Chapter 2.12
The Semiotics of Smart Appliances and Pervasive Computing

Peter Bøgh Andersen
University of Aarhus, Denmark

Martin Brynskov
Center for Interactive Spaces, University of Aarhus, Denmark

ABSTRACT

This chapter presents digital habitats, a conceptual and methodological framework for analyzing and designing smart appliances in the context of pervasive computing. The concrete topic is a project in pervasive gaming for children. The framework consists of a set of theoretical concepts supplemented by diagrams for representing semiformal models. We give a short overview of selected theories of play and gaming and apply the framework to an implemented simple pervasive game. Finally, we use the framework in a constructive manner to produce a concrete design of a new game. The result is discussed and compared to other approaches. The main points are the following: (a) it can describe communicative as well as material acts plus the way they hang together; (b) it provides an explicit link between human activities and their spatial context; (c) it has an explicit dynamic model that precisely describes the conditions for executing actions; and (d) it offers a typology of participant roles based on linguistic theory, which supports design processes.

INTRODUCTION

In this chapter, we will present an approach to analysis and design of computing systems that transcends the boundaries of traditional office computer systems such as PCs and laptops. These transcending systems are called ambient, ubiquitous, or pervasive computing systems, and they pose new challenges to the way we understand, analyze, and design information technology. With such systems, computing power spreads from dedicated computing hardware into other artifacts and places, both at the workplace and

in everyday life. Microcontrollers, sensors, and actuators have been embedded in machines for decades, but the functionality was tied closely to the artefact in which it was embedded (e.g., a washing machine or the side mirror of a car), and therefore, the computational "smartness" was not foregrounded in itself. Two factors have changed this: (a) the increasing flexibility and computing power of smaller-scale devices, and (b) the wireless networking capabilities and structured exchange of information. In this world of smart phones, GPS (location tracking), and software agents, we need concepts to communicate about human needs and activities as well as technical infrastructures. Digital habitats is a suggestion for such a framework. In our presentation, we focus on fun and games, but the framework originally was conceived in a workplace setting.

"On the Concept of Intelligence" discusses the concept of intelligence and concludes that the everyday use of the concept applies to a disposition to act in a certain way in a network of other actors and artefacts. To be intelligent is to fill out Agent roles appropriately in activities conducted by such networks.

The habitat concept defines the framework we use. On the one hand, it defines activities in terms of roles, participants, actions, and glue binding participants to roles. The well-known automatic door opener is used as an example. On the other hand, it offers a maplike representation that ties activities to physical and informational spaces and describes the various types of interplay between physical and informational space. This is particularly relevant to pervasive computing, since pervasive computing is characterized by being distributed in physical space and by overlaying physical space with digital information.

In "Play and Games," we give a short overview of theories of play and gaming. In "Designing Pervasive Games," we adapt the framework to the domain of games and describe an implemented simple pervasive game called *StarCatcher*. "The Bogeyman" puts all the ends together in a concrete design of the game *Bogeyman* that elaborates on StarCatcher by drawing on the presented theory. "Related Work" compares this chapter to related fields, and the conclusion summarizes the advantages of the present approach, as we see it.

ON THE CONCEPT OF INTELLIGENCE

The first issue that must be discussed is what *smart* and *intelligent* mean.

Intelligence

Since there is no universally accepted definition of intelligence (Roth & Dicke, 2005), we accept Gilbert Ryle's (1970) claim that these words denote (a) the manner in which an action is performed and (b) a prediction about the way other actions are performed. In this case, intelligent does not denote a special mental process that is the cause of the action but rather a disposition generally to act in a certain manner. What is intelligent depends upon the circumstances but often involves features such as: the action achieves its goal, it does not contain superfluous steps, it economizes with resources, it does not destroy or hurt participants, it is an innovative way of solving a difficult problem, and so forth.

This definition is similar to a prevalent view in contemporary cognitive science, that "mental or behavioral *flexibility* is a good measure of intelligence, resulting in the appearance of novel solutions that are not part of the animal's normal repertoire" (Roth & Dick, 2005, 250). We choose to focus on the behavioral aspect and, thus, preclude ourselves from making inferences about neuroanatomy or mental mechanisms. On the other hand, this choice to focus strictly on behavior allows us to use the word about humans as well as artifacts without committing ourselves to philosophical doctrines about the nature of the mind (see Dennett, 1991).