

Controlling multiple devices

Physical Interaction (PI03)
Workshop on Real World User Interfaces

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Background and motivation

• PDA development

- Pocket PC based pedestrian navigation system.
- Single user, mobile setting, multiple device inputs, and advanced interaction types.

User: How do I get from here to there?



• Intelligent environments

- Many more devices: Same type, different type.
- Multiple users.
- Several different services, simultaneously accessible.



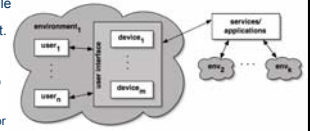
What this talk is on?

- Interacting elements in an intelligent environment:
 - Devices, services and users.
- One aspect specific to multiple users in an intelligent environment:
 - Device control.
- Factors influencing device control:
 - Resource limitations, and social-, spatial- and temporal-aspects.
- Conceptualizing a device allocation strategy (our start to tackling the problems).

NB: The goal of this talk is not to present solutions, but rather, to define terms, raise concerns and help categorize these concerns for the topics of "device control", "multiple users", and "intelligent environments".

The intelligent environment

- Consists of:
 - **Multiple devices** distributed throughout the environment, and
 - **multiple users**, on the go, while simultaneously requesting **services** from the environment.
- Scenario:
 - The issues raised are scenario independent.
 - Example scenario's include: Work, home, museum, outdoor settings, or shopping.
 - The scenario's we are most concerned with include: Pedestrian navigation, and shopping.

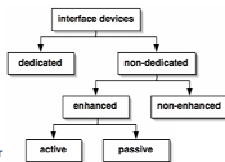


Situated interfaces

Categorization of devices

Device types:

- **Dedicated:**
 - Dedicated to Input / Output.
 - E.g. Microphone, keyboard.
- **Enhanced active:**
 - Pursues interaction with the environment.
 - E.g. Smart bookshelf, or touch-sensitive table.
- **Enhanced passive:**
 - Environment must pursue interaction with device.
 - E.g. RFID-tagged book.
- **Non-enhanced:**
 - Ordinary, dumb-device.
 - E.g. a non-tagged coffee mug.



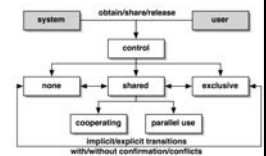
Device taxonomy

Device profiling:

- E.g. Private or public. Shareable, semi-shareable, or non-shareable. Input modalities best catered for (sight, sound, touch, smell, taste).

Categorization of users

- **Goal:**
 - To share devices among multiple users, that may be moving around.
- **User types:**
 - Distributed, collocated.
 - Exclusive, cooperating, or in parallel.
- **User modelling:**
 - Preference for using particular devices:
 - Based on geographical position, physical characteristics, or supporting input modalities.
 - Preference for a particular service.



Assigning device control

Controlling devices

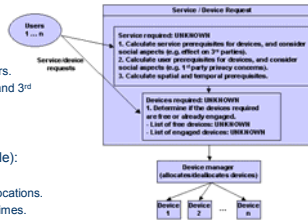
- Obtaining control:
 - User-initiated
 - E.g. Spoken commands, multimodal references, physical acts.
 - System-initiated
 - Will this displease users?
 - User-system-initiated.
 - Perhaps the best of both worlds. Frees the user from having to specify all devices.
- Sharing and releasing control:
 - Similar to obtaining control.
 - Can be performed either explicitly or implicitly.
- Area's requiring more thought:
 - Can all devices be shared?
 - Should we be allowed to reallocate devices for a better fit, even if they are currently in use (e.g. semi-reallocate, completely reallocate)?
 - Who owns the device: The user or the environment? What if a user brings an alien PDA into the environment?

Factors influencing control

- Resource limitations
 - Redistributing allocated devices, or informing the user of expected waiting times.
 - Providing resources in a "fair" manner.
 - First come, first serve.
 - Soft and hard pre-requisites (e.g. visually impaired user requiring the use of a large display).
 - Valuing the importance of a user's work (e.g. CEO vs. intern).
 - Access rights (to services and devices).
- Social aspects
 - Parties affected:
 - 1st party, e.g. the user themselves, as in the case of *privacy* concerns.
 - 2nd party, e.g. cooperating users, as in the case of *device-type discrimination*.
 - 3rd party, e.g. unrelated users, as in the case of *background noise*.
 - Differing characteristics of services (e.g. bank transfer), and tasks (e.g. PIN number).
- Spatial influences
 - Distributing users to areas that best suite their needs.
 - More complex when devices are already in use. We must predict an optimal allocation of devices for the future as well as for the present.
 - What if a user has not used a service for a period of time, or simply walks away from the service (e.g. going to the toilet)?
- Temporal influences
 - Urgency in a user requiring a service or set of devices.
 - Are we allowed to disrupt users currently using devices?

Conceptualizing a device allocation strategy

- User selects a:
 - Service.
 - Set of devices.
 - Service and set of devices.
- System considers:
 - Prerequisites of devices and users.
 - Any social implications (1st, 2nd, and 3rd parties).
 - Spatial and temporal constraints.
- => Allocate devices.
- Conflict handling (if at all solvable):
 - Remove soft prerequisites.
 - Calculate new optimal device allocations.
 - Inform user of expected waiting times.

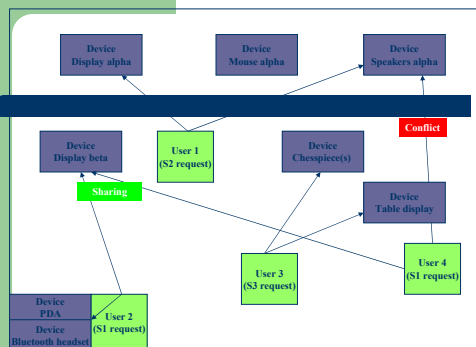


Thankyou, Questions?

Questions for thought:

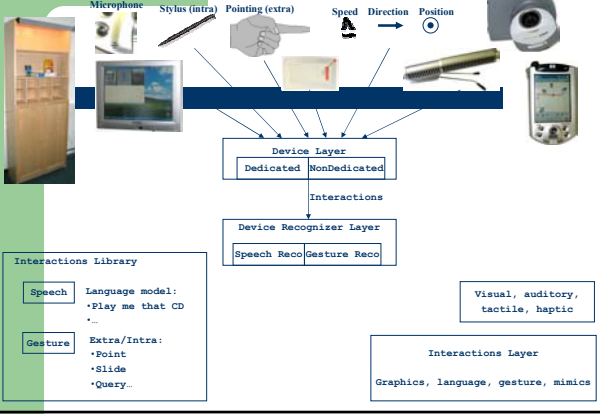
- Who controls what device at what time?
- What does this control look like?
- Can devices be shared? which ones? and by how many users?
- Will we see an effect on quality as multiple services are delivered simultaneously to the users?

User-to-Device Assignments 1



- S1 - Watch movie
- S2 - Read book
- S3 - Play chess
- S4 - Check fridge
- S5
- S6 -
- S7

Interactions Library Architecture



Interactions Library

Speech Language model:
 •Play me that CD
 •_

Gesture Extra/Intra:
 •Point
 •Slide
 •Query_

Visual, auditory,
 tactile, haptic

Interactions Layer
 Graphics, language, gesture, mimics