Massachusetts Institute of Technology

House_n

Current Projects

House_n projects, although diverse, begin with the idea that the design of places of living and work – and the associated technologies and services - must respond directly to the unique needs, values, and activities of the individual.

Open Source Building Alliance (OSBA):

House_n team

The goal of the Open Source Building Alliance is to develop key components of a more responsive model for creating places of living where: (1) Developers become integrators and alliance builders to offer tailored solutions to individuals, (2) Architects design design-engines to efficiently create thousands of unique environments, (3) Manufacturers agree on interface standards and become tier-one suppliers of components, (4) Builders become installers and assemblers, and (5) Customers (home-buyers) become "designers" at the center of the process by receiving personalized information about design, products, and services at the point of decision. (see separate document for more detail on the Open Source Building Alliance).

OSBA: Chassis

Kent Larson and Jarmo Suominen

Borrowing from recent innovations in the automobile, electronics, aviation, and ship building industries, researchers are developing concepts for creating buildings from an integrated “chassis” that can be rapidly and precisely installed with minimal field labor. One integrated assembly provides structure, ductwork, power, signal, plumbing connections, mechanical attachments for infill, HVAC systems, floor finishes, and ceiling finishes. At the point of sale, demising walls are added to create the size unit required, and the buyer then engages in a design process to define the interior design, systems, and services. The chassis provides the necessary physical, power, and signal connections for mass customized infill components to be quickly installed, replaced and upgraded without disruption.

OSBA: Integrated Interior Infill (I3)

Kent Larson, Jarmo Suominen, Pilar Botana, Soraia S. de Souza, and Stephen Intille

Integrated Interior Infill (i3) components take advantage of computational design and fabrication tools to produce cost-effective, high-performance places of living. I3 components replace interior walls and rapidly connect to an OSBA chassis with highly varied and customizable cabinetry-like components, systems, and technologies - including work-at-home solutions, integrated room acoustics and entertainment systems, transformable elements, networked appliances and devices, etc. Criteria will be established that may inform industry standards for connections of both physical and digital

components for new design and construction methodologies. This work is funded by a grant from the PATH/National Science Foundation.

OSBA: Design and Configuration Tools for Non-expert Designers

Kent Larson, Stephen Intille, Jarmo Suominen, and TJ McLeish (alumnus)
In contrast to the generic housing development process, this new model places the individual in the center of participative process via a design platform for non-experts. A tangible interface allows consumers to access sophisticated design tools without requiring them to think like an expert designer. Three design representations are presented: an initial conceptual design to understand relationships and adjacencies, optically tagged physical components permit an exploration of alternative adjacencies and configurations, and real time perceptual representations communicate the resulting form, materials, and light. If adopted by industry, such a strategy could create powerful incentives for innovation.

PlaceLab

A House_n and TIAX, LLC Initiative
PlaceLab is a highly instrumented apartment-scale shared research facility where new technologies and design concepts can be tested and evaluated in the context of everyday living. This 1000-square-foot facility is located on the ground floor of a new full-service condominium building between Harvard and MIT. Not a prototype, and not a demonstration environment, the PlaceLab is a new type of scientific “instrument” that allows researchers to collect fine-grained human behavior and environmental data, and to systematically test and evaluate strategies and technologies for the home in a natural setting with volunteer occupants. The PlaceLab is capable of accommodating multiple and simultaneous experiments proposed by academic researchers, industrial researchers, or collaborative groups. The PlaceLab interior consists of instrumented laboratory versions of the Integrated Interior Infill (I3) methodology.

Strategies for Building and Operating Living Laboratories

Jennifer Beaudin, Jason Nawyn, Pallavi Kaushik, Emmanuel Munguia Tapia, Stephen Intille, Kent Larson
The PlaceLab is a Living Laboratory for studying people and their interaction with technologies and design strategies in a natural setting. We are documenting the lessons learned with the PlaceLab and creating design guidelines for other organizations interested in creating and operating such facilities.

Just-In-Time Persuasive User Interfaces for Motivating Healthy Behaviors

Stephen Intille
This research program investigates technologies and user interface design strategies for creating persuasive devices and spaces. We are developing new computer technologies that automatically detect “point-of-decision” contexts using mobile computers and environmental sensors. Interfaces use this “just-in-time” information about what people are doing and ideas from behavioral science and social psychology in order to motivate behavior change in fun, educational, non-irritating ways over very long periods of time. Application areas include motivating energy and resource conservation, healthy eating, physical activity, personal and work safety, and learning. Information delivery platforms of interest include ubiquitous computing devices in the home and mobile computers, such as phones.

Context-Sensitive Measurement of Physical Activity

Stephen Intille, Boston Medical, Stanford Medical
This research program is focused on the development of portable technologies that can be used to measure moderate or greater intensity physical activity for medical studies on preventive health care in natural settings such as the home and workplace.

Context-Sensitive Measurement of Sedentary Activity

Jason Nawyn, Stephen Intille, University of North Carolina Medical School
This research program is focused on the development of portable technologies that can be used to measure sedentary activity in the home setting for medical studies, particularly focused on television watching behavior.

Recognizing Activities of Daily Living in the Home Setting using Ubiquitous Sensors

Emmanuel Munguia Tapia, Stephen Intille, Kent Larson
Medical professionals believe that one of the best ways to detect an emerging medical condition before it becomes critical is to look for changes in the "activities of daily living" (ADLs). We are developing new pattern classification and context-based AI algorithms that detect changes in ADLs and other everyday activities automatically. Such algorithms can be applied to both preventative medicine and to devices that monitor and control home and work spaces. Particular attention is focused on identifying behaviors that indicate mental illness and cognitive aging and associated medication compliance issues. This project is sponsored by the National Science Foundation.

Context-Aware Experience Sampling

Stephen Intille, Ling Bao (alumnus), John Rondoni (alumnus), Joyce Ho (alumnus)
We believe that environmental sensors combined with wearable sensors may offer the most potential for automatic recognition of everyday activity to enable new generations of context-aware computing devices. We are developing algorithms that automatically detect some activities from portable biometric and motion sensors. We have created software that runs on PocketPC devices and can be used to collect data using context-aware experience sampling – where sensors automatically trigger a computing devices to ask a volunteer a set of questions in a particular situation. This software is being used both for studies of people and technology in natural environments such as homes and workplaces as well as to collect data needed to develop new context detection algorithms.

MITes+: Portable Wireless Sensors for Studying Behavior in Natural Settings

Louis Lopez, Emmanuel Munguia Tapia, Stephen Intille
MITes (MIT environmental sensors) are low-cost, wireless devices for detecting motion of people and objects in environments. We are extending these devices to provide other information to technology and medical researchers, such as position, ultra-violet light exposure, heart rate, and tactile feedback.

Proactive Health Displays for Health Assessment and Self Reflection and KinQuery

Jennifer Beaudin, Stephen Intille, Margaret Morris (Intel Research)
In this project we have created example health displays showing the type of data that a home health system could collect about a person's behavior. The example displays were used in interviews with consumers and health professionals to learn about the type of health-related information people might want to track in their own home. These interviews have been used to develop designs for a proactive health application for the home called KinQuery.

Detecting Idle Moments for Proactive Health Activities Using Personal and Environmental Sensors and Interfaces

Stephen Intille, Jennifer Beaudin, Emmanuel Munguia Tapia, Kent Larson, Intel Research
Wearable and environmental sensing are used to detect an person's specific activities to select an appropriate time to present novel, computerize generated proactive health messages. Our goal is to demonstrate that by detecting such moments in time, innovative

proactive health applications can be created. In particular, we will develop software that uses mobile computing devices for "embedded cognitive assessment," where users are continuously providing health data via games, memory recall exercises, and other quick tasks even as they go about their typical, everyday home activities.

Reducing “Interruption Irritability” from Mobile and Ubiquitous Computing Devices

Stephen Intille, Joyce Ho (Alumnus)
The potential for sensor-enabled mobile devices to proactively present information when and where users need it ranks among the greatest promises of ubiquitous computing. Unfortunately, mobile phones, PDAs, and other computing devices
that compete for the user’s attention can contribute to interruption irritability and feelings of information overload. In this project we are studying ways of using machine learning and sensing to create context-aware computing devices that minimize the perceived interruption burden of proactively delivered messages. Context-aware computers can present information ubiquitously in environments without overwhelming users with information or creating annoying interruptions. One strategy is to exploit the visual phenomena of change blindness. Another is to tie interruptions to changes in physical activity.

Developing Ubiquitous Computer Interfaces for the Home

Stephen Intille, Claudio Pinhanez (IBM Research)
This project explores ways of extending traditional rapid prototyping techniques and user interface designs to interfaces for future environments with sophisticated sensing and display capabilities. Research includes work on how new displays such as the IBM Everywhere Display that permit “pixels anywhere” influence the design of user-friendly interfaces. IBM Research provided a seed grant for this research.

Measuring and Motivating Stair Use in Public Spaces

Stephen Intille, Ron MacNeil, Jason Nawyn, Jacob Hyman (alumnus)
Changing Places researchers are creating physical and digital systems for the home and community that promote healthy lifestyles. An effective way to proactively promote health is to design environments that encourage short spurts of daily exercise. Stair use, for example, is one of the best forms of short spurt exercise. We have developed technology for measuring and motivating stair use in public spaces. We are evaluating our system in some of Boston’s public spaces. The Robert Wood Johnson Foundation provided a seed grant for this research.

Unfunded Project Ideas

Portable Tools for Studying the Workplace

Michael Joroff, Chuck Kukla, Stephen Intille, Kent Larson
We do not fully understand the changing nature of work. Some components of the sensor infrastructure of the PlaceLab have been developed so they can be used as portable tools for studying existing workplaces. In addition to existing environmental sensors and PDA-based experience sampling tools, tools for use logging, identity recognition, position recognition, activity recognition, and photographic self-reflection may be developed and used with traditional, manual fieldwork techniques. This research platform will be used to collect workplace activity data in a variety of settings and organizational types, with the goal of improving existing and future workplaces.

Former Projects

Architectural Design Critics

Reid Williams (alumnus), Stephen Intille, Kent Larson
This project investigates how machine learning techniques can be used to create computerized architectural design critics. Web based design critics can automatically

provide non-experts with feedback based upon a particular architect's style. This system has been prototyped using the Platform for Consumer Driven Participative Design of Open (Source) Buildings described above.

From Personal Experience to Design

Jennifer Beaudin and Kent Larson

Advances in building and computational technologies, coupled with a reorganized and integrated system of residential design, may make personal environments tailored to the needs of the individual a possibility for a larger segment of the population. This project explores the essential first step towards ubiquitous personalized design: the development of tools to help non-expert designers identify their perspective, needs, and goals. The resulting information can then be linked to new design algorithms and a more rational and integrated just-in-time manufacturing process.

See separate documents for the following House_n Projects:

PlaceLab: An MIT and TIAX LLC Initiative

Portable Place-Based Research Tools: A House_n Project

MIT Open Source Building Alliance: A House_n Project

For more information, please contact:

Kent Larson, Director
Stephen Intille, Technology Director

Ms. Deenie Pacik
Changing Places / House_n Administrator
Massachusetts Institute of Technology (MIT Bldg NE18-4FL)
One Cambridge Center, 4FL
Cambridge, MA 02142 USA
tel 617-452-5676 fax 617-225-0027 email dpacik@media.mit.edu

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