GAINING DESIGN INSIGHT THROUGH INTERACTION PROTOTYPING TOOLS

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DOCTOR OF PHILOSOPHY

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I certify that I have read this dissertation and that in my opinion it is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

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ABSTRACT

Prototyping is the fundamental activity that structures innovation in design. While prototyping tools are now common for graphical user interfaces on personal computers, prototyping interactions for ubiquitous computing systems remains out of reach for designers. This dissertation contributes concepts and techniques, embodied in software and hardware artifacts, to answer two research questions:

1) How can design tools enable a wider range of designers to create functional prototypes of ubiquitous computing user interfaces?
2) How can design tools support the larger process of learning from these prototypes?

Fieldwork at professional design companies showed that design generalists lack the tools to fluently experiment with interactions for sensor-based interfaces and information appliances. The first contribution of this dissertation is a set of methods, embodied in authoring tools, that lower the expertise threshold required to author such novel interfaces. These tools enable more designers to author a wider range of interfaces, faster. Visual authoring of control flow diagrams and plug-and-play hardware linked to software abstractions for hardware components enable rapid authoring of interaction logic. This dissertation also introduces programming by demonstration techniques for sensor-based interactions to derive high-level events from continuous sensor data streams.

Enabling the construction of prototypes is an important function of design tools; however, it should not be the only goal. Prototypes are just a means to an end — they are built to elicit feedback about design choices. The second contribution of this thesis is a set of systems that explicitly support the design practices of exploration and iteration. Exploration is supported through enabling the creation of multiple, parallel user interface alternatives. The design-test-analysis loop of iterative design is supported through techniques for rapid review of user test data and techniques for revision of interaction diagrams. The presented work is informed by interviews and collaborations with professional interaction designers. The tools are evaluated through a combination of laboratory studies and deployments to interaction design students at Stanford and in industry.

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