el deseo de contribuir a fomentar la aparición de diseños y usos de robots más sostenibles y democráticos desde este tipo de perspectivas hibridas y de co-evolución entre lo social y lo técnico.

Palabras Clave

Estética interactiva, historia de dispositivos autónomos, robots socialmente interactivos.

Summary

Socially Responsible Robots in Pop Culture

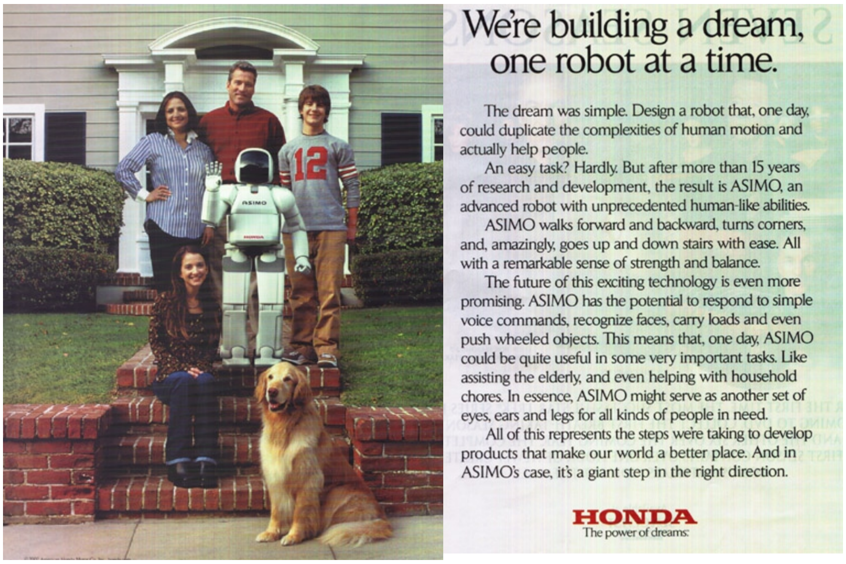

Figure 1 Discover magazine April 2002, inside cover ad reads: "We're building a dream, one robot at a time. The dream was simple. Design a robot that, one day, could duplicate the complexities of human motion and actually help people…after more than 15 years of research and development, the result is ASIMO, an advanced robot with unprecedented human-like abilities. The future of this exciting technology is even more promising. ASIMO has the potential to respond to simple voice commands, recognize faces, carry loads and even push wheeled objects. This means that, one day, ASIMO could be quite useful in some very important tasks. Like assisting the elderly, and even helping with household chores. All of this represents the steps we're taking to develop products that make our world a better place."

Asimo

According to the company's literature, Honda designed Asimo to help people. (Honda n.d.) This autonomous robot looks like an astronaut and flaunts unprecedented human-like features including the ability to sit down and bend its elbows and knees. Standing 4 feet tall, it can assist a person to sit down in a chair or up in bed. Asimo's (arguably) unrivaled flexibility allows it to move in twenty-six different directions. Its mechanical fingers can turn off light switches, grasp and carry objects, and even shake hands. On the other hand, some critics maintain that Asimo is actually holding back robotics research, not moving it forward, and that it was really designed more for publicity purposes.(Sofge 2008) At the 2006 RoboBusiness conference iRobot CEO Colin Angle suggested that the obsession overwalking robots had stunted the growth of a consumer robotics industry: he pointed out that while his company's robotic vacuum cleaner (*Roomba*) had sold over 2 million units,rugged terrain robots had been used to locate survivors buried under rubble, and medical robotics had now assisted with brain surgery, Asimo's publicity stunts—conducting an orchestra or greeting visiting dignitaries— seemed to be getting all the press coverage , despite the fact that none of its highly publicized feats were performing useful labor. From his view legged mobility provided an unstable basis for the domestic chores that Honda's press release highlighted. A recent video showed it falling down stairs and lying on the ground as it continued its prepared speech; yet the Honda literature predicted that it could be used for helping the elderly and other tasks that would clearly require absolutely certain balance for shifting loads. From the view of critics such as Angle, Asimo merely diverted research dollars from the kinds of technology (eg tank-style treads that alter shape for stairs and obstacles) which would represent practical progress.

Whether the critics are right or not, the contradictions that arise in discussions about Asimo help alert us to the critical role that culture plays in robotics: many defend his legged mobility on the basis of the need for social acceptance. Critics counter that defense with the claim that culture will easily adjust to wheeled beings (as it has, for example, in architectural accommodations and public attitudes about wheel chairs since the 1970s). No doubt there will be changes for both humans and machines, but we know that different futures are possible depending on how this co-evolution of people and machines is implemented.

For example, it is easy to extrapolate and imagine how a domestic robot (whether wheeled or legged) might be able to help an elderly person, fetch the newspaper, pick up and put away toys. Imagine however Asimo (in Figure 1) standing next to a single mother and her two children in front of a low-income apartment complex. Now, imagine what robotic needs for that low-income household (perhaps a single parent, or a senior without support) might be in contrast to the upper middle class family photographed in Figure 1.

Leaving aside for the moment the economic question of affordability (for automobiles and television sets were also unheard of in low-income homes at one time), how would the social issues facing these low-income households intersect with the kinds of design decisions that drive the appearance and functionality that Asimo and similar robots aspire to? For instance, could Asimo's fingers turn the delicate pages of a book, read with emotional expression, and perform the other tasks needed as a tutor for a child with a learning disability? Could Asimo bend and pick up broken glass and hazardous waste that plague inner-city playgrounds? Could Asimo provide supervision for latch key children, prepare meals for the homeless or elderly, or do the laundry for a single mother?These imagined tasks are in themselves fraught categories influenced by stereotypes and other political baggage: we would not encourage robotics designers to assume that they are problems in search of a technological solution without social research. There is also the danger that even if they were addressing needed solutions, we create a scenario in which the wealthy get human tutors, nursing aids etc. while the poor get machines (consider how quickly we have adjusted to the idea that our bank changes us an additional fee for transactions with a human teller). Or would humanoid robots become a luxury version, with lower-cost, more utilitarian models the only affordable option for lower-income families? One way to read the Asimo project's prioritization of legged mobility is a universal human fascination for human-like things. But the preference over lower-cost utility could also be viewed as resulting from the race and class priorities of the dominant groups.

Of course that is only if we assume such utility would have beneficial outcomes, which is by no means guaranteed. African Americans, for example, have been over-represented in the military for decades: would the impact of autonomous robots in war mean that these soldiers are less likely to come home in a coffin? Perhaps the use of robots to reduce US military fatalities would also mean greater numbers of deaths in among third world opponents and civilian casualties, as we are currently seeing as a result of drone attacks. The case of drones is particularly useful for thinking about the social consequences of robotics because they illustrate how ethical and legal responsibilities can be adopted, shifted, or evaded by even non-autonomous machines. On the one hand, civilian casualties may be viewed as more acceptable when done by drones because there is a "layer" of automation between the human and the resulting death. On the other hand, President Obama's recent decision to transfer control from the CIA to the military (Barnes 2013) for example would mean that drone strikes will fall under Title 10 of the U.S. Code, which in turn requires permission of the local government. As Latour (1992) notes, we "delegate agency" to machines with the assumption that our ethical relations move with them, but these surrogates are a displacement in which these relations can be further modified—for better or worse.

Given the fact that the loss of manufacturing jobs shifted many low-income and minority workers to the service industry, robotic service workers may also raise ethical issues in economic terms. In the past, new jobs have developed to which seem to compensate for positions lost to mechanization; perhaps even raising demands for skills and knowledge that have a long-term positive effect for underrepresented groups. Recently MIT economists Brynjolfsson and McAfee (2011) made a case for why the new generation of automated devices may not continue that trend, as advanced computational sciences are increasingly automating white collar jobs. Some scholars see one possible outcome as a move to redefine labor economics; for example by reducing the work week. A 1966 paper by African-American activist James Boggs, titled "The Negro in Cybernation" prophetically outlined this scenario and suggested that black experiences with under-employment could help inform such social transformations; implying new common grounds across racial divides.

These are some of the important questions that roboticists need to grapple with; and that cannot be done effectively unless it is in dialogue with people from different cultural and economic geographies, locally and globally.

As another example let's consider Kismet, the robotic head depicted in Figure 2, which has the ability to autonomously communicate the following emotions through non-verbal "facial" expressions: interest, calmness, anger, happiness, sadness, surprise, and disgust. In the process of designing how Kismet should look, roboticist Dr. Cynthia Breazeal queried laypeople—one of which told her to design Kismet to "look like the gerber baby."[1]

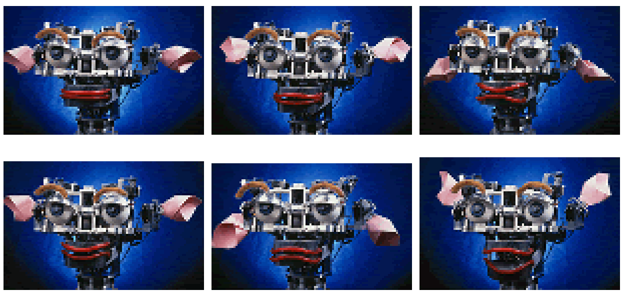

Figure 2: Kismet, an autonomous robotic bust

In this case, Dr. Breazeal did engage in a dialogue with the audience/users as we recommended above. However, her decision to move forward with the advice of what seems to be one member of the audience resulted in a design with the blue eyes that famouslymarks Caucasian ethnicity. Just as the white middle class family of Asimo's advertisement hints at the possibility of its design focus on their priorities, Kismet's blue eyes also suggest that robotic design is by no means neutral regarding ethnicity. The solution in this case is not difficult: should some future version of Kismet become a mass-produced robot, then another iteration of its visual interface design is in order. As Dr Breazeal herself notes, Kismet is "a

[1] Personal communication with Dr. Cynthia Breazeal.

social machine"; alternative features would aid its ability to resonate with a broader range of ethnic identities.Such alternative ethnic features are already present in a number of virtual robots or agents, and have been found to have positive benefit for underrepresented children's learning engagement.[2]

What will happen as the mass production of SIRs opens opportunities to address the needs of economically disadvantaged communities? Figure 3 depicts one of several photomontages by African artist Fatimah Tuggar that fuses images of western technological artifacts with images of rural Nigeria. Tuggar's art work is wonderfully ambiguous; it avoids the moral scolding of much "culture clash" discourse. Rather her work inspires reflection: why do artifacts like robots seem so incongruous in these settings of rural Nigeria? Do they make us squirm because we still maintain a colonial view of third world child-like innocence? Do they expose a power dynamic we would rather have remain invisible?It is in this reflective mode that we need to question our immediate reactions to the possibilities for contextual functionality for autonomous robots.

[2] See for example Parks, Simmons, Sapp and Gilbert 2003.

Figure 3 Still from "Fusion Cuisine" by multidisciplinary artist Fatimah Tuggar

The "DIY" or "Maker" movement has an increasing presence in developing nations, and perhaps the first viable nonwestern robots will emerge as a result of these grassroots hackers. Paola Santana, a former lawyer from the Dominican Republic, founded the startup *Matternet* in 2011 with the intention of using the open-source "quadcopter" drones—tiny hovering aircraft originally created by DIY amateurs—to deliver supplies for crises or even everyday use in developing nations that lack a transportation infrastructure. While there have been valid criticisms of the project (for example the components are not manufactured in the developing nations in which they would be used, and the fundamental physics of transporting mass by flight creates severe weight limits), the fact that it is innovation arising from developing nation citizens, with an effort to make the technology appropriate to the context, matters greatly.

Similarly, in order to successfully integrate robots into social contexts—whether third world or first world— roboticists will need collaboration with both the users and with other multidisciplinary experts so the cultural differences in many dimensions (ethnic, economic, religious, etc.) can be taken into account. Humans differences in languages, visual understanding, body conceptions, and myriad other modalities will influence the way they decode the meaning of a designed form, and that will in turn affect their experience with the designed form.

The first instinct of many engineers, as we have seen repeatedly in the case of artificial intelligence, is to ask "how would I think about this?" (Forsythe 1993) That is not problematic in itself, but there is typically very little reflection—they quickly universalize the "I" to "everyone." Roboticists cannot assume they have the knowledge background needed to design a social robot for a given context; indeed even those with the same cultural background as the users will benefit from having their designs informed by social research. If we do not integrate these cultural and economic perspectives into the design process of social robots, society might see very negative stereotypes of "otherness" and practices of class-based exclusion manifest themselves in the design and production of SIRs.

Solo

The film Solo debuted in 1996. Although the book it was based on, Robert Mason's Weapon, did not provide a racially defined robot, African American director Norberto Barba "appropriated" the script (in the sense of Eglash et al 2004), placing Mario Van Peebles in the title role as one of film's first black robot.[3] The film opens with Solo sans skin; when his designer asks him what exterior he wants, the nearly finished android points to the television set, which is showing Michael Jordan playing basketball, and says "like Mike!" This moment of choice pre-sages the film's central plot: although he was designed for use by the military, Solo learns about the value of human life through encounters with unarmed Latin American peasants, and eventually he refuses to carry out an order that would mean the death of many innocent civilians.

Figure 2 Mario Van Peebles as a robot in film "Solo."

The value of the film for our analysis is in its resonance between one of the central issues in robotics—the question of autonomy from human control—and one of the central issues in cultural politics: the autonomy of ethnic minorities from white control. At a personal level, we encounter the familiar question: if you had a choice, would you choose to be black? Solo answers this in the affirmative—one could say out of ignorance, but even so it

[3] The first black robot in film was probably from the 1968 independent film "Black Golem." Others include the Movellans, black robots from the 1979 Dr. Who episode "*Destiny of the Daleks,* and Urkelbot (1991) from the television series "Family Matters."

is refreshing to see this black self-birthing. Despite the B-movie context, there is a profound juxtaposition between the familiar science fiction theme of self-controlled machines and the all too real quest for social justice.

One could read this as the triumph of a humanities narrative over technological practice. But in keeping with our themes of hybridity, we would like to use this to emphasize the parallels between the two domains, rather than the triumph of one over the other. The humanist basis for liberty—whether espoused as individual choice or collective democracy —is the hermeneutic circle from the self to the self: self-governance by independent nations, peer-to-peer learning in education, worker controlled work in management, and so on. Similarly, the technological foundations of robotics are based on self-looping: feedback in analog systems, recursive programming, self-monitoring sensory systems, and so on.

A political history of robotics technology

This resonance between technological self-governance and social self-governance has not gone unnoticed. The contemporary term "cybernetics," the science of control systems, was derived by mathematician Norbert Wiener from the ancient Greek word for steersman—kubernon—in part because of their analogy (in Plato's Republic for example) between steering a ship and steering a state: indeed our word "govern" comes from this same root. Historian Otto Mayr (1986) noted that feedback devices were ignored or rejected in continental Europe well into the eighteenth century, but cultivated and appreciated in Britain. His hypothesis was that the reasons are, in part, political: automatic devices without feedback—essentially clockwork mechanisms—became metaphors for authoritarian social control, while feedback mechanisms were symbolic of more democratic systems (indeed the famous feedback mechanism in James Watt's steam engine was called a "governor").

Another automated control system referenced by social metaphor is the "master-slave" system, in which one device controls another (e.g. the master brake cylinder controls the slave break cylinder in your car). Eglash (2007) traces this terminology from its first use in a "master-slave clock system" in 1904 to its subsequent diffusion (flip-flop circuits, automotive hydraulics, computer drives, etc.), as well as the reactions of black engineers to the contemporary usage of this dubious phrase. Unlike the case of feedback mechanisms in Mayr's study, the political resonance for "master-slave" is much more subtle: there is no indication that those favoring the phrase included a statistically larger number of racists. We do know, for example, that William Shockley, co-inventor of the transistor, persisted in the

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racist belief that IQ differences between Black and White Americans were primarily due to genetics (Shockley 1967). But the reaction from his engineering colleagues was overwhelmingly rejection (Shurkin 2006). The “master-slave” phrase was not broadly in engineering use until after WWII, but begins its first usage for special cases around the mid 1920s, at the same time that the word “robot” was imported from Czech to English:

> Robot: 1923, from Eng. translation of 1920 play "R.U.R." ("Rossum's Universal Robots"), by Karel Capek (1890-1938), from Czech robotnik "slave," from robota "forced labor, drudgery," from robotiti "to work, drudge," from Old Church Slavonic rabota "servitude," from rabu "slave”.”
>
> (http://www.etymonline.com/index.php?l=r&p=16).

The popularity of the “master-slave” phrase in device description cannot be explained by utility. In fact the most common encounter we have with this term—a phrase such as “master/slave bios” flashing onscreen as our computer boots up—is an entirely erroneous usage:

> Note that despite the hierarchical-sounding names of "master" and "slave", the master drive does not have any special status compared to the slave one; they are really equals in most respects. The slave drive doesn't rely on the master drive for its operation or anything like that, despite the names (which are poorly-chosen--in the standards the master is usually just "drive 0" and the slave "drive 1"). The only practical difference between master and slave is that the PC considers the master "first" and the slave "second" in general terms.
>
> (www.pcguide.com)

Here it is clear that the phrase has been applied not because it helps the technical description, but merely because it was appealing to the designer. This seems to be the case for many instances of its use. Why use the term if it offers a less accurate technical description, implying a control relationship that does not exist?Both robots in fiction and the master-slave phrase in fact become popular, we suspect, for the same reason: because they address anxieties about dependence and autonomy. Just as S.A. Cartwright (1851), a prominent Southern physician, offered drapetomaniaas the diagnosis for the insane desire of slaves to run away from their masters, similar reassuring discourse takes place in technical domains—in this case the 1964 Dartmouth timesharing system:

> First, all computing for users takes place in the slave computer, while the executive program (the "brains" of the system) resides in the master computer. It is thus impossible for an erroneous or runaway user program in the slave computer to "damage" the executive program and thereby bring the whole system to a halt.
>
> (Kemeny and Kurtz 1968)

The resonance between "runaway user program" and "runaway slave," or masters who see themselves as the brains of the plantation and an "executive program" that is billed as "the brains of the system" is remarkable. Although we reject a reading of this resonance as merely disguised racism, we also note that it is not merely metaphor. Combined with changing human managerial systems, such systems allowed a greater split between skilled and unskilled labor. One of the most vivid descriptions of this coupled techno-social change can be found in David Nobel's classic paper (1979) on numerically controlled machine tools. Nobel provides convincing evidence that the 1950s introduction of digital control over lathes, mills etc. was just as strongly motivated by managerial concerns for avoiding shop floor control and union power as it was for hopes in improving accuracy or efficiency.There is at least as much relevance here for the "wage slave" as there is for racial slavery.

Norbert Wiener, the father of cybernetics, foresaw this clash between the autonomy of people and the autonomy of machines. In 1950, Wiener met with the president of the United Automobile Workers, UAW, Walter Reuther to warn him about the threats that automation posed to the working class, and to suggest that they work together to find a solution, but Reuther refused. Wiener also declined offers to advise corporations on the use of automation in factories; as a result the FBI opened a file on him and, despite the utter lack of evidence, claimed he was a "very strong communist."

The history of robotics is not a monolithic story of technological oppression; there are rays of hope that suggest libratory possibilities; one hope for extending such possibilities in the future is that of participatory design.

Participatory design of SIRs

"Form follows function" is a phrase usually attributed to architect Louis Sullivan (although its originator is sculptor Horatio Greenough),[4] and repeatedly taught to many generations of designers. Although it can be innocently viewed as a positive truism of design—reduce unnecessary ornamentation and allow function to determine form—in its historical context it provided modernist designers such as those of the Bauhaus with a rhetorical excuse to break with tradition and promote their austere geometric designs. No doubt any attempt to claim that one knows the "true" function and has objectively translate this into its one "optimal" design is suspect. Yet the simple slogan seems remarkably oppositional when we consider how well its reverse characterizes contemporary marketing strategies for selling on looks rather than utility.

Despite occasional attempts to focus on functional quality (e.g. oppositional groups such as the Whole Earth Catalog in the 1970s, individual rebels such as Victor Papanek, or social movements such as green design), for many U.S. consumers aesthetic appeal has trumpedfunctionality in purchase decisions: function becomes an afterthought to form. A free market ideology would insist that this is by definition the best system for allowing consumers to satisfy their needs: since people are choosing it, it must be what they want. Conversely, many scholars believe we are duped by shallow facades and slick marketing into purchasing items which, although "freely" chosen, do not actually enhance our well-being. (Lindner 2003; Taussing 1980) Similarly, we can question the design goals of specific SIR projects as to their varying relations between form and function.

Victor and Sylvia Margolin(2002) critique the polarization of design practice into two models, one satisfying social needs and the other focused on profit. In their view rebels like Papanek rightly criticize the poor design or useless products that often results from shallow marketing motives, but they point out that by implying that the alternative socially responsible design can only occur outside the mainstream market, Papanek "limits the options for a social designer." Margolin and Margolin then detail several examples in which social intervention methods (in which advocates for disempowered help them voice their views and needs) were brought into collaboration with commercial designers.However the vast majority of the cases they cite—including the forty "socially conscious designs" featured in the

[4] Louis Sullivan used it in a 1896 lecture that he delivered. However sculptor Horatio Greenough introduced it in "Form and Function" written in 1851 as noted in Owen (1991).

February 2001 issue of ID magazine—fall into the categories of either green design or design for disability (whether by age, disease, etc.). While these are not trivial categories, they are predictable: helping the environment and the infirm are both compatible with dominant race, class, and gender interests. On the other hand, the rise of "social entrepreneurship" in the last few years, in which socially responsible designs such as third world appropriate technology is spread by market methods rather than charity, gives new hope to Margolin and Margolin's ideals vision for a synthesis between social responsibility and market compatibility.

Finally, to further complicate matters, market forces may create opportunities for low-income access to products which, had they been designed without regard to salability, may not have been affordable. For example, in the 1970s the video game industry—mostly products with dubious social value—created demand for computing chips, which brought down their prices enough to make them affordable for the birth of the home computing industry.

Thus our "cultural robotics" framework would encourage inquiry into all the issues covered above: how to avoid a form that embeds dominant racial characteristics, how to avoid restrictions of functionality that limit its applicability to particular groups, and how to position its development in relation to both market and non-market institutions such that SIRs can improve the quality of all lives and not just those of the elite. We posit that these questions can be best addressed through direct interaction with members of these populations, with two caveats.

First, they must be carried out in such a way that lay decisions are not limited to trivial aspects (whether surface form or underlying functionality). As pointed out in Foucault's work on humanist reform as a disguise for social control (1979), to provide a deceptive guise of participation while elite power interests pull the strings is perhaps worse than no participation at all. (Cooke and Kathari 2001) A useful concept here might be "upstreaming," a term from British policy studies which rejects waiting for problems due to scientific developments to occur ("you mean you don't like eating genetically modified foods? Well it's too late now…") and rather moves the public debate "upstream" and into the laboratory itself. (Wilsden and Willis 2004)

Upstreaming robotics research would mean examining the technosocial ecology in which this robot would be introduced. For example, in "Mechanization and Mexicanization," Carlos Martín describesthe introduction of the mechanical tomato harvester in California. Spurred by fears of unionized farm labor, farm owners supplied funding for mechanization researchers. Because only the harvesting task was targeted ("uneven development of technology"), the labor demand became increasingly sporadic, resulting in an even greater demand for temporary, low-wage workers, which was almost exclusively filled by Mexican laborers.

What point would there be in engaging low-income participants in the design process for a robot they cannot afford, let alone one that increases exploitation and racialization of labor? Participation is not enough; it is often not sufficiently "upstream" in the technology development process. The lay audience, including those typically marginalized, needs to have a strong voice in problem definition, and access to discussion (including the kind of public science and technology education thatfacilitates such discussion) of science and technology at every level, from basic science to application. Should efforts to overcome the "digital divide" move beyond the screen and include such digital/mechanical devices as robots? In what way might the innovation in "bottom-up" robotics, such as Rodney Brook'ssubsumption architecture (Brooks 1986) or Manuela Veloso's Collaborative learning (Stone and Veloso 1996) be applied to creating bottom-up economic development in low-income communities? Perhaps the robots that have the greatest impact for the poor will be the smallest: cheap microbots that can be scattered about and then alert authorities to environmental toxins or support decentralized neighborhood watch programs. Cultural robotics would require participatory design methods that not only include members of disadvantaged populations, but also collaboration with a multidisciplinary group of humanists and engineers (e.g. social scientists, graphic designers, mechanical and electrical engineers, and experts from other disciplines) at the earliest stages of conception, and in a manner that takes into account all dimensions of the technosocial ecology in which this robot will be introduced. As Eevi Beck (1996) puts it, the "PD" of participatory design needs to stand for Politics and not just Participation.

Visualization Methodologies in Participatory Design of SIRs

One method for advancing towards those goals might be through the use of visual rhetoric as developed by participation-oriented researchers in the field of graphic design.

Visual aesthetics need not be restricted to a means for persuading viewers to buy an SIR after it has been engineered; it can also be a potential means for representing the needs and views of the users, including those users traditionally excluded from robotic design. Of course the use of visual rhetoric to give voice to those at the margins is not new; we have seen the use of murals by Latino rights advocates in the 1960s, protest art from the anti-apartheid movement of the 1980s, feminist guerrilla theater in the 1990s, and so on. But deploying visual aesthetics for the purpose of involving those marginalized voices in robotic design calls for an entirely different method; here we will use Bennett's "interactive aesthetics"[5] to refer to this use of visual communication for making a more democratically representative audience an active participant in the design process. (Tyler 1992)

With interactive aesthetics, visual language can facilitate user input in the design process (Bennett and Restivo 2004). At a purely instrumental level, interactive features can improve static images (for example mouse roll-over help features).Static images, colors, and other image-based graphics can also use interactive elements--which range from paper-based low-tech forms, to web-based forms, image-editing applets, etc.--to engage members of the audience in the design process and allow them to change prototypes, imagine different scenarios of interaction with design variations, and explore problem definition. In the UTOPIA(Ehn 1992) project described by Pelle Ehn, for example, static images on paper were used to represent prototype computer screens in mockup exercises that allowed the labor force to participate in the design of technology that would replace their current tools.

Objects that have complex motion, like robots, may require interactive aesthetics that concern time-varying phenomena. Hence the term "dynamic interactive aesthetics" (Bennett 2004) has been introduced to consider real-time simulations, virtual reality technologies, and other instrumentation that can aid the user population in exploring the development and quality of experience with prototypes dynamically. The method need not be strictly high-tech: for example, Muller's PICTIVE (Muller 1993) system provides "quick and dirty" animation for participatory design by videotaping the movement of low-tech paper mockups collectively manipulated by users.

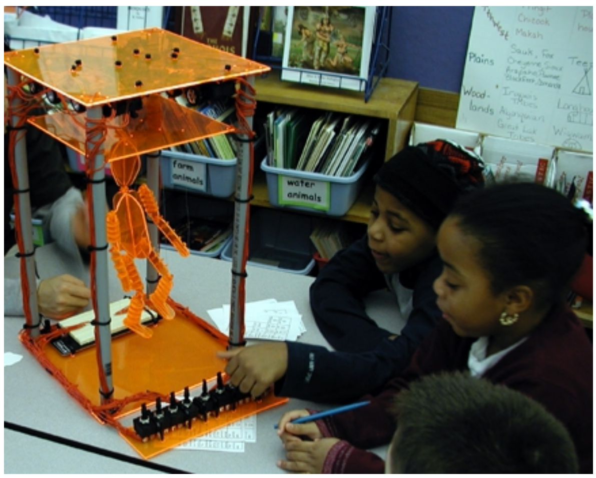

Figure 3, physical dance-bot

[5] See Bennett 2002. Of course this method could also be applied to non-visual sensory modalities (hearing, touch, etc.) as well.

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Case Study

We recently developed two robots specifically for use in the education of low-income minority children. These developed out of a long-term project in ethnomathematics; that is, using the mathematics embedded in cultural practices such as native American beadwork or African American cornrows in classrooms with children from those ethnic groups (Eglash et al 2006).One of the cultural practices of interest was dance, since it crosses so many ethnic groups but also develops a wide variety of mathematical concepts (rotation, iteration, etc.) that are know to the practitioners, albeit not in the formal representations used in school. The problem then becomes how to “translate” that vernacular knowledge into its formal form. One solution we pursued is shown in figure 3, in which students controlled a dancing robot. Another solution is to use the technology of motion-detection, turning the children into cyborgs (http://www.3helix.rpi.edu/?cat=159). Our research there is too preliminary to report. But our third approach, a virtual robot (figure 4) has some direct relevance to this discussion.

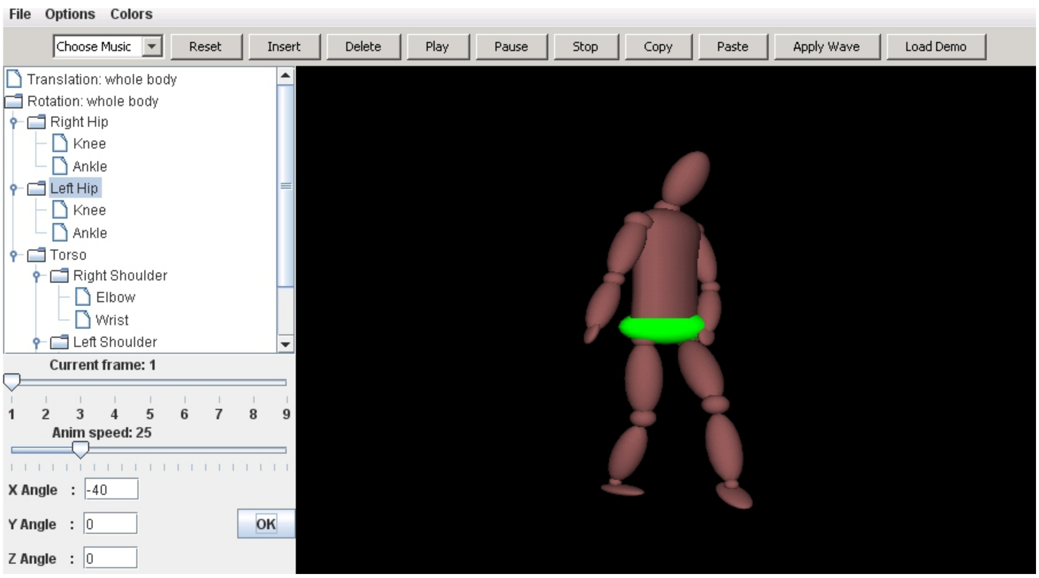

Figure 4, virtual dance-bot

Readers can try out the robot themselves at: http://csdt.rpi.edu (click on “breakdancer”).In its current incarnation it has no face. But at one point we decided to try merging a photo with the head. Our software developer, who was white, used his own face in the photo, superimposing it on a white robot. When we pointed out that this was supposed to be for minority children, he colored the body and face brown, and insisted we continue to use his photo on the face (citing the many hours he had spent morphing the 2D photo to fit the 3D head). We finally were able to convince him of the problem using the example of "ethnic" dolls created by pouring brown plastic into white molds (Chin 1999), and the bad reaction of minority communities to this updated version of blackface.

On the other hand, we noticed that some of the African American children using the virtual robot for dance were able to appropriate the device to create body poses that seemed distinctly "black." Art historian Robert Ferris Thompson has detailed many specific body poses and gestures, some of which appear in black dance traditions in the new world, which can be linked to specific corresponding African gestures. (Thompson 2005) The gesture that was most striking in this case was a head tilt, as can be seen in figure 4. What was made this stand out for us was not its link to African cultural retention—it is enough to simply say that it reflects the norms of African American pop culture (one student called it "Michael Jackson")—but rather the fact that we had initially considered eliminating the neck joint (simply because we were looking for ways to simplify the interface). It's now clear to us that culturally specific body movements will require even greater flexibility in the artificial body (for example doing a shoulder hunch). By acting as advocates for these students during the design process, we can seek a robotic form (albeit virtual) that can act as a bridge to their cultural expression rather than a barrier.

Conclusion

The lesson we draw from the above case study is not that there was anything objectionable about the software developer himself—in fact he was strongly supportive of the application to underrepresented student education—but rather to draw attention to the gap between the technical aspects of design and the social aspects of design. As we have endeavored to show throughout the paper, identity and autonomy can play strong roles in both maintaining and contesting the gap between technical and social attributes of robotic design. But these roles are not "mechanically" assigned; there is no deterministic law which dictates under which circumstances negative social metaphors result in negative outcomes, or positive programming intentions ("let's simplify the interface by removing the neck joint") give positive results. Only our constant efforts to keep social issues at the forefront of science and technology development will provide us with an ethically progressive path for negotiating the tensions between the autonomy of machines and those of people.

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