Context-aware Multi Sensor Fusion Models for Healthcare Applications

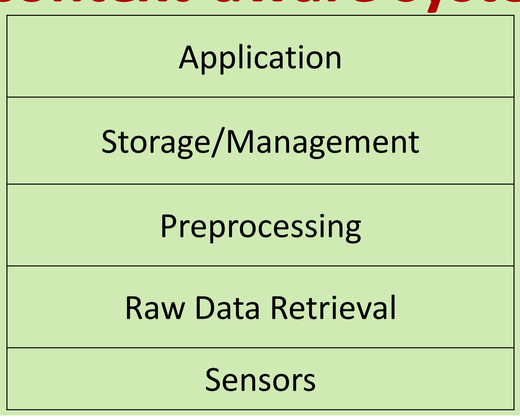
Muhammad Rizwan Abid

Distributed and Collaborative Virtual Environments Research Laboratory
School of Information Technology & Engineering
University of Ottawa, Ontario, Canada

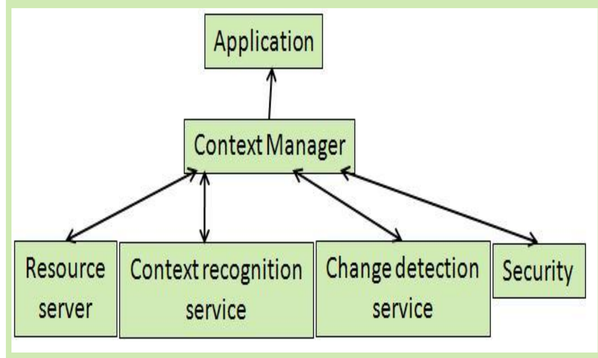
Abstract

The technological advances in healthcare can lead to longer life expectancy. We present survey of context-aware framework solutions for healthcare applications. Context aware systems offer entirely new opportunities for application developers and for end users by gathering context data and adapting systems behavior accordingly. These framework reduce the complexity of context-aware applications and improve their maintainability and evolvability.

Layered Conceptual Framework for context-aware systems



Hierarchical Framework



Key Value Models

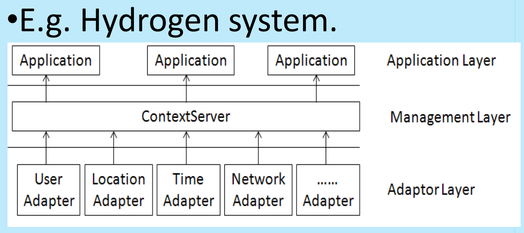
- Use as key-value pairs to describe the capabilities of a service
- Matching algorithms use for service discovery
- Frequently use in distributed service framework
- Easy to manage but lacking capabilities for sophisticated structuring for enabling efficient context retrieval algorithms.

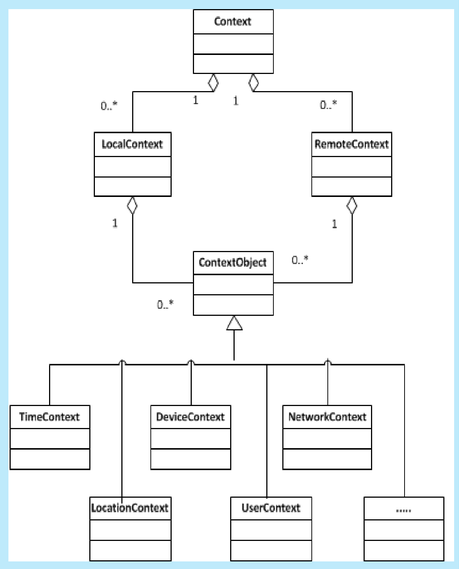
Markup Scheme Models

Use hierarchical data structure consisting of markup tags with attributes and content
e.g. composite capabilities/ preferences Profiles(CC/PP), User agent profile (UaProf)

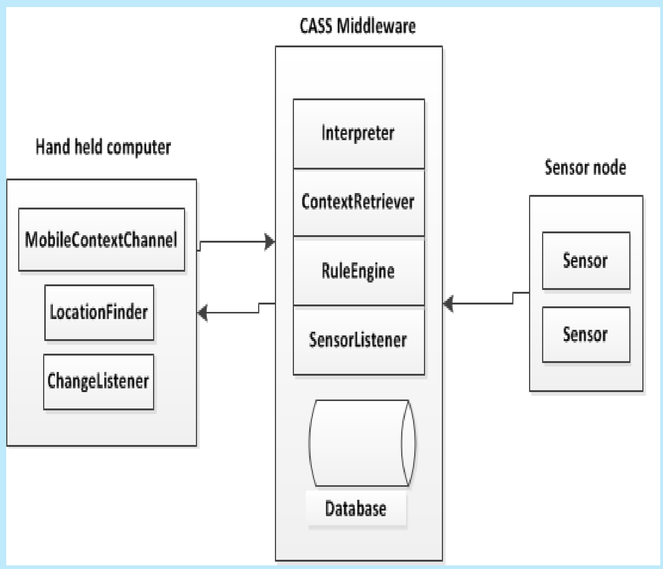
Object Oriented Models

- Modeling context by using object-oriented techniques.
- Use full power of encapsulation, reusability and inheritance.
- E.g. Hydrogen system.





Centralized Middleware Architecture



Graphical Models

- Use Unified Modeling Language(UML) to model context.
- Use Object –Role Modeling (ORM) for modeling context.

Logic Based Models

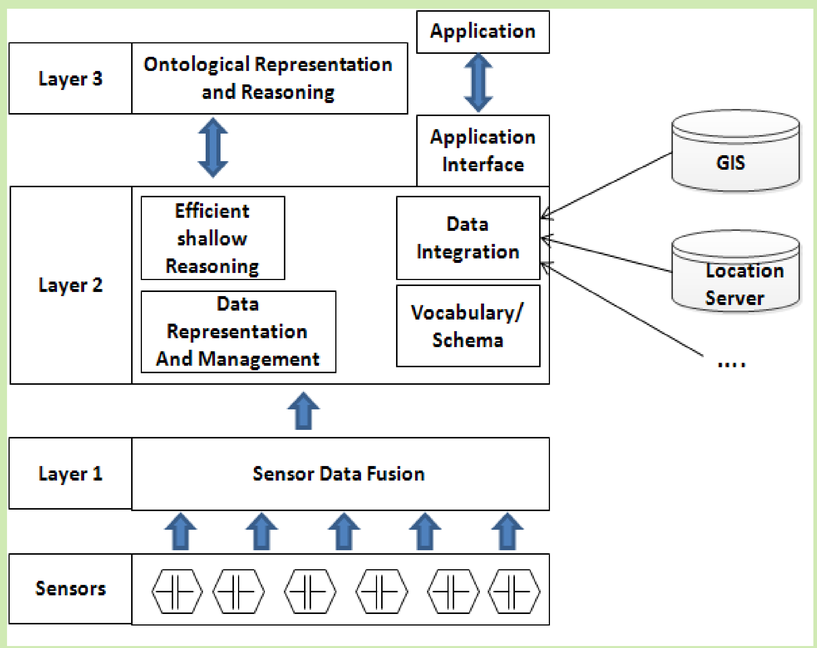
- Facts, expressions and rules are used to define context model.
- Allows to add, update or remove new facts.
- The inference/reasoning process can be used to derive new facts based on existing rules in the systems.

Ontology Based Models

- Ontology based models have following proven properties: Simplicity, flexibility and extensibility, genericity, expressiveness.
- A single context atom can be described with a couple of attributes: Context type, context value, time stamp, source, confidence.

Hierarchical Hybrid Model

- Comprehensive solution , both in terms of integration different forms of reasoning and in terms of expressiveness.
- Data directly acquired from sensors (or retrieved from a module executing some sensor data fusion technique).
- Support the execution of efficient reasoning techniques to derive high-level context data on the basis of raw ones.
- ontology-based context model is desirable on top of it. In addition to providing a formal semantics of the data, an ontological context model also supports the execution of reasoning tasks such as consistency checking and derivation of new context information.



Hybrid Fact-based / Ontological Model

- Goal is to combine the particular advantages of fact-based model especially the handling of ambiguous and imperfect context information with interoperability support and various types of reasoning provided by ontological models.
- Worth nothing because of some expressivity limitations.

Loosely Coupled Markup-based/Ontological Model

- It is based on loose integration between a markup model extended with policy rules expressed in a restricted logic programming language and an ontological model.
- To preserve efficiency, ontological reasoning is mainly performed in advance with respect to the service provision.