Architecture and Models of the DANAH Assistive System

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Outline

1 Overview of DANAH
2 Services
3 Environment
4 Integration
5 Conclusion
Context and Needs

- Growing aging population
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  - Need solutions to keep autonomy
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⇒ Environmental Control

- Physically *disabled* people
Context and Needs

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  - Need solutions to compensate disability
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  - For people on **Autonomous Wheelchairs**
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  - to provide **Automated Navigation**
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⇒ Environmental Navigation
Purpose

DANAH is an Assistive System

It combines Environmental Control and Environmental Navigation
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- Environmental Control (*Services*)
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- Environmental Control (*Services*)
  - Control *standard* electrical devices with a *computer*
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  - Make services *available* somewhere in env.
  - Provide *tools* to facilitate deployment
System Architecture
What is a “Service”?

Generic term to designate what the User can ask the System for
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- Simple services
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  - E.g. “If the door cannot open, Call Emergency”
  - Provided by Abstract/High-level devices, E.g. Rooms
Services at Device Level: the Resource

- A Resource is the DANAH’s view of a device
Services at Device Level: the **Resource**

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- It **describes** the device
Services at Device Level: the Resource

- A Resource is the DANAH’s view of a device
  - Concrete resources for physical devices (Doors, Lights)
  - Composite resources for abstract/high-level devices (Rooms, Homes)
- It describes the device
- It specifies its behavior
Resource Contents

- Description part
Resource Contents

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  - Operative Modes that contain States
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  - **Operations**: the services provided by that resource
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  - a **Service Expression** for each operation in composite resources
Examples

- Concrete resource Phone
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  - Operative Mode: AUTO, MANUAL
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- **Composite resource Addressbook**
  - Operations: Emergency, Infirmary, ...
  - Emergency = SEQ(Phone.1 Phone.1 Phone.2 Phone.Call)
Examples

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  - Operations: Emergency, Infirmary, ...
  - Emergency = SEQ(Phone.1 Phone.1 Phone.2 Phone.Call)
  - Infirmary = SEQ(Phone.9 Phone.5 Phone.Call)
Service Expressions

Used to *compose* resource operations, using *operators*
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Used to compose resource operations, using operators

- Operators express
  
  - SEQAND
    - Runs operations successively, returns TRUE if everything is OK
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Service Expressions : Example

- Scenario
  - Open the door *then* Switch on the lights
  - Make emergency call *if* opening the door fails and *stop* the scenario
Service Expressions : Example

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- **Expression**
  
  $\text{SEQAND}(\text{EX} (\text{Door}.\text{Open} \ \text{Addressbook}.\text{Emergency}) \ \text{Light}.\text{On})$
Model

- Topological Map
Model

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  - Indoor ⇒ Offline map
Model

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  - Indoor $\Rightarrow$ Offline map
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**Model**

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  - Indoor $\Rightarrow$ **Offline map**
  - Because of **distribution**, it is **Clustered**

![Diagram of Topological Map with Indoor and Offline maps andClustered coverage](image)
### Purpose

- Make the two models **collaborate**
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  1. Resources are **localized** in environment
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  2. Environment **triggers** services...
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  1. Resources are **localized** in environment
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  3. ... when wheelchair crosses **edges**
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![Diagram](image-url)
Purpose (2)

- Make the data *easily available*
Purpose (2)

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- Using **Model Transformations**
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Purpose (2)

- Make the data **easily available**
- Using **Model Transformations**

![Diagram showing the process of making data easily available using model transformations.](image-url)
DANAH is unique as an ATS
Conclusion

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  - Combines Navigation and Env. Control
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  - Combines Navigation and Env. Control
  - Distributed, Multi-user, Modular arch.
  - Uses models and Model Transformations
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  - The whole system as philosophy
  - Built from user and specialist needs
Future Work

- Reconfiguration
Future Work

- Reconfiguration
- QoS evaluation
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- Reconfiguration
- QoS evaluation
  - On-line service selection
Future Work

- Reconfiguration
- QoS evaluation
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  - Dynamically composed services
Thank you