

Distributed Information Processing

16th Lecture

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Outline

- Embedded Software/Systems Research
 - Building the Foundation
- Context-Aware Mobile Computing Research
 - Introduction
 - Survey
- Q&A

Building the Foundation [Leed05]

■ Embedded Software Issues

- Resource Constraints Not at the Heart
- Time Omitted in Abstractions
- Inherent Concurrency
- Rarely Used OO Techniques
- Avoided Memory Hierarchy & Dynamic Memory Management
- Not Much Attention Paid to Non-Functional Properties
 - Time, security, fault tolerance, power consumption, memory management, etc.

Due to Mismatch of the Provided Abstractions and the Application Domain


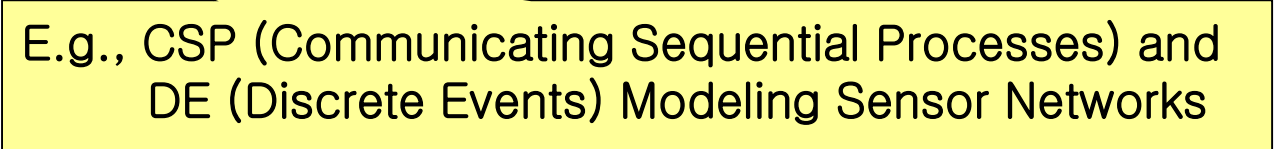
Building the Foundation (Cont'd)

■ Embedded Software Issues

- “Hard to Guarantee” Real Time
- Indirect Timing Specification
 - Avoided concurrency & benchmarking
 - Prioritization
- Progression of Time Ignored by Abstractions
- Incomprehensible Concurrency
 - Semaphores, Mutexes, Rendezvous, etc.
- Unreliability
 - Module Dependency
 - Lack of Compositionality of Core Abstractions

Because Timing Properties Are Not Part of Program Specs

Building the Foundation (Cont'd)

- Actor-Oriented Models as Better Concurrency Models
 - Key Idea: Flow of Streams of Data, Not Flow of Control
 - Ports as the Interface to a component
 - Concurrency of components
 - Interpreting & Specializing the Idea
 - Ptolemy II (a Lab)  Using a Visual Editor
 - Block diagrams as syntax & various semantics defined by “directors” with which diagrams are annotated 

Context Is Key [Coutaz05]

■ Introduction to Context

□ Part of a Process of Interacting with an Ever-Changing Environment Composed of Reconfigurable, Migratory, Distributed, & Multiscale Resources

- Continuity
- Ubiquity

Structured, Flexible Approach to Challenges of Large-Scale Ubiquitous Computing

■ Context Issues

- Part of a Process
- Holistic Treatment
- Mismatch between the System's Interaction Model and Users' Mental System Model

Need for New Interaction Techniques

Context Is Key (Cont'd)

■ Framework for Context-Aware Systems

□ Ontological Framework

- Context as an information space that can be modeled as a directed state graph, where each node denotes a context, and edges denote the conditions for change in context

□ Runtime Infrastructure Model

- Sensing: numeric observables
- Perception: symbolic observables
- Situation and context identification
- Exploitation

Incorporating
Privacy/
Security/Trust,
History, and
Discovery/
Recovery

□ Adaptation & Development

Automatic Acquisition of Situation & Context, and Ultimately the Acquisition of the Entities, Roles, and Relations from Which Situations & Contexts Emerge

References

- [Lee05] E. Lee, “Embedded Software: Building the Foundation,” Berkeley EECS Annual Research Symposium, University of California at Berkeley, February 2005
- [Coutaz05] J. Coutaz, *et al.*, “Context Is Key,” *CACM*, Vol. 48, No. 3, March 2005, pp. 49–53