Digital Craftsmanship: HCI Takes on Technology as an Expressive Medium

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Abstract
Traditional HCI goals like efficiency and ease-of-use, while important, are not sufficient for digital technology to function as an expressive medium. This digital craftsmanship also requires diversity, risk, personal taste, mastery, and respect for materials. We discuss how digital tools can support expressive practices and highlight multiple strands of relevant HCI research. This workshop brings together tool developers, practitioners, ethnographers, and others engaged with digital technology as an expressive medium. It highlights digital craftsmanship as a distinct domain for HCI research and seeks to distill insights and best practices for the HCI community.

Author Keywords
Expressiveness; Fabrication, Design, Craft; CAD; Materials

ACM Classification Keywords
H.5.2 [Information Interfaces and Presentation]: Interaction styles; D.2.2 [Design Tools and Techniques]: User interfaces

Introduction
Digital technology creates new opportunities for the exercise of craftsmanship. It extends the possibilities of existing expressive mediums and promotes creation of others. Domains like computer-aided design (CAD) [7], elec-

Figure 1: Procedurally designed laser-cut lamps created using Codeable Objects.

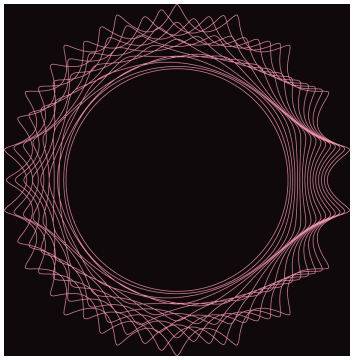

Figure 2: Processing is a simplified programming language and development environment used across the visual arts community in professional and novice practices.

tronic crafts [2, 9, 10], procedural design [5, 11], and hybrid human-computer digital fabrication [4, 15, 16] provide new opportunities for artists, designers, and craftspeople. Yet integrating digital technology and craftsmanship is not easy. The abstractions required to build technological systems impose a separation between craftspeople and their materials. Technological systems often are brittle, requiring the correctness of low-level elements to function. Digital technology changes rapidly, making it difficult for craftspeople to continuously master emerging tools and interfaces. The availability of technological components may impose constraints on the form or function of the works that can be built using them, which then may constrain artistic practice. Even successful digital crafting technologies can disrupt cultures of practice by de-skilling the craftsperson.

Applying HCI to digital craftsmanship requires a different focus than traditional HCI goals of efficiency and ease-of-use. Expressive mediums allow for continuous work, engagement, and varied outcomes. Such mediums provide opportunities for individual mastery and enable communities of practice [7]. Developing and supporting expressive technological mediums requires an understanding of the nature of creative practice, something that is not discussed in many areas of HCI research. We question how technology and craftsmanship can be reconciled to enable diverse forms of expressive practice by many different people. How can we build interfaces to allow direct manipulation of algorithmic processes? What does it mean to treat microcontrollers as craft material? How can a computer guide, but not determine, a sculptor's hand movement? Answering such questions requires research in multiple technological and traditional disciplines. In the following, we describe domains of HCI research that are relevant to digital craftsmanship. This is followed by a list of topics of interest and a summary of the goals of the proposed workshop.

HCI Perspectives on Digital Craftsmanship

Our workshop invites submissions that inform digital craftsmanship in any of the following areas.

Building expressive computational tools

We focus on tool- and systems-building research that simultaneously lowers technical barriers and refines technical interactions to enable expressive and open-ended practice. In the domain of programming, Processing simplifies and contextualizes programming within visual art and design while supporting extensibility through extensions and community development (Figure 2). In CAD, Meshmixer applies a collaging interaction to fluidly composite multiple high-density meshes, enabling easy entry to 3D modeling and production of sophisticated sculptural forms through extended practice [12]. MetaMorphe applies a web-programming metaphor to parametric design, which makes it accessible to users familiar with HTML and CSS, and enables transparent modeling of design processes through a "view-source" interaction [14].

Blending the digital and physical

Other HCI research focuses on the role of digital technology in the crafting of physical artifacts. Some work explores the integration of electronics and physical materials. Mellis et al. [9] emphasize the importance of tightly integrating electronic components with craft materials and practices (Figure 4). Perner-Wilson et al. [10] demonstrate how constructing sensors from conductive textiles yields diverse forms and aesthetics. Other research leverages digital fabrication. Codeable Objects [5] makes computer programming relevant to people interested in aesthetics by combining programming and craft through digital fabrication (Figure 1). Zoran et al. [16] use parametric models to inform the behavior of a hand-held tool. This extends the fabrication

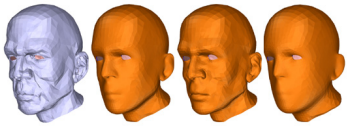

Figure 3: Meshmixer allows for sculpting and manipulation of 3D meshes.

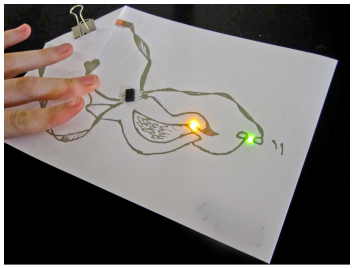

Figure 4: Mellis et al. couple electronic components with craft materials to leverage the accessibility and expressivity of drawing.

Figure 5: FreeD is an augmented sculpting tool that guides user movement.

capabilities of practitioners while preserving the ability for selective manual control (Figure 5).

Research through artifact creation or in-the-wild studies
Producing technological artifacts and examining real-world technological practice helps researchers understand how digital technology enhances or conflicts with existing forms of making and creates opportunities for new forms. Mellis and Buechley use the process of designing and fabricating a cell phone to explore the limits and opportunities of high-tech DIY [8]. Artifact development can help bridge technological and cultural differences, as Jacobs and Zoran demonstrate through collaboration with Namibian craftspeople [6]. HCI also provides a context to examine real-world practitioners, thereby revealing opportunities for future development. Brandt et. al's observations of programmers' behavior reveals how they use online resources with multiple intentions [1]. Tanenbaum et. al's study of maker culture reveals how craftspeople value utility, expressiveness, and engagement, suggesting that future tools for making should balance these qualities [13]. Cheatle and Jackson observe how incorporation of digital technologies in a furniture-making studio reveals aspects of manual production that machines cannot yet replace [3].

Workshop Goals and Outcomes

The proposed workshop is a forum for discussion of digital craftsmanship as a domain of HCI research. We will solicit participation from academia, industry, and art, including developers of software-design tools, educators, artists using technology in their work, and ethnographers exploring the use of digital technologies in creative communities. The workshop provides an opportunity for these practitioners to share knowledge and experience, showcase relevant projects, receive feedback, identify areas for investigation, and establish collaborations. We are particularly interested in exploring ways to overcome tensions between digital technology and craftsmanship and to consider strategies for evaluating the expressiveness of digital tools and interfaces. We plan to highlight the importance of craftsmanship in design and use of technological systems, and to distill best practices for the HCI community. We will submit our results as an article to ACM Interactions.

Workshop Structure

The one-day workshop will begin with introduction of the workshop by organizers and introduction of participants to one another. Then an hour will be devoted to '"science-fair-style" sharing of participant work, such as artifacts and artwork, interactive demonstrations of tools and interfaces, and documentation of ethnographic research. Next, we will facilitate a group brainstorming of themes for further examination during two 90-minute breakout sessions. Possible topics include ways to support collaboration and dialog between researchers and creative practitioners, delineating relevant evaluation criteria and methodology, and identifying new creative communities and mediums for future exploration. The workshop will end with a sharing by participants of the results of the breakout discussions and a facilitated discussion of the overall workshop themes. During this, we will work to collectively articulate a summary of the implications of the workshop for the broader HCI community. We require space for 10-25 participants to present interactive tools, systems, and artifacts.

Organizers

Jennifer Jacobs is an artist, and Ph.D. student at the MIT Media Lab researching procedural tools for art. David Mellis is a post-doc at U.C.-Berkeley researching ways to diversify making of technology. Amit Zoran is a senior lecturer at the Hebrew University of Jerusalem researching HCI, design, and craft. Cesar Torres is a Ph.D. student at U.C.-Berkeley

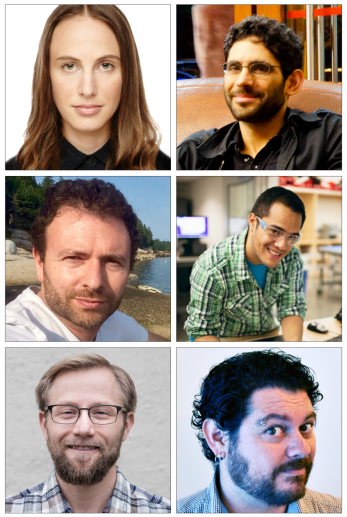

Figure 6: Workshop organizers. Clockwise from top-left: Jennifer Jacobs, David Mellis, Cesar Torres, Joshua Tanenbaum, Joel Brandt, and Amit Zoran.

researching digital fabrication as new media. Joel Brandt is Director of Research Engineering at Adobe researching tools that help designers and developers be creative. Joshua Tanenbaum is an assistant professor at U.C.-Irvine researching playful systems for transformation, and DIY and maker cultures.

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