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Architecting Smart Home Environments for Healthcare: A Database-Centric Approach

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Opponent är docent Dr. Diego López-de-Ipiña González-de-Artaza, Universidad de Deusto, Spanien.

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Abstract

Considering existing system architectures for smart environments, the database management system (DBMS) is the most common but the least exploited architectural component, devoted exclusively for data storage and retrieval. However, database technology has advanced and matured considerably over the years, and, as a result, current DBMSs can be and do more.

The scope of this thesis is therefore to investigate the possibility of using different features supported by modern DBMSs to create a database-centric system architecture to serve as a platform for smart environments. The thesis also investigates the development of applications for health monitoring and assistance: 1) a serious game for fall prevention that assists people in practicing Tai Chi at home, and 2) a non-intrusive home-based method for sleep assessment.

The event-driven architecture of active databases, extensions for in-database processing, and built-in mechanisms for inter-process communication are technical features of some novel DBMSs and are explored in this thesis to address general functional aspects of smart environments, such as monitoring, processing and control of various types of events in a given environment. Extensibility and security features and cross-platform capabilities of DBMSs are employed to accommodate non-functional properties of smart environments, including interoperability, extensibility, portability, scalability, security and privacy. Heterogeneous technologies are integrated into the system using programming language and platform independent software resource adapters.

The feasibility of the proposed system architecture was pragmatically investigated with the development of a "smart bedroom" demonstrator and with the implementation of a number of services to support ambient assisted living. In the proposed architecture, active in-database processing maintains sensitive data within the database. This increases data security and independence from external software tools for data analysis. Changes in the system are managed during runtime, which improves flexibility and avoids system downtime. The developed architecture was evaluated taking into account different application scenarios and heterogeneous computing platforms.

As a conclusion, modern DBMSs support features that can be successfully employed in a database-centric system architecture to effectively and efficiently address functional and non-functional requirements of smart environments.