Eliciting User Preferences Using Image-Based Experience Sampling and Reflection

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ABSTRACT
Determining requirements for any design project involves identifying and ranking user needs and preferences. User needs are typically elicited via personal or focus group interviews, site visits, and photographic and video analysis. Often, however, users know more than they say in a single or even several interviews [1]. We propose a methodology for assisting a user who is interested in learning about his or her own preferences using a process we call image-based experience sampling and reflection. We describe the methodology using a storyboard example from the domain of architectural redesign of home environments.

Keywords
Experience sampling, reflection, eliciting preferences, conjoint analysis, user-based digital design.

THE PROBLEM
Consider this scenario. Susan feels unhappy with her current kitchen and plans to remodel it sometime in the next six months. She has a limited budget and knows that she must prioritize the changes she would like to make. Such a scenario is common. The user knows that something in his or her life needs to change but is uncertain how to evaluate the relative importance of different options.

A common method for helping users evaluate their preferences in such instances is to construct interfaces that prompt the user for information that is used to determine the combination of attributes that provides the most perceived value to the user [2]. Interfaces that use such an approach are typically prompting the user about preferences outside of the context of everyday activity (i.e. kitchen redesign software might ask Susan a series of questions about her kitchen). The best time to ask the user about preferences, however, would be in the midst of the actual activity being scrutinized. Further, most desirable would be if an interface could help the user build up awareness and understanding of the user's preferences *over time.*

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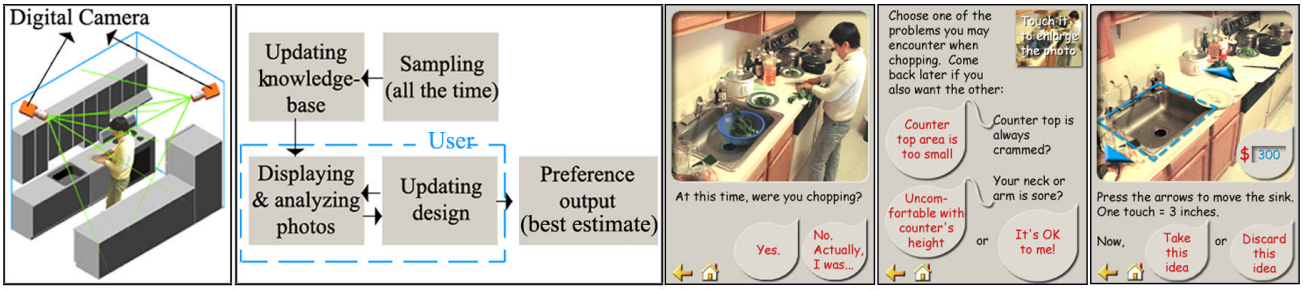
IMAGE BASED EXPERIENCE SAMPLING
We advocate an approach that allows preferences about real-world activities or environments to be obtained from the user with less reliance on user memory by exploitation of the user's context. The approach uses a combination of experience sampling and conjoint analysis to measure user preference; however, using an image-based methodology reduces the need for an interface that disrupts the user during everyday activity. Combining these three components, a non-disruptive but context-sensitive preference elicitation user interface mechanism can be developed.

The experience sampling method (ESM) is used primarily for time-use studies [4]. Subjects are asked to carry a beeper device that randomly sounds during fixed windows of time. Each time the beeper activates, subjects fill out a quick survey that typically includes questions asking what the subject was doing and how the subject was feeling at the time of the alarm. With a sufficient number of subjects and samples, a statistical model of activities can be generated. ESM is less susceptible to subject recall errors than other self-report feedback elicitation methods.

Conjoint analysis is typically implemented via a written or online survey. A large set of features is preference ranked by asking users to compare smaller sets of features against each other. For example, Susan might be asked, "Choose a number from 1 (always) to 10 (never) indicating how often each of the following situations occur: kitchen counter too crowded, I feel tired, shoulders get sore, feel somewhat drab." If Susan answers a sufficient number of such questions, statistical analysis can be used to weight the relative importance of features and conditions.

By combining ESM and conjoint analysis, context-sensitive feedback can be obtained. Unfortunately, ESM disrupts the user's activity, requiring the user to stop the current activity and answer questions on paper or on an electronic device. Therefore, we advocate the use of context-sensitive image capture. In image-based experience sampling, instead of disrupting the current activity with an alert, an audio-visual "image" is captured of the current activity at each sample time. The image can be a static picture or a small video clip of activity taken from a recording device installed in the environment. At a later time that is convenient for the user, the image samples can be browsed. The rich contextual information provided by the image or video clip triggers the



(a) (b) (c) (d) (e)

user's memory of the moment when the sample was taken [3]. User preferences are elicited about the images and then fed into conjoint analysis algorithms.

EXAMPLE: ARCHITECTURAL DESIGN

We have been exploring the use of image-based experience sampling in paper prototyping sessions with potential users of a "virtual architect" kitchen redesign tool. The tool would help users such as Susan identify and rank their design preferences. This tool is being designed to run on a portable computer (e.g. PDA). It assumes that two small wireless video cameras have been placed in opposite corners of the ceiling of each room, as shown in Figure 1a. Although not required to use image-based experience sampling, in this example we also assume that the 3D positions of the cameras relative to the fixed furniture in the environment have been calibrated. We also assume that algorithms are in place that can detect when a person in a home is within a particular room.

Figure 1b illustrates the interface' s operation. Using the cameras located in the environment, samples are randomly acquired whenever the user is in the kitchen area. Each day a few new images are acquired. The goal is to acquire samples of everyday activity so that the user can later refer back to remember a particular situation and comment on how the user was feeling about the environment.

At the user's convenience, subsets of images can be reviewed on a mobile computing device. Our model is that the user interacts with the interface in bursts of 30-90 seconds during idle moments throughout the day. The user can quickly scan an image or two and provide some preference information. This creates awareness and learning during short bursts of activity on a regular basis. Upon viewing a picture, the user will see the image or video clip, the time the clip was taken, and information the interface would like to acquire about how the person was feeling about the adequacy of the physical environment during the pictured activity. Figure 1c shows the interface eliciting feedback about what the user was doing at a particular moment, and Figure 1d shows the interface inquiring about how the user was feeling about counter space clutter at that instant. Eventually, after many short interactions, the user will have labeled a sufficiently large set of images (several hundred). The user's preferences can then be accurately ranked using conjoint analysis.

During our prototyping, we have been exploring how new sensing technologies can be combined with image-based experience sampling to not only allow the user to reflect on his or her experiences but to experiment with new possibilities. We do this by assuming the 3D position of the cameras are known relative to the 3D positions of fixed furniture and appliances in an environment. Figure 1e shows how the calibrated sampled images could have information automatically overlaid on top of them. Users can then be asked to rank not only how they felt about a particular situation but also how they would feel about change to the environment that is presented as a photo-realistic graphic alteration to the actual sampled image of the user's environment.

Finally, we are exploring one further extension to this design. In addition to ranking images or clips of their actual environment, intermixed with these images can be images of professionally designed environments with other people working in them. The interface can select images to show based upon the user preferences generated by the conjoint analysis. The user's own understanding placed in the context of professionally-designed environments should further improve the quality of the dialogue between the professional designer and the user.

CONCLUSION

Image-based experience sampling combines the power of three techniques: use of media for contextual recall, use of experience sampling for contextual information extraction, and use of conjoint analysis for preference rankings. We are developing this idea for a particular "virtual architect" kitchen redesign application. User feedback from paper prototype testing indicates that the technique could prove valuable in other applications that elicit user preferences.

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