

A MODEL CHECKING BASED FRAMEWORK FOR BUILDING CORRECT CONTEXT-AWARE SYSTEMS

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Abstract

CONTEXT-AWARE COMPUTING refers to the idea that computing devices can sense and react to the physical environment where they are deployed. For example, a context-aware corporate office would intelligently respond to peoples locations and activities by self-adjusting its lighting and temperature automatically, thus reducing its energy footprint.

Context-aware systems model the real world by using increasingly complex and refined contextual-data representations. As a result, their design and management raise several challenges. An important and somewhat unexplored one is to guarantee that context-aware systems correctly capture the intent of their designers once deployed. For example, we might want to assure that the energy conservation of the aforementioned corporate office is actually preserved.

We propose in this thesis a query processing and specification framework that alleviates designing and building context-aware systems. It guarantees the management of contextual information, and can be used for specifying the underlying rules of context-aware systems. Our approach encourages a high-level of abstraction for retrieving contextual information in a robust manner, and supports building “provably-correct” context-aware systems incrementally, by providing modularity and separation of concerns.

The proposed approach aims at complementing existing context-aware services wherein contextual information about the physical and computational environment – information about people, objects, and services – is modeled in a symbolic fashion, and is independent of any particular sensing technology. In current pervasive computing platform, contextual information and their underlying models are queried an ad-hoc manner. Which makes it impossible to guarantee the quality of the results being returned, and hence the reliability of context-aware services.

The main idea behind our framework is to apply and adapt the principles of model checking to query the contextual data structures. Because such query mechanisms have to be sound, our approach is build upon a logic-based query language. We therefore ensure that the results of any query (i) do not miss any information that satisfy its necessary and sufficient conditions and (ii) do not contain any information that does not satisfy the conditions. We describe the implementation of our framework and discuss its applicability to existing graph-based contextual models.

