Knowledge Design — Towards an Inclusive, AI Design Practice

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Abstract

We share two prototypes that explore different aspects of the design and application of inclusive AI. This approach to inclusive AI Design seeks to engage typically excluded communities, such as individuals of varying socioeconomic status, race, age, gender (and those who do not identify with a gender), as well as to critique and explore alternatives to conventional AI Design.

Introduction

There are many ways to approach intelligence and many definitions of artificial intelligence. This paper uses Nils J. Nilsson's definition: "Artificial intelligence is that activity devoted to making machines intelligent, and intelligence is that quality that enables an entity to function appropriately and with foresight in its environment" (Nilsson 2010). Similarly, there are multiple ways to approach Artificial Intelligence (AI) Design. This paper presents an inclusive approach to Artificial Intelligence (AI) Design, which we frame as being part of a practice we call Knowledge Design. Referencing Alison Adam (Adam 1998), in this practice, knowledge encompasses the artificial life and intelligence spectrum, while at the same time honoring different ways of thinking and knowing. Thus, the process of AI Design we propose is collaborative and it defines the context of the "knowledge" upon which an entire (intelligent) system is structured. In other words, Knowledge Design allows for conversations about wanted and unwanted bias in AI systems, while also modeling an inclusive approach to authoring and sourcing contexts and data.

We see AI Design as a material practice of working with code and context (or sociocultural considerations) to frame and generate computational experience. In essence, this can be simply and reductively stated as AI Design = (code x material x context) + (experience x form). In this paper we combine development concepts with physical objects (such as products) and digital materials (code) to produce form and critically intelligent cultural interactions.

Under the umbrella of Knowledge Design, we present an approach to AI Design that is inclusive, embodied, and co-creative. In practice, this translates to collaboratively interrogating concepts (knowledge) with stakeholders, creating prototypes and bringing those prototypes to a community. We share two research projects, "Intelligent Protest" and "Accumulative Collaboration," which address the question of how we conduct AI Design from an inclusive perspective and how this approach generates conversation and co-creation with a range of communities not typically included in the design and implementation of AI systems (on excluded communities, see Byrnes 2016). Our process allows us to co-create and train data inclusively—with and for the community the intelligent system will serve. Further, these projects demonstrate an embodied approach to the creation of training data, which allows us to generate new conversations and insights, design for excluded communities, and explore models for training individually curated algorithms or systems trained by specific nontraditional user types.

Excluded communities, included bodies

The inclusive AI Design utilizes an embodied approach to conducting training that can generate unique data tied to a location or object. In our research we ask questions such as, what does it mean to use computer vision to allow access to buildings, parking garages, cars and apartments, and what are the social implications of purchasing products with pre-trained data sets over products that include all members of a community (and can be trained on small sample data)?

Overall, an embodied approach to AI Design offers two advantages. First, participants with limited exposure or understanding of intelligent systems encounter less of a barrier when they are able to engage with a system through their body. Instead of introducing linear regression in training a data set, for example, or relying on participants'

computer literacy (which can be exclusionary), the participant interrogates the system through facial expressions or hand gestures. This empowers participants with any level of knowledge to engage with a system, and the form of engagement often looks and feels like play, which conveys to participants that there is no "correct" way of interrogating a system. This playful, embodied approach to co-creation and research allows for a very wide range of feedback and insights. In "Intelligent Protest," participants engaged with the system through their bodily presence and facial expressions, and in "Accumulative Collaboration" through simple hand gestures.

Second, an embodied approach to co-creation and training of data sets also reinforces inclusive design by designing with and for all bodies. Designing with different bodies from the outset can allow us to think about what it means to design across variances in hair, beard, skin, size, ability and so forth, especially in the digital space, not only to effectively design these products, but to reduce bias in things like auto tagging and image recognition. Although we need to approach AI Design from an inclusive perspective so these technologies can work on all bodies, we must also consider ways to guard against potential discernments from machine learning advances, such as algorithms that purportedly identify sexuality (Wang and Kosinski 2017; significantly, this paper is now under ethical review), and the ramifications of using such tools in conservative societies. An embodied, community-generated training data approach allows the AI Designer to decrease algorithmic bias, such as the other race effect (own race bias) evidenced in face recognition algorithms (Phillips, et al., 2011). Recognizing that human bias can be translated to bias evidence in algorithms, this embodied approach to co-creating with typically excluded communities allows the AI Designer to include and acknowledge multiple, diverse, and varied bodies and experiences.

Methodology

Dara Blumenthal's research proposes that living-sensory embodiment is an ongoing process, and looks at the body as beyond being enfleshed (Blumenthal 2014). Paul Dourish suggests that everyday human interaction is embodied (Dourish 2001), but while he highlights embodiment and offers guidelines, he refrains from offering a model or methods for embodied approaches to human-computer interaction (HCI). We apply this lens of embodiment to AI Design, updating "interactive system" to "intelligent system" in Dourish's argument, while additionally taking the step of sharing methods for engaging in an embodied research practice.

Embodied Approach, Different Data

Performative Prototyping (Sweidan 2016) is a proprietary method that harnesses movement-based research to prototype from an embodied perspective. Performative Prototyping updates HCI research methods to engage embodied thinking in the research process (specifically in the ideation and prototyping phases). The AI Designer leads the participant through an imagined scenario or a designed system which requires movement and physical engagement. Performative Prototyping intersects traditions of dance improvisation and somatic research with HCI. It draws from "critical making" (Ratto and Boler 2014) in that the act of prototyping is framed as a means of interrogating and unpacking the assumptions and conceptual framework of the designed artifact. Performative Prototyping also draws from qualitative research practices in the HCI space, such as the "think aloud" methodology (Lewis and Rieman 1993) which includes a debriefing process involving extensive questioning of the participant following the embodied action/enactment. Performative Prototyping is both divergent and affords a low barrier for participation since basic movements (such as walking) can be harnessed to allow workshop participants to engage in basic system design.

In practical terms, collaborative, embodied AI Design entails using AI systems and machine learning tools to encourage human-to-human and human-to-machine connections. Our research does not result in one finished product, but rather a collection of prototypes, designed for experiences in the AI Design space. These prototypes serve as tools that help us envision how to design for and with intelligent systems, allowing us to move outside of the product-driven design space into the inclusive, intelligent experiential space.

The two projects we present include the following methods:

- Co-creation and community research: we conducted research in various locations with different communities in Los Angeles. We intentionally sought to prototype with audiences that were varied in age, race/ethnicity, SES, gender (and non-gender), and technical background. We took special care to target audiences that were not primarily cis male. The project "Intelligent Protest," was a year-long research project in which we were invited to specific communities around Los Angeles. This was carefully curated so voices that are typically not heard in the AI Design space were a part of the co-making project. In the project "Accumulative Collaboration," we playfully explored what it means to use the physical bodies of artists as material for the training data, sourcing people as data.

- Performative Prototyping.
- Wekinator is an open source machine learning tool.

AI Design Research Projects

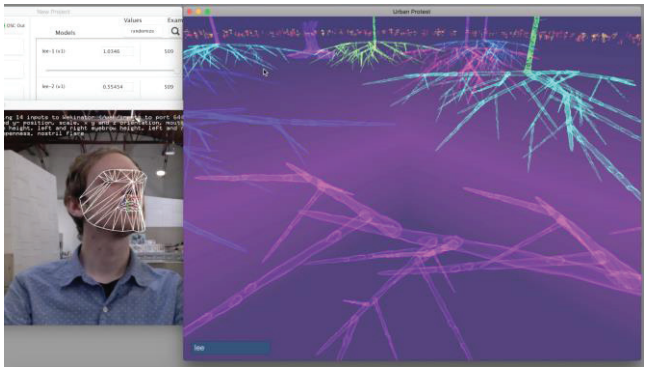
"Intelligent Protest" and "Accumulative Collaboration" are two experimental prototypes which utilize co-creative and embodied research methods and illustrate our vision of AI Design within a broader Knowledge Design practice. Both projects feature inclusive ways to think about different aspects of design and implementation. By engaging with typically excluded communities, we explore alternative explorations to conventional approaches to AI Design.

Intelligent Protest

The project "Intelligent Protest" stemmed from our collaborative AI research group, "Feminist AI Projects: Bits and Bytes." The research and design of this project involved a year of holding local community workshops that provided access to AI Design tools, with a particular outreach to those who have not been socialized to participate in shaping technology and its applications. A pilot series of AI workshops was planned to foster gender-equitable, creative tech spaces in which small working groups agreed upon a mutual area of concern (such as immigration reform). Then, drawing upon their collective skills, the group explored the potential of the AI tools to create a project around the area of concern. The groups consisted of students, mothers, software engineers, makers, researchers, and artists. This research resulted in new thinking and outcomes in the AI Design space and explored new experiences in civic engagement.

Using the Intelligent Protest prototype, individuals can login from a home computer and participate in the virtual protest space. Additionally, this virtual space can be utilized and displayed at an actual physical protest site, using AI Design and physical movement to bridge physical and virtual worlds. This application of embodied research with the community exemplifies broader thinking around what it means to embody artificial knowledge from a research and design perspective (Meinders 2017).

During the "Intelligent Protest" project, individuals used their bodies to engage in a collaborative protest in virtual and physical spaces. The embodied expression of protest emerged from the co-creators' desire to scream using new parts of (or the whole) body, not just a voice. This framed the way we prototyped our protest and allowed for multiple bodies to strengthen the experience of the protest. A virtual sit-in was created by using Rebecca Fiebrink's machine learning tool Wekinator with Open-Frameworks' detailed facial feature tracking software to occupy a virtual sit-in, and a collaboratively created app (using the game engine Unity), in response to protesting tree removal in the city of Alhambra, CA (Fiebrink 2009; Kogan 2015). When individual users launched Wekinator, the Unity app, and the facial feature tracking software, they could provide training examples of facial movements which were mapped to outputs in the Unity app. For example, when an individual's tree avatar roots connected with the roots of other trees, they acquired the sound associated with the other trees' roots. Users thus can be present and are rewarded the longer they are in the space, collecting the sounds of other avatars once the tree roots interconnect. Users' avatars remained for twenty-four hours. The idea of using body information (biometrics, facial recognition) in civic discourse makes it possible for individuals working multiple jobs, or caring for children and parents, to participate in civic engagement.



Users engage with Wekinator to connect with other protesters in an avatar sit-in.

To coordinate this sit-in, we set up Wekinator to receive 14 input values and compute 5 continuous output values which were mapped to an avatar in the Unity game engine. We selected Wekinator's default neural network algorithm and used 5 collaboratively designed facial movements to train the neural network for the face protest. These outputs were used in a designed Unity environment, where each individual who logged in had an avatar of a tree with roots. The roots were created by a simulation of a Lindenmayer System (L-System) and the 5 outputs affecting the individual avatars in the collaborative protest space were:

Output 1. Rotation of tree canopy
Output 2. Modified root color (constrained to hues near the hue of the canopy)
Output 3. Root network growth rate
Output 4. Level of audio distortion
Output 5. Cut-off frequency for audio low-pass filter

This design approach generated new ideas and conversations within communities typically excluded from the AI Design space (such as individuals working multiple jobs, or those with no tech background). Our goal was to create

an accessible project for individuals new to the machine learning space. Rather than optimize the existing neural network, we created a simple example, using Wekinator and collaboratively-sourced materials that showed the basic functionality of machine learning. The community of AI researchers co-developed specific facial movements of protests, inspired by the physical behaviors of protests, from the rhythm of the face movements matching the sounds of a rally to the movement of the eyebrows. The face in the app became the body in the plaza. New movements and protest behaviors emerged based on collaborative thinking in the physical space, along with ways to magnify the impact through machine learning models and collaboratively designed outputs.

One interesting observation that emerged from this research was that individuals liked to engage with models created by other people, often passing a laptop around. Another insight occurred when this project was collaboratively prototyped: new interactions and movements continued to occur as the participants observed each other and became more playful with their creation of training data. Also, in the design process participants wanted to design for multiple modes of presence (X Reality), in both the virtual reality, augmented reality, web and physical experiences. The possibility of porting one behavior across multiple representations of presence could result in interesting design opportunities, within alternative spaces or produce new experiences in the physical space.

Intelligent Protest is an example of embodied community-sourced AI Design, where the outcome designs for multiple bodies engage in a shared goal of protest. Our AI Design resulted in rethinking the Knowledge Design of protest.

Accumulative Collaboration

In "Accumulative Collaboration" we chose a specific audience who attended a performance art event as co-creators. The community co-creation was conducted successively with thirty participants contributing hand gestures, one after another. One "station" containing a computer, cameras, Leap Motion controller, and Wekinator was set up during the performative art event, which enabled us to perform as researchers, facilitating conversations about how these systems may apply, and enabled the participants to observe each other contributing movement data sets through improvised hand motions. This format allowed for a different form of conversation and play because the co-creators were able to observe others creating training data. For example, while the Leap Motion itself affords the usage of hands, the hand improvisations became more interesting when participants began designing with other body parts, such as their feet, or when two participants started training the data together—each using one hand. Such unexpected, impromptu moments arose out of the performativity of this research format, which offers a method for creating more personalized algorithm designs by specialized audiences (such as artists, athletes and so forth). In other words, this research format allowed us to explore what it means to create group-specific or individually curated algorithms by specific nontraditional users.

Research for "Accumulative Collaboration." Community artists engaged with Wekinator to create training examples.

In "Accumulative Collaboration," we collaborated with an open-source machine learning tool Wekinator (Fiebrink 2009) to facilitate human-to-human connections, human-to-machine interactions, and the creation of embodied training data. The research was conducted in a domestic space as part of a curated performance art event. Participants performed improvised hand gestures with the goal of training the open-source machine learning neural network in succession. Thirty participants contributed three hand improvisations each. Each participant's improvised contribution built off the next, creating a growing chain of gestural data and a neural net, thus an accumulation of collaboration. The community creation focused on designing with artists only, a unique collaboration in that it did not focus on one final output, but rather produced conversations and approaches to training data outside of the intended design of the inputs.

To create this accumulative collaboration, we set up Wekinator to receive 15 input values (using the LeapMotion_Fingertips_15Inputs Processing program) and computed 3 continuous output values which were mapped to sound outputs using the Processing_FMSynth_3 ContinuousOutputs mac executable. We selected the neural network algorithm option in Wekinator and defined the ranges for the sound output. Using Leap Motion, participants improvised gestures with their hands to provide unique movement inputs. Hand improvisations became training data for the model, and a duet between machine and human ensued. This approach facilitated an accumulative choreography—one participant followed another, building off previously improvised hand gestures. The ensuing contagion

of choreography brought participants (strangers to one another) into a collaborative relationship facilitated by AI.

"Accumulative Collaboration" asks what it means to conduct co-creation of and/or testing of intelligent systems through an accumulative approach. Using this embodied approach to conduct machine learning training results in new playful opportunities with the data, and new design opportunities emerging from training with different kinds of bodies. Thus, the bodies of a given community can be utilized to prototype machine learning systems that can more easily address outliers and design challenges, rather than simply designing with analytic data with which the community has little physical connection to. The benefits of this approach is to engage in useful, inclusive, community-specific AI Design.

Conclusion

Under the umbrella of a concept we call Knowledge Design, we have demonstrated an approach to AI Design that addresses culture, civic engagement, and human-to-human and human-to-machine interactions. We argue for an embodied collaborative knowledge to inform how we engage in AI Design. We present our experimental prototypes and co-creative and embodied research methods to share our vision of an AI Design practice based on Knowledge Design. We used an embodied approach to conduct machine learning training because the data it generates is community sourced. Different bodies, skin tones, and types of faces can be challenging when designing facial recognition systems utilizing computer vision. Using an embodied approach allows AI Designers to design with different bodies. Keeping data diverse from the onset makes it easier to design for those opportunities as they arise.

In the project "Accumulative Collaboration," we explored what it means to engage in collaboratively trained (curated) algorithms and design. In "Intelligent Protest," we engaged in Knowledge Design to create an AI Design project to prototype a new way to protest across spaces. Our prototyping has focused on neural networks. From a technical perspective, we would like to continue to prototype with our community on "Accumulative Collaboration" and "Intelligent Protest" in Wekinator by modifying the neural network algorithm and refining hidden layers, nodes, and training data to create an optimal model for collaboratively preferred output. Additionally, we intend to collaboratively design with linear and polynomial regression algorithms to probe new design opportunities. Overall, the focus of our work is not only to make AI Design more accessible to individuals distanced from AI, but also to create inclusive intelligent products and thinking in the Knowledge Design space.

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References

Adam, A. 1998. *Artificial Knowing: Gender and the Thinking Machine*, 86. London, U.K.: Routledge.

Blumenthal, D. 2014. *Little Vast Rooms of Undoing: Exploring Identity and Embodiment through Public Toilet Spaces.* London, U.K.: Rowman & Littlefield, 47.

Byrnes, N. 2016. Why We Should Expect Algorithms to Be Biased. *MIT Technology Review*.

Dourish, P. 2001. *Where the Action Is: The Foundations of Embodied Interaction.* Cambridge, Mass.: MIT Press, 20.

Fiebrink, R. 2009. Wekinator [Computer software]. Retrieved from http://www.wekinator.org.

Fry, B., and Casey, R. 2001. Processing [computer software], version 3.3.6, December 2017. Retrieved from http://www.processing.org.

Kogan, G. 2015. ofxFaceTracker [Computer software]. Retrieved from https://github.com/genekogan/ofxFaceTracker.

Lewis, C. and Rieman, J. 1993. *Task Centered User Interface Design: A Practical Introduction*. Boulder, Colo.: University of Colorado Department of Computer Science.

Leap Motion [Computer software and controller]. San Francisco, Calif.: Leap Motion, Inc.

Meinders, C. 2017. Embodying Artificial Knowing. M.F.A. diss., Graduate Media Design Practices, ArtCenter College of Design, Pasadena, CA.

Nilsson, N. 2010. *The Quest for Artificial Intelligence: A History of Ideas and Achievements*. Cambridge, U.K.: Cambridge University Press, xiii.

openFrameworks Community. 2004. openFrameworks [Computer software], MIT License. Retrieved from http://openframeworks.cc.

Phillips, P. J., Jiang, F., Narvekar, A., Ayyad, J., and O'Toole, J. 2011. An Other-Race Effect for Face Recognition Algorithms. *ACM Transactions on Applied Perception* 8(2):18–19.

Ratto, M. and Boler, M. eds. 2014. *DIY Citizenship: Critical Making and Social Media*. Cambridge, Mass.: MIT Press.

Sweidan, S. 2016. Improvisation, Quantum Data, Wandering. M.F.A. diss., Graduate Media Design Practices, ArtCenter College of Design, Pasadena, CA.

Wang, Y., and Kosinski, M. 2017. Deep Neural Networks Are More Accurate Than Humans at Detecting Sexual Orientation from Facial Images. Retrieved from psyarxiv.com/hv28a.