
Principles of Context aware systems



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DEFINITIONS

Why?

- Why to study context?
 - User
 - Take advantage of Human-Computer dialogue.
 - Increased Richness in Human-Computer Interaction → More useful computational services.
 - Developer
 - Determine what Context Behaviors to support in their applications.
 - How to choose the Context in the Application.

Contents - 1:

- **Context**
- Categories of Context
- **Context aware computing**
- Characterization

Context:

- “Context is any Information that can be used to characterize the situation of an entity”
- An Entity is a person, place or object that is considered relevant to the interaction between a user and an application, including the user and applications themselves.

Categories of Context

- Why?
 - Help Application Designers uncover the most likely pieces of context that will be useful in their applications.
- Primary Context types are
 - Location
 - Identity
 - Activity
 - Time
- Secondary Context types

Context Aware Systems

- *“A System is context-aware if it uses context to provide relevant information and/or services to the user, where relevancy depends on the user’s task.”*
- *Common Misunderstood is Self Modifying Systems.*

Categorization of Features for Context Aware Applications

- Presentation of Information and services to the user.
 - Example: Display
- Automatic execution of a service
 - Example: Alarm
- Tagging of context to information for later retrieval.
 - Example: Prediction

A-Analysis I-Identity L-Location T-Time

P- Presentation E-Execution T-Tracking

Table 1. Application of context and context-aware categories

System Name	System Description	Context Type				Context-Aware		
		A	I	L	T	P	E	T
Classroom 2000 [1]	Capture of a classroom lecture			X	X			X
Cyberguide [1]	Tour guide		X	X		X		
Teleport [2]	Teleporting	X	X	X			X	
Stick-e Documents [3,4,5]	Tour guide		X	X	X	X		X
	Paging and reminders	X	X			X		X
Reactive Room [6]	Intelligent control of audiovisuals	X	X	X			X	
GUIDE [7]	Tour guide			X		X		
CyberDesk [8,9,10]	Automatic integration of user services	X				X	X	
Conference Assistant [11]	Conference capture and tour guide	X	X	X	X	X		X
Responsive Office [12]	Office environment control			X	X		X	
NETMAN [13,16]	Network maintenance			X		X		
Fieldwork [17,18,22]	Fieldwork data collection			X	X	X		X
Augment-able Reality [19]	Virtual post-it notes			X		X		X
Context Toolkit [24]	In/Out Board		X	X	X	X		
	Capture of serendipitous meetings		X	X	X		X	X
Active Badge [28]	Call forwarding		X	X		X	X	

Contents - 2

- Common Architecture Principles
- Middleware/ Layered Conceptual framework
- Context Models
- Context Abstractions
- Context Aware Frameworks
- Requirements for dealing with context.
- Context Toolkit

SOFTWARE FRAMEWORKS AND DESIGN

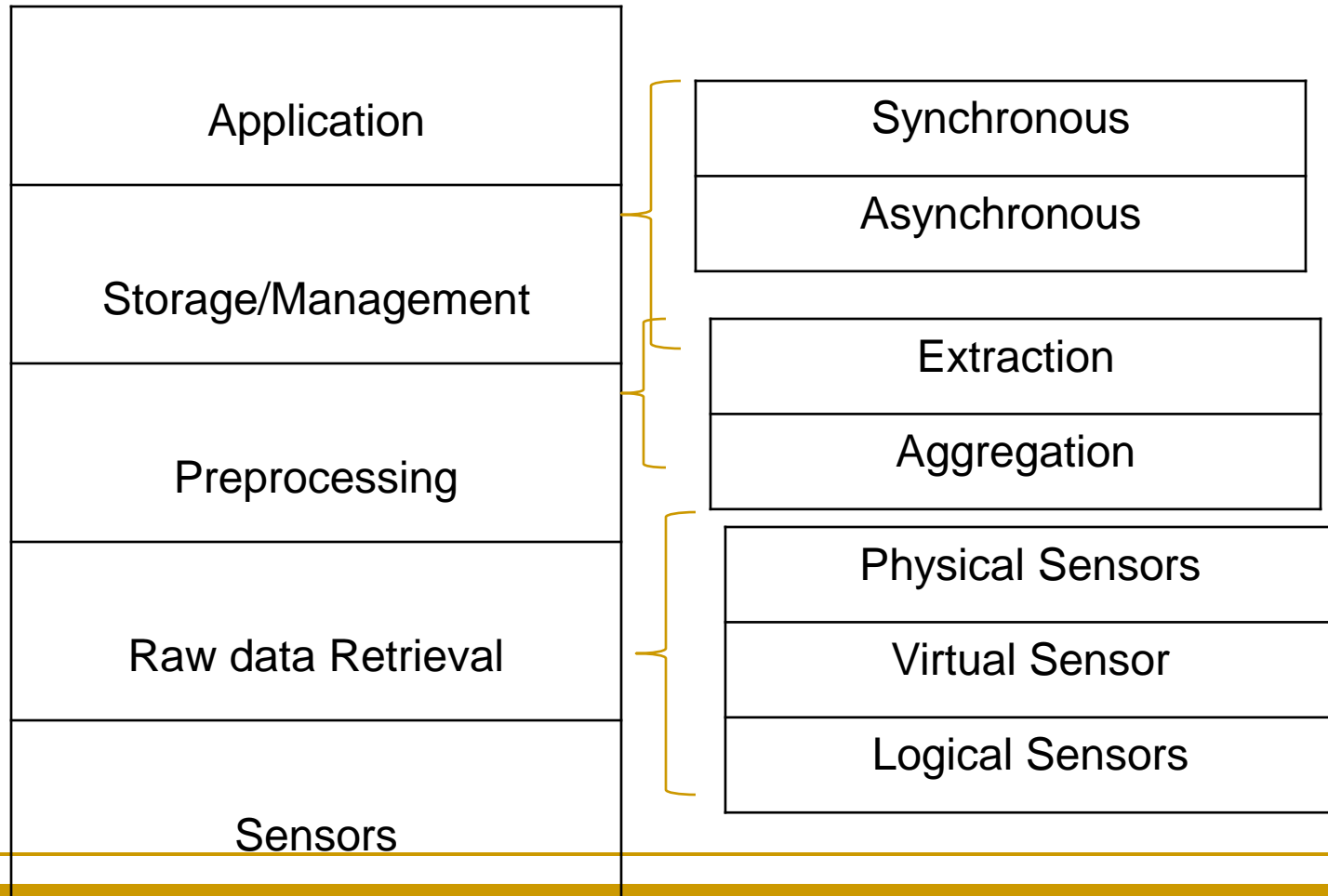
Frameworks

- Direct Sensor Access
- Middleware Infrastructure
 - A Layered Architecture.
- Context Server

More..

- Widgets
- Networked Services
 - Can thwart unreliability.
- Blackboard Model
 - Publish-Subscribe Model.

Middleware/ Layered Conceptual Framework



Context Models

- Key-Value Models
- Markup Scheme Models
- Graphical Models
- Object oriented Models
- Logic based Models
- **Ontology based Models**
 - **Simplicity, flexibility and extensibility, genericity, expressiveness**
 - **Context type, Context Value , Time Stamp, Source, Confidence.**

Context Abstractions

- Context Widgets
 - Provides Reusability, inheritance and encapsulation.
- Interpreters
 - Interpretation from sensory data.
- Aggregators
 - Similar to Widget. Differs in how context is aquired and used.
- Services
 - Synchronous and Asynchronous.
- Discoverers
 - Similar to ARP and RARP in computer Networks.

Context Aware Frameworks

- Architectures
- Resource Discovery
- Sensing
- Context Model
- Context Processing
- Historical Context Data
- Security and Privacy

Requirements for Dealing with Context

- Separation of context.
- Context Interpretation
- Transparent, Distributed Communication
- Constant availability of Context Acquisition

Features in Context Toolkit

- Distributed Communications
- Subscriptions
- Event Handling
- Discovery
- Context Services

Table 4 Summary of discussed approaches

<i>Architecture</i>	<i>Sensing</i>	<i>Context model</i>	<i>Context processing</i>	<i>Resource discovery</i>	<i>Historical context data</i>	<i>Security and privacy</i>	
CASS	Centralised middleware	Sensor nodes	Relational data model	Inference engine and knowledge base	n.a.	Available	n.a.
CoBra	Agent based	Context acquisition module	Ontologies (OWL)	Inference engine and knowledge base	n.a.	Available	Rei policy language
Context Management Framework	Blackboard based	Resource servers	Ontologies (RDF)	Context recognition service	Resource servers + subscription mechanism	n.a.	n.a.
Context Toolkit	Widget based	Context widgets	Attribute-value tuples	Context interpretation and aggregation	Discoverer component	Available	Context ownership
CORTEX	Sentient object model	Context component framework	Relational data model	Service discovery framework	Resource management component framework	Available	n.a.
Gaia	MVC (extended)	Context providers	4-ary predicates (DAML + OIL)	Context-service module (first-order logic)	Discovery service	Available	Supported (e.g., secure tracking, location privacy, access control)
Hydrogen	Three layered architecture	Adapters for various context types	Object-oriented	Interpretation and aggregation of raw data only	n.a.	n.a.	n.a.
SOCAM	Distributed with centralised server	Context providers	Ontologies (OWL)	Context reasoning engine	Service locating service	Available	n.a.

Discussion

- Reliability of the Sensors is not considered in most of the Context Aware Designs.
- What changes will the Context Aware Programs need while addressing Automatic Trust Negotiation and Policy managements.

References:

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- Thank You!