Science of Design: Software-Intensive Systems
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Position Paper
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Broad Views

Design is an orientation we bring to the activity of creating technological artifacts and embedding them in people's lives. Although we can label fields of design by the kind of artifact ("product design," "software design," "systems design", etc.) every successful design is more. It is an intervention in the individual and social lives of the people who encounter it. The field of software design has often focused on the software artifact, identifying the design processes, tradeoffs, and decisions that will make the software robust, efficient, and malleable. It works in tandem (when things are going well) with interaction design, which focuses on the fit of the resulting software to human abilities, needs, and concerns.

Today, most of the challenging software design problems are not bounded by a particular application or device, but require attention to the totality of aspects of a socio-techincal system. Security is an obvious example. The overall security of a network is not just a matter of well-designed code, but requires an understanding of the ways in which people will interact, both individually and in the large. The design process needs to encompass knowledge that goes well beyond "computing" or "software" in the narrow sense. It has to incorporate knowledge from many disciplines at all levels and stages of design. Today's software architects and programmers are designing more than software-intensive systems: they are also designing people-intensive systems. The research challenge is to integrate the approach to design that has been applied in the more computer-focused aspects of software design with the broader orientation of interaction design and product design.

There is a great deal of informal wisdom about designing human-machine and computer-mediated-human-human interactions. Research is needed on how to make this wisdom rigorous and reusable, without forcing it into the strictures of methods that have worked in fields that could safely bracket out the unpredictability and idiosyncrasies of the human mind.

Current Interests

I am currently working with David Kelley of the Stanford Design Division (and founder of IDEO Design) along with a number of other faculty to create a new design program at Stanford. This program will incorporate the highly successful Product Design program from the Design Division of the Mechanical Engineering Department with other programs in the School of Engineering, including the Interaction Design (HCI) program in the Computer Science Department, the Center for Design Research, and programs from the Department of Management Science and Engineering.

The new design program is intended to advance interdisciplinary research and teaching and to strengthen the connection between the university and industry. If successful, the ideas and people that emerge from this new program will set the standard for how teams innovate, how universities integrate disciplines, and how design is taught around the world. We are drawing from the experience of other universities, such as MIT, CMU and UC Irvine, which have recently created

departments and schools centered around design as an enterprise that includes a wide variety of disciplines, of which computer science is a critical component.

We will be building on the base of long-established teaching and research programs in the component departments at Stanford, re-focusing and creating new ways of integrating them, so that we can have a shared central focus on design and its ramifications in different kinds of products and services.

For this program to be successful at a research-oriented university, it is critical that it have a strong research component, engaging both faculty and advanced graduate students in adding to the body of knowledge about design, as well as conveying that knowledge in teaching. Although we have a great deal of experience in design teaching in the various disciplines, it is still much more speculative to identify appropriate topics for research that will have the scientific substance and relevance that will make it a central component of the activity. My interest in attending this workshop is to help identify and generate the broad directions for design research that we hope our program will contribute to in the future.

Design Programs at Stanford

- Design Division (ME): http://design.stanford.edu/
- Product Design (ME): http://design.stanford.edu/PD/home.html
- Center for Design Research (ME): http://www-cdr.stanford.edu/
- HCI Design Program (CS): http://hci.stanford.edu/interactions.pdf
- Center for Work, Technology, and Organization (MS&E): http://www.stanford.edu/group/WTO/overview/welcome.shtml
- Media-X (cross-departmental): http://mediax.stanford.edu

References

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2. Winograd, Terry (1996), *Bringing Design to Software* , Reading, MA: Addison Wesley.
3. Winograd, Terry (1995), "Environments for Software Design," *Communications of the ACM*, 38:6 (June 1995), 65-74.
4. Winograd, Terry (1994), "Designing the Designer," *Human-Computer Interaction*, 9:1, 1994, 128-132.