World Academy of Science, Engineering and Technology
International Journal of Computer and Information Engineering
Vol:11, No:04, 2017

Automated Adaptions of Semantic User- and Service Profile Representations by Learning the User Context

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Abstract : Ambient Assisted Living (AAL) describes a technological and methodological stack of (e.g. formal model-theoretic semantics, rule-based reasoning and machine learning), different aspects regarding the behavior, activities and characteristics of humans. Hence, a semantic representation of the user environment and its relevant elements are required in order to allow assistive agents to recognize situations and deduce appropriate actions. Furthermore, the user and his/her characteristics (e.g. physical, cognitive, preferences) need to be represented with a high degree of expressiveness in order to allow software agents a precise evaluation of the users' context models. The correct interpretation of these context models highly depends on temporal, spatial circumstances as well as individual user preferences. In most AAL approaches, model representations of real world situations represent the current state of a universe of discourse at a given point in time by neglecting transitions between a set of states. However, the AAL domain currently lacks sufficient approaches that contemplate on the dynamic adaptions of context-related representations. Semantic representations of relevant real-world excerpts (e.g. user activities) help cognitive, rule-based agents to reason and make decisions in order to help users in appropriate tasks and situations. Furthermore, rules and reasoning on semantic models are not sufficient for handling uncertainty and fuzzy situations. A certain situation can require different (re-)actions in order to achieve the best results with respect to the user and his/her needs. But what is the best result? To answer this question, we need to consider that every smart agent requires to achieve an objective, but this objective is mostly defined by domain experts who can also fail in their estimation of what is desired by the user and what not. Hence, a smart agent has to be able to learn from context history data and estimate or predict what is most likely in certain contexts. Furthermore, different agents with contrary objectives can cause collisions as their actions influence the user's context and constituting conditions in unintended or uncontrolled ways. We present an approach for dynamically updating a semantic model with respect to the current user context that allows flexibility of the software agents and enhances their conformance in order to improve the user experience. The presented approach adapts rules by learning sensor evidence and user actions using probabilistic reasoning approaches, based on given expert knowledge. The semantic domain model consists basically of device-, service- and user profile representations. In this paper, we present how this semantic domain model can be used in order to compute the probability of matching rules and actions. We apply this probability estimation to compare the current domain model representation with the computed one in order to adapt the formal semantic representation. Our approach aims at minimizing the likelihood of unintended interferences in order to eliminate conflicts and unpredictable side-effects by updating pre-defined expert knowledge according to the most probable context representation. This enables agents to adapt to dynamic changes in the environment which enhances the provision of adequate assistance and affects positively the user satisfaction.

Keywords : ambient intelligence, machine learning, semantic web, software agents
Conference Title : ICKESW 2017 : International Conference on Knowledge Engineering and Semantic Web
Conference Location : Lisbon, Portugal
Conference Dates : April 16-17, 2017