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Nowadays, the vision of ``Ubiquitous Computing'' is partly put into practice, as users have many networked interaction devices at hand such as mobile phones, PDAs, Laptops etc. To allow unobtrusive and natural interaction with the devices in the user's environment remains a major challenge, as many different platforms, modalities and even contexts of use have to be supported. Traditional approaches in developing tailored user interfaces for each platform, device and modality are bound to fail since they neither take the dynamic usage context into account nor are they adaptable to the user's preferences and capabilities.

Within this thesis, the aforementioned challenges are addressed by a model-based approach, which allows the specification of device- and modality-independent context-aware user interfaces by a combination of dialogue and presentation models, profiles describing users, devices, modalities and context, as well as transformations between models and target user interfaces. The work carried out in this thesis is divided into three major topics: modeling the user interfaces, modeling and managing context information, and the adaptation of user interfaces based on the previous two concepts.

For the user interface modeling part, the Dialogue and Interface Specification Language (DISL) has been developed, which is an XML-based UI description language, closely related to the User Interface Markup Language (UIML). DISL incorporates a powerful dialogue model and a modality-independent presentation model. Some properties of DISL are now included in the upcoming OASIS-standard UIML 4.0. Together with DISL, a rendering architecture is presented, which allows interaction with different devices and modalities.

Concepts for context modeling have been established by using sets of interrelated profiles that are used to describe different aspects of users, devices and environments they are in. Furthermore, means for acquiring and processing contextual information, while maintaining the user's privacy, have been addressed.

The glue between the user interface models and the final user interfaces is provided through transformations which take the contextual information into account. As a transformation tool, the development of the Rule Description Language for Tree Transformation (RDL/TT) proved to be useful for many tasks provided in the scope of this thesis.

The contributions of this thesis have been validated by proof-of-concept implementations, a set of case studies that combine these implementations and examinations of requirements for the domains addressed.