Chapter 8.1
Ambient Learning

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ABSTRACT

The vision where living and working spaces adapt to people is becoming a reality thanks to the increased embedding of computing power into everyday objects. Ambient learning focuses on the way people adopt technology in their everyday life and how technology adapts to the environment. Ambient learning is a new area in ubiquitous computing (UC) about the different learning processes that occur between people and smart technology environments. This chapter is organized as follows. First, we provide a definition of what ambient learning is, and its relevance to ubiquitous computing. Next, we present the learning concepts behind ambient learning and a detailed example of training a user. Then we examine in detail the technological building blocks behind the smart products supporting their ability to learn from each other and assemble or "compose" their functionality.

INTRODUCTION

As smart technology becomes ubiquitous, we must keep in mind that both humans and technology are in a process of constant evolution. We must foresee a process in which technology and humans cooperatively increase and adapt their knowledge about one another.

This process has three technology related facets:

1. Technology must learn from—and adapt to—its users.
2. Users must learn from—and about—technology.
3. Technology must learn from—and adapt to—other technology.

Accordingly, we define ambient learning as the learning issues and activities of ubiquitous computing: ambient learning is the evolution of mutual knowledge among technology components and humans in the course of their cooperation, with the aim of improving the level of cooperative achievements.

Obviously, this definition requires autonomous, communication-enabled and "smart" technology components, and is therefore bound to ubiquitous computing, unthinkable in the preceding eras of technology. We will call such components *smart products*.

In this chapter, we will only be able to—roughly—lead the way towards a first level of ambient learning, with rather modest learning goals, centered on operational features and workflows of technology and relatively simple user needs and plans. This first step can be called "ambient instruction:" technology and users instruct each other. It is our belief that scientific maturity of this first step is required as a prerequisite for next steps towards more ambitious educational or pedagogical goals, where technology and users truly educate one another.

Other definitions of ambient learning have recently emerged in the literature. Most often, they can be rephrased as mobile learning; corresponding projects emphasize the adaptation of learning material and learning processes to the learning context, that is, the situation in which a user learns. However, the situation is usually considered to be unrelated to the learning content itself (e.g., learning while riding the bus as opposed to learning about riding a bus). Admittedly, these projects are not as restricted in terms of educational ambitions as we are (yet). In the future, we expect a convergence of these conflicting notions of ambient learning:

- Ambient learning as sometimes defined in the literature—better called mobile learning—will gradually move from "context-aware learning" to "in-situ learning."
- Ambient learning as we address it in the present chapter—which may even be called ambient instruction—will gradually move towards more ambitious educational goals.

The first of the three facets of ambient learning as mentioned in the beginning is already covered in the chapter "Adapting to the User" in this book. We will therefore concentrate on the other two facets, rephrasing them as follows:

- "Technology teaches users" (see point 2 above): it is important to foster the development of smart products that explain themselves and their usage to their users. In this way, the products should dynamically adapt to the level of knowledge acquired by their users – in addition to adapting to the context of use, user preferences, and to other parameters as already discussed in the chapter "Service Discovery."
- "Technology teaches technology" in the UC vision, assemblies of smart products (smart environments, if you wish) are not blueprinted and carefully configured from scratch. Users and smart products come and go rather arbitrarily, without a need for explicit configuration. Beyond the service discovery mechanisms described in the chapter "A Focus on Location Context" of this book, we need ways for "accidentally" grouped entities (users, objects) to make sense of their being grouped together. They must be able to understand one another beyond syntax and beyond pre-established common semantics, and to collectively develop and carry out plans towards common higher-level goals.

UBIQUITOUS COMPUTING AND LEARNING

Modern life poses new challenges to people, since changes and technologies are being introduced with increasing speed in our lives and jobs. Therefore, we must learn more things through our entire working life to remain useful and competitive.

In this context, traditional learning has some important disadvantages:

- It concentrates all the learning into one period of life, when learners may not be mature enough, ready or just don't care.