# New Directions:
# A Value-Sensitive Design Approach to Augmented Reality

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**ABSTRACT**
In this position paper we bring a new approach – Value-Sensitive Design -- to understanding the value implications of augmented reality. We examine seven values: psychological well-being, physical well-being, privacy, deception, informed consent, ownership and property, and trust. In addition, we briefly describe our work where we apply a Value-Sensitive Design approach to augmented reality of the natural world.

**Keywords**
Augmented reality, Value-Sensitive Design.

**INTRODUCTION**
In their work, designers of technology necessarily impart social and moral values. Yet how? What values? Whose values?

These questions have been at the heart of an emerging multi-disciplinary field called Value-Sensitive Design [1, 2, 4]. This field seeks to design technology that accounts for human values in a principled and comprehensive manner throughout the design process. Value-Sensitive Design is primarily concerned with values that center on human well-being, human dignity, justice, welfare, and human rights. Recent studies, for example, have focused on bias in computer systems, network browser security, privacy in relation to computerized highway systems, universal access within a communications company, and accountability in a computerized society.

From the Value-Sensitive Design approach, technologies in general, and computer technologies in particular, provide suitabilities that follow from features of the technology. That is, a given technology is more suitable for certain activities and more readily supports certain values while rendering other activities and values more difficult to realize. For example, a hammer is well suited for driving nails, but functions poorly as a ladle, pillow, or wheel. Or an online calendar system that displays individuals' scheduled events in detail readily supports accountability within an organization but makes privacy difficult. Thus the general question becomes: How can we design augmented realities to better account for human values?


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Toward addressing this question, future value-oriented analyses of augmented reality need to distinguish between the content that is being augmented, the technology performing the augmentation, and the social context of the augmented interaction. Consider, for example, a telegarden. The content involves a garden, and potentially promotes values typically associated with gardening (a connection to the earth, nurturing, and physiological and mental health). Based on issues of suitablity (above), the technology's design can more readily support either nurturance (e.g., to plant seedlings) or destruction (to crush plants and flood the garden). Finally, numerous value issues arise once the augmented content and technology is viewed within a larger social system. For example, are one's interactions kept private? Can one cooperate with others in this garden (e.g., tending another's plants while they are gone)? Does one participate in collaborative management of an ecosystem or not? – for example, who decides how to respond to an infestation of pests? If the garden becomes overcrowded, can the people who maintain the site physically uproot all the plants? Do interactions with a telegarden lead people toward greater responsiveness to nature, or less dependency on the "real" thing and thereby to less regard for the well-being of the natural world?

**HUMAN VALUES AND AUGMENTED REALITY**
We anticipate value-oriented analyses of augmented reality will involve, among others, the following values:

**Psychological Well-Being**
Augmented interactions have the potential to affect users psychological and emotional states. For example, augmented interactions with nature – like direct interactions with nature – may help to reduce stress and benefit psychological functioning. Similarly, sympathetic embodied agents (e.g., ActiMates Barney) have been hypothesized to provide companionship and emotional support for children.

**Physical Well-Being**
In the vast majority of online interactions (as occur, for example, in email and ecommerce), users are buffered from physical harm. But because of the physicality embedded in augmented reality, greater attention needs to be given to protecting individuals' physical security. That said, some forms of augmented reality might enhance physical well-being. For example, augmented interactions with nature –

like direct interactions with nature – may help individuals to maintain health and, when sick, to heal quickly.

### Privacy

Some of our traditional privacy protections in the physical world arise because physical objects do not readily tell where they have been, what they have been used for, and who has used them. But augmented reality can upset these conditions for privacy. For example, the computation linked with an electronic tag can be designed to retain a record of the interaction between a person, the computation, and the physical object. How can we design augmented reality to reasonably protect privacy?

### Deception

At times, augmented reality attempts to create a system such that the user cannot tell the difference between the real world and the augmentation of it. Yet, when all is said and done, and the technology is turned off, many users will want to know what was "real" and what was "augmented computation". Was the TV news reporter really standing in front of gunfire in Bosnia? Or was the news reporter in a quiet studio with an augmented backdrop?

### Informed Consent

Augmented reality technologies can allow users to do things to others via the technology. How do we ensure that users have a means to obtain the consent of others before engaging in such interactions? For example, while real-time Web camcorders in daycare centers allow individuals to view the children and caretakers in the daycare center, how can designers help ensure that those individuals who are being recorded have consented?

### Ownership and Property

Coupling physical objects and computation can challenge traditional concepts of ownership and property rights. For example, is the owner of the physical object always the same as the owner of the computation with which it is coupled?

### Trust

Trust matters. It allows us to reveal vulnerable parts of ourselves to others, and to allow us to know others intimately in return. Moreover, on the societal level trust enhances our social capital [3, 5]. Thus, because augmented reality often supports interactions among persons – particularly interactions that have the potential to leave some persons vulnerable to the actions of other persons – it becomes crucial to design augmented reality such that trust can thrive.

## CURRENT AND FUTURE WORK: A VALUE-SENSITIVE DESIGN APPROACH TO AUGMENTED REALITY OF NATURE

In our work (we are currently seeking funding), we use Value-Sensitive Design to help us frame and analyze the data from five psychological studies of users interactions with augmented reality systems. Studies 1 and 2 involve real-time video (a Web camcorder on Old Faithful and a room with an augmented "window" view). Studies 3 and 4 involve personal embodied agents (robot pets with children and robot pets as companions for the elderly). And study 5 involves telepresence (a telegarden). Physiological, behavioral, and value-oriented social-cognitive data will be collected. For this particular set of augmented reality technologies, we anticipate that the above value considerations will be central to our analyses.

## BIOGRAPHIES

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Batya Friedman is Associate Professor in the School of Library and Information Science and Adjunct Associate Professor in the Department of Computer Science and Engineering at the University of Washington. She received both her B. A. and Ph.D. from the University of California, Berkeley. Her research program has commitments to the areas of Value-Sensitive Design, social-cognitive and cultural aspects of information systems, and human-computer interaction. In 1997 she edited *Human Values and the Design of Computer Technology* (Cambridge University Press). She is currently funded by the National Science Foundation for several projects, including (a) *Network Browser Security and Human Values: Theory and Practice* and (b) *Informed Consent Online: Criteria, Metrics and the Design of Web-Based Programming Languages*.

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Peter H. Kahn, Jr. is Research Associate Professor in the Department of Psychology at the University of Washington. He is also Co-Director of The Mina Institute – an organization that seeks to promote, from an ethical perspective, the human relationship with nature and technology. He received his B. A., M.S., and Ph.D. from the University of California, Berkeley. In 1999 he wrote *The Human Relationship with Nature: Development and Culture* (MIT Press). Dr. Kahn is currently editing a volume, also to be published by MIT Press, titled *Children and Nature: Theoretical and Scientific Foundations.*

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