



## Chapter XI

# Activity-Oriented Computing

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## Abstract

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*This chapter introduces a new way of thinking about software systems for supporting the activities of end-users. In this approach, models of user activities are promoted to first class entities, and software systems are assembled and configured dynamically based on activity models. This constitutes a fundamental change of perspective over traditional applications; activities take the main stage and may be long-lived, whereas the agents that carry them out are plentiful and interchangeable. The core of the chapter describes a closed-loop control design that enables activity-oriented systems to become self-aware and self-configurable, and to adapt to dynamic changes both in the requirements of user activities and in the environment resources. The chapter discusses how that design addresses challenges such as user mobility, resolving conflicts in accessing scarce resources, and robustness in the broad sense of*

*responding adequately to user expectations, even in unpredictable situations, such as random failures, erroneous user input, and continuously changing resources. The chapter further summarizes challenges and ongoing work related to managing activities where humans and automated agents collaborate, human-computer interactions for managing activities, and privacy and security aspects.*

## Introduction

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Over the past few years, considerable effort has been put into developing networking and middleware infrastructures for ubiquitous computing, as well as in novel human-computer interfaces based on speech, vision, and gesture. These efforts tackle ubiquitous computing from two different perspectives—systems research and HCI research—hoping to converge and result in software that can support a rich variety of successful ubiquitous computing applications. However, although examples of successful applications exist, a good understanding of frameworks for designing ubiquitous computing applications is still largely missing.

A key reason for the lack of a broadly applicable framework is that many research efforts are based on an obsolete application model. This model assumes that ubiquitous computing applications can support user activities by packaging, at design time, a set of related functionalities within a specific domain, such as spatial navigation, finding information on the Web, or online chatting. However, user **activities** may require much diverse functionality, often spanning different domains. Which functionalities are required to support an activity can only be determined at runtime, depending on the user needs, and may need to evolve in response to changes in those needs. Examples of user activities targeted by ubiquitous computing are navigating spaces such as museums, assisting debilitated people in their daily living, activities at the office such as producing reports, as well as activities in the home such as watching a TV show, answering the doorbell, or enhancing house security.

This chapter introduces activity-oriented computing (AoC) as a basis for developing more comprehensive and dynamic applications for ubiquitous computing. Activity-oriented computing brings user activities to the foreground by promoting models of such activities to first class primitives in computing systems.

In the remainder of this chapter, the section on background presents our vision for activity-oriented computing and compares it with related work. Next we discuss the main challenges of this approach to ubiquitous computing. Specifically, we discuss user mobility (as opposed to mobile computing), conflict resolution and robustness, mixed-initiative control, human-computer interaction, and security and privacy.

The main body of the chapter presents our work towards a solution. Specifically, we discuss software architectures for activity-oriented computing and how to address the

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