The Role of a Context Service in a System that aims at integrating the Digital with the Real World

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Outline

- The Overall Vision
- Services of a Corresponding System
- The Context Service
- Conclusion

The Overall Vision

Integrating the Digital with the Real World

- Real World objects are represented in the Digital World
- changes in the Real World are reflected in the Digital World
  - so we can support real world processes by digital means without a break in media
- the Digital World allows to change some things of the Real World
  - this enhances the potential of the possible support
- this approach certainly has many social and ethical risks!

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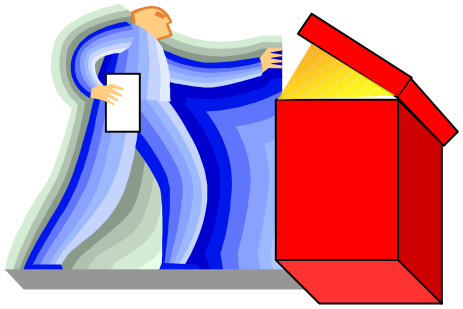

intelligent copy machine

- recognize which user uses machine
- bill copies to his/her department
- offer customized user interface

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socially-aware phone

- recognize social situation of the called user
- recognizes importance of call
- decides whether to ignore the call, to vibrate, to flash or to ring with an appropriate volume

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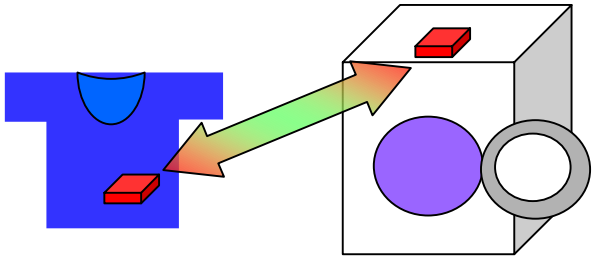
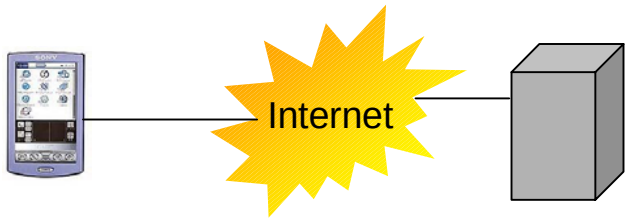
reminders

- recognize people I'm approaching
- present me a list of notes about things I wanted to talk about with that person

Communication: Two Extremes (1)





Local Interaction

- direct short-range communication between involved devices
- usage of Bluetooth, WLAN, IR
- concerned object includes computer
- Thesis: very cheap computers & local communication in every thing

Remote Interaction

- indirect communication between involved devices
- usage of PANs & Access Points, LANs
- usage of digital representants of concerned objects possible
- Thesis: all devices have always access to the network

Communication: Two Extremes (2)

- task: attach annotations to plant pot

Local Interaction

- plant pot stores notes
- when in range, user device can contact plant pot server
- application can query annotation

Remote Interaction

- multimedia annotation server stores notes associated with plant pot
- system knows user position
- application can query correct annotation

- in reality, both approaches have to be used when appropriate
- let's have a look on a system that uses more the second possibility

Services of a Corresponding System (1)

Real World objects are represented in the Digital World

- World Model Service
  - holds (static) data about digital *objects* that represent real world objects (example: plant pot object)
  - queries can be oriented
    - to these objects (get all annotations of the plant pot)
    - to spatial attributes (get all plant pot objects in a circle around a certain position)

changes in the Real World are reflected in the Digital World

- Dynamic Context Service
  - gathers dynamic data from sensors, processes it, and offers it to other components
  - example: location of a mobile user

Services of a Corresponding System (2)

Digital World allows to change some things of the Real World

- Different Services, e.g.
  - Inhouse Management Systems
  - Phone Network Management Systems
  - Printing Service

Other Complimentary Services are useful,e.g.:

- Event Service
  - informs components when certain changes occur or certain conditions are met
- Geographic DNS
  - associates symbolic names to geographic areas
- Area Service Directory
  - returns all services of a certain type responsible for a certain area

These Services do not need to be implemented as separate Components!

- in principle, a World Model can be used as an single interface to all components
  - model hold static & dynamic data about objects
  - some objects offer API that allows to interact with reality
- practically, often different components exist that combine different parts of these services because
  - systems do not want to satisfy the overall vision, but only limited parts of it
  - specialized components are able to offer functionality more efficiently
- examples:
  - location service
  - **context service**

What is Context?

"... any information that can be used to characterise the situation of a [focus] entity ..." (Anind Dey)

Examples:

- time and date
- location
- usage history
- preferences
- terminal capabilities
- social situation of a user

context *(in our understanding)*

- always relate to a focus entity
- is of a certain context *type*
- occurs in a certain *format*

Classification of Context Data (1)

- entity-defined data
  - data defined by focus entity (e.g. user)
- system-defined data
  - data defined by the system
- constant data
  - data typically changes rarely or never
- dynamic data
  - data typically change frequently
- distinction entity-/system applies by choice
- distinction constant/dynamic applies by nature

Classification of Context Data (2)

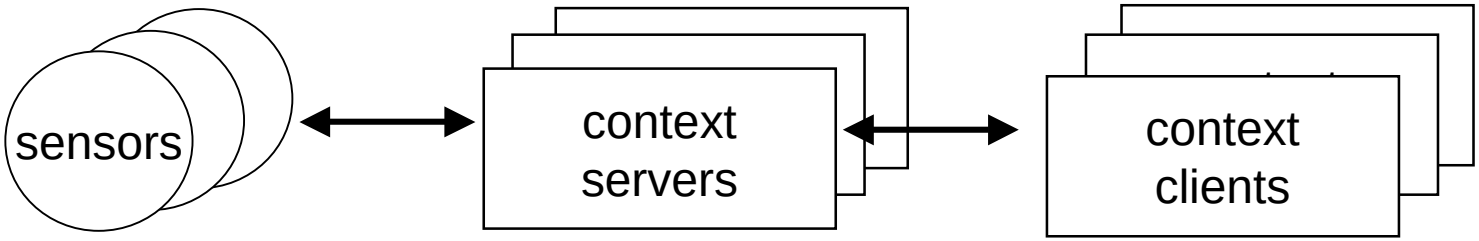
- pairs are orthogonal, but it is more likely that:
  - that entity-defined data are constant
  - system-defined data are (partially) dynamic
- normally, only the present context is considered, but
  - also past context data might be of interest
    - e.g. history of service usage
    - context just can be stored
  - future context data might be of interest
    - where is the user in 10 min?
    - context needs to be predicted
- other possible aspects:
  - level-of-detail
  - accuracy
  - cost to gather context data

What can be done with Context?

- usage as data to be presented to the user
- adaptation of applications (personalization)
- usage in triggers to initiate something if a certain context constellation occurs
- usage as index to other data
- storing, processing, etc. etc. pp.

✉ *personalization is just one application area!*

Elements of a Context Service



- sensors sense context data
- context clients access context data
- context servers mediate between sensors and context clients
- a Location Service is a (specialized) Context Service

Sensor Types

- Type a sensors
  - attached to user devices, e.g. GPS sensors
- Type b sensors
  - part of the physical environment, sense environmental data
  - Type b.1 sensors
    - sense data related to a certain entity
    - example: tracking systems
  - Type b.2 sensors
    - all other type b sensors
    - example: networked thermometer in a room
- Type c sensors
  - logical sensors, e.g. „Calendar sensor“

Context Servers

- gathers (partially highly-dynamic) data from sensors
- handles sensor aspects like:
  - discovery of sensors
  - availability issues
  - automatic change of sensors according to e.g. movements of a user
- processes them to a convenient form
- store context data
- decouple data generation and data consumption
- handles access-control aspects
- deduces higher-level data from lower-level ones
- deals with entity-related data
- offers some events

Security & Privacy Aspects

The relevant questions include:

- Which context server is allowed to access sensor data?
- Can we achieve anonymity of the tracked user for type b.1 sensors?
- How to protect the transport of sensor data from sensors to context servers if done via an insecure network?
- Which context client is allowed to access context data on a server?
- How to protect the transport of context data from servers to context clients if done via an insecure network?

Conclusion: How does the Context Service fits in the Overall Picture?

- a Context Service concentrates all data that define the situation of an entity
- motivation: context data is needed to
  - offer new services
  - to personalize services
- context data therefore includes dynamic data as well as static data
- strength of a context service is the handling of dynamic data via sensors

✉ for this purpose, a context service can be used in a system that integrates the Digital with the Real World

✉ so all we need is that overall system :-)

SONY
International (Europe) GmbH

Sony International (Europe)
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youngster

End-of-Presentation

What is Youngster ?

- EU IST project
- Duration: 01.01.2001 - 31.12.2002 (24 months)
- Partners: Heriot-Watt University, NRK, Siemens, Sony, Steria, T-Systems, Telenor
- Project aims:
  - development of an open service platform for mobile users
    - multi-accessible
    - context-awareness support
    - personalization support
    - community support
  - development of new, attractive mobile services
  - examine new business models
  - field-test of a version of the platform and some services
- Target group: young people (youngsters): 15-25 years

Mobile Services Platform (MSP)

- **multi-accessible**: accessible from anywhere by a wide range of devices and networks
- **context-aware**: provides a wide range of context-aware features (including location-awareness) allowing seamless and highly adaptive delivery of services and applications
- **personalized**: user-aware with different forms of personalization based on a dynamic user profile
- **community-support**: supports advanced communication services for communities of users
- **near-by device interaction**: the user can interact with devices in the environment
- **service creation by users**: users can create services using components of the environment, put own content and work in it, and offer these services through the environment to other users

Field Test

- July 2002 - October 2002 (4 months)
  - prepared and evaluated by Telenor
  - takes place at a Highschool in Grimstad, Norway (http://www.dahlske.vgs.no/)
  - usage of a GSM/GPRS coverage
  - 100 participants

More Information

- visit the project homepage: **http://www.ist-youngster.org**
- or contact me (hohl@sony.de)