Programming with Location—from Conceptualization to language design

In the pervasive computing domain, location is an important concept. A conceptual framework for location models that takes its outset in the human conceptualization of locations and space may improve the understandability of the models. We investigate classic space philosophy and psychological examinations of spatial aspects of objects and environment navigation in order to formulate recommendations for location models based thereon. In an experimental approach we consider questions that arise in three different projects, in which location is a central aspect.

The philosophical examination includes a general introduction to space philosophy topics, such as the distinction between spatial order and spatial magnitude. Furthermore, we introduce the discussion about the status of space, whether it exists, and if it does, what it is. Kant's theory, that space is a part of the mind that let us understand the non-spatial outer objects, is also reviewed.

The psychological core knowledge theory is presented. It maintains that concepts formed in the early infanthood are preserved in the core of adult knowledge. These knowledge cores contain both concepts of the spatiality of objects and representations of the environment. They are fast, autonomous, and inaccessible for conscious inspection, which are reasons for making location models that adhere to the principles expressed in core knowledge.

In the first of the experimental projects, we worked with a new combination of strong migration and dynamical rebinding of coarse-grained object structures for allowing pervasive applications to use resources in the environment. In the pervasive computing applications of the project object structures relate to each other through a multitude of spatial structures, such as cooperation relations and communication relations. We worked on expressing these abstract spaces in the system.

In the second project, we worked with safety aspects of home network applications. A row of safety issues, which could be expressed as having a maximal safe distance for operation, was identified. The levels in a coarse-grained graduation of physical distance were sufficient for expression of the safety concerns. These levels were expressed as method annotations, thereby allowing for a dynamically determined distance based access to method invocation.

In the third project we worked with mobility prediction for vehicles in an outdoor environment. The ability of Bayesian networks to reason about knowledge expressed as probabilities was used for predicting the future location of the vehicle. In this project, it was necessary to have a complex interaction between various location models, which all modeled aspects of the physical environment.

Space is a fundamental part of the world that governs our interaction with objects and our navigation in the environment. The philosophical and psychological foundation for location models allow us to define location models that are in better accord with our basic space concepts. Thereby we facilitate the interaction of the programmers with the inevitable location models of pervasive

computing.