Abstract

In Ubiquitous Computing environments, people are surrounded by a lot of embedded services. Since ubiquitous devices, such as mobile phones, have become a key part of our everyday life, they enable users to be always connected to the environment and interact with it. However, unlike traditional desktop interactions where users are used to request for information or input data, ubiquitous interactions have to face with variable user's environment, making demands on one of the most valuable resources of users: human attention. A challenge in the Ubiquitous Computing paradigm is regulating the request for user's attention. That is, service interactions should behave in a considerate manner by taking into account the degree in which each service intrudes the user's mind (i.e., the obtrusiveness degree).

In order to prevent service behavior from becoming overwhelming, this work, based on Model Driven Engineering foundations and the Considerate Computing principles, is devoted to design and develop services that adapt their interactions according to user's attention. The main goal of the present thesis is to introduce considerate adaptation capabilities in ubiquitous services to provide non-disturbing interactions. We achieve this by means of a systematic method that covers from the services' design to their implementation and later adaptation of interaction at runtime.

Models of obtrusiveness and interaction are used to define the interaction obtrusiveness adaptation behavior in a technology-independent way. These models drive the dynamic interaction adaptation by means of an autonomic infrastructure that leverages them at runtime. This infrastructure is capable of detecting changing circumstances (e.g., changes in user location, profile, activity, etc.), and planning and deploying interaction modifications. When a change in the user's situation is detected, services are retargeted to make use of the appropriate interaction components in an automated fashion. Under this autonomic infrastructure, we leverage technology-independent models as if they were the policies that drive the interaction adaptation in a considerate manner.

Furthermore, as user needs and preferences can change over time, we make use of a reinforcement learning strategy in order to adjust the initial obtrusiveness design in a way that maximizes the user's experience. The initial interaction obtrusiveness design ensures a consistent initial behavior according to the user needs at the moment. This design is then adapted for each service to the individual behavior and preferences of users based on user's feedback through experience. Also, models can be further customized by end-users using a mobile interface that allows them to change their own preferences manually.

The proposal has been applied in practice to evaluate it from the designers and the end-users viewpoint. First, the design method has been validated to show its usefulness in helping designers specify this kind of services. Although the development of the services is not completely automated, the guidance offered and the formalization of the involved concepts were proven helpful for designers to develop unobtrusive service interactions. Second, the interaction obtrusiveness adaptation has put in practice with end-users in order to evaluate the user's satisfaction and experience. This validation turned out the relevance of considering obtrusiveness aspects in the interaction adaptation process to enhance user's experience.