

CHI Work Shop Position Paper
Ted Selker and Winslow Burleson
MIT Media Lab Contextually-Aware-Computing Group

The aesthetics, ergonomics, and function are central to the support of context aware systems. We are striving to integrate contextual information embodied in user experience and situation with the design process to create computer systems that integrate task, user and system models into system design. This holistic approach to utilizing situational awareness or contextual awareness in creating contextually aware systems places systems where they can be used naturally. We are striving to explore the contextual computing framework through design and testing of examples across a wide domain including seductive and persuasive.

Experiences in the design of contextually aware systems has lead us to develop a framework for using task, user, and system models. We have been designing contextually aware systems in specific places, which implement appropriate technologies in support of user driven scenarios that have to do with solving problems and integrating elements of a person's life with appropriate feedback. We believe this approach has the potential to make these places more interesting and useful. In designing contextually aware systems one can think about what technologies are available and where they could be used. Alternatively one can integrate technologies into a designed device which to be used in a variety of scenarios associated with a particular person, place, or task. We divide the world of contextual models into task, user, and system models:

- A task model refers to the acts that a person performs with a system, and what s/he intend to accomplish (ie Consider an oven mitt; the task for the person is to remove food from the oven and protect the surface that food is removed to. The task for the mitt is to protect the person and the surface from heat; it expects to be hot and then to cool. A new augmented task model might include the mitt telling the person that food is too hot or that food is getting cold).

With respect to the aspect of the user model that focuses on what a person wants to accomplish there are at least two elements:

- Explicit Congruency: The object must have the ability to accomplish the explicit intended goal. A plastic knife cannot cut glass and is therefore incongruent for the user if they want to cut glass.
 - Implicit Comfort: The object must meet needs broader than its specific task because the user has needs which are broader than their specific task. These often include intangible needs such as: the need to project a style or identity; the need to be fashionable; and the need to be motivated to accomplish a task which has been difficult for them and to succeed at it in more productive ways than they have been able to to date (the need to be peak performers of that task).
- A person's user model refers to the knowledge that a user has about what s/he is doing and about his or her ability to accomplish set goals. The user model, developed, and stored in the computer consists of this information along with task

relevant background information about the user. (ie. The threshold of an entrance knows who its users are, what access they should be given, and what their preferences are).

- The system model refers to the capabilities of the computer system, its structure and ability to accomplish an existing task (ie. A multimedia bed has the ability to project an image on the ceiling and play sound, track a three dimensional input device, and record body posture through a sensor mattress; to this extent it has the ability to help people relax, keep them entertained and facilitate effective sleep).

To the extent that the task, user, and systems models can be used to support and create new augmented tasks which meet the explicit congruency and implicit comfort needs of users, the design of contextually aware systems will be successful.

We have developed several working systems designed for tasks performed by users. They incorporate increasingly explicit and dynamic models, which are used to increase their value and flexibility as interaction tools. The techniques and technologies used to develop contextually aware systems include examples both with and without computers. Many contextually aware scenarios can be developed spatially or mechanically without the need for electronic sensors. Two such systems we have developed are the smart box – a just-in-time presentation of information during the unpacking process of a computer – and the universal plug -- a plug that self adapts to any standard outlet anywhere in the world. Analogue sensors and switches are the simplest kinds of electronic sensors. We have implemented these in the social floor – a floor that is projected upon to facilitate and augment individual behavior and interaction in a social environment. The most advanced systems are a complete integration of numerous sensors in support of task, user, and system models. Examples in this area include the multimedia bed and coffee table. Memory reasoning and learning systems are critical elements of great consequence for the design and development of contextually aware systems. The simplest form of memory is a single variable. In many of the design examples the hierarchy of memory and learning is quite deep; it is often used to direct change to the computer system as a technique for improving contextual systems.

Seduction and surface finish are particularly relevant to the design of contextually aware systems. Seductive experience is subjective and transient. The seductive element of experience is usually the interaction with a physical form; the experience is the experience of interaction and the experience of the intangible qualities of its feedback, which link to memory and anthropomorphic qualities (the mood, emotion, lighting, cute sounds, etc.) (Khavslavsky and Shedroff). For any context aware system to be successful it must be seductive enough for users to continue to engage the technology until their user model is developed. In a phenomenon not unlike the increasing value of antiques with age, as a contextually aware system continues to develop its task, user, and system models, it will become increasingly beneficial. Brian Clarkson is developing a remembrance agent to identify and record events in a user's life (MIT). This system ideally will become more valuable the longer it has recorded one's actions. This in itself is a seductive element of this type of technology. It is likely that this element of seduction is not enough, especially at the beginning of its use, to maintain user interest. A seductive physical form can overcome the deficiencies of the task, user, and system models.

Form and surface are important elements of contextually aware systems. Materials and how they are displayed effect function dramatically. The design of the case of a notebook computer is a good example of the importance of seductive surface. In the early '90s, some notebooks differentiated themselves by putting tens of dollars of extra cost into the case in the form of a stylish, textured coating. In the late '90s, some people put a similar amount into different materials that were perceived as being stronger. Now, people are considering other external materials that might understate the look. These cost, decisions are significant, and the amounts of money that people are spending on them are enough to upgrade any part of the computer to the next level of quality. Seductive form is an integral part of contextual design. It might be nice to show a visitor something when they walk up to a door but a 40-pound CRT monitor mounted in a door would make the door unwieldy and dangerous; a flat panel display or a rear projected touch screen might be seductive alternatives. A wooden clock case wouldn't do for taking the time at a swimming event. Although plastic can be used as a cutting material (e.g. Plastic knives), harder materials such as diamond, can be used in a greater variety of cutting situations with greater success; at the same time diamond implements are not currently cheap enough or disposable enough for family picnics. Design and aesthetics effect a user's perception, belief system, and therefore their task ability. The texture of something can effect whether a person can or wants to touch it, wear it, or take it with them. The gray metal surface of a cardpunch would not fit nearly as well in a home library as the rubber covered plastic of a notebook computer. Likewise, the spiky side of Velcro dose not feel good against your skin. Function, style, perceived reliability, and learning curve for the designed object or scenario are as important as the designs ability to complete a task.

There are at least three phases of user interaction that need to be balanced and mediated to sustain user interaction with a contextually aware technology. In some simple systems and elegant designs one or more of these phases may not be evident. These phases are: a *learning phase*, an exciting period in which a user is getting familiar with the use of the technology and their response to it. In this stage users will be forgiving if

things are not going quite as expected. The second phase is a *frustration phase*, a phase in which confidence and credibility are essential (www.webcredibility.org). Some of the issues during this phase are the accuracy, reliability, credibility, and predictability of the technology, as well as the user's satisfaction with his or her interaction with the technology. Up until this point, there has been some opportunity for personalization, but the model has not been completed. This is where appropriate design presents a significant opportunity to overcome the limits of the personalized model and sustain the users interaction with the system until credibility can be regained. The third phase is the *mature user phase*, representing an appreciation of the system benefits and an increasing appreciation for the seductive experience due to the ongoing personalization of the contextually aware system. The four elements of creating seductive interfaces which can contribute most to the design efforts for contextually aware systems include: creating instinctive emotional responses; connecting with personal values and goals; creating ongoing surprises; enabling discovery of the unexpected or deeper value (www.captology.org). These qualities of seductive design are particularly constructive for the development of contextually aware peak performance systems.

Through aesthetics , ergonomics, seduction, form and function we are learning how to develop context aware systems focusing our design efforts around the task, user and system models and their integration into system design.