
A Model for Making User Interaction Design Decisions in AmI Environments

Pascal Hamisu

Department Interactive Multimedia Appliances
Fraunhofer-Institut for Computer Graphics IGD
Fraunhoferstraße 5
64283 Darmstadt
Germany

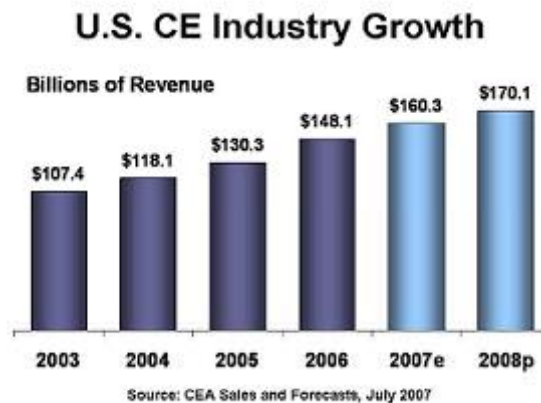
Tel.: +49 6151 155 –579
Fax.: +49 6151 155 –480

Email: pascal.hamisu@igd.fraunhofer.de
<http://www.igd.fraunhofer.de>



Facts and Currents Trends in Aml (Market and Economic Impact)

- *Vision of Ambient Intelligence...in the near future, we will be living in intelligent spaces with...*
- *“A wide diversity of advanced electronic (multimedia) devices embedded in our homes or neighboring (neighborhood, office, and city) spaces ... forming a **device ensemble**“*
- Today this is evident through:
 - New product lines in CE with sophisticated digital or analogue as well as wireless interfaces
 - Global market for Consumer Electronics (CE) is nearly \$618 billion (Source: CEA)
 - Growth is almost exponential as demonstrated here in a US CE Industry growth forecast for 2008



US makes up c. 26% of global market
Source: CEA

- Similar trends in the CE industry across the EU and Asia as well!

Facts and Current Trends in Aml (Scientific R&D)

- In the EU expert groups like ARTEMISIA in the field of ARTEMIS
 - ARTEMIS - *Advanced Research & Technology for EMbedded Intelligence and Systems.*
 - Aim: to stimulate R&D of methods, tools and technologies needed to incorporate intelligent and safe “Embedded Systems” in:
 - cars, airplanes, home, manufacturing lines, industrial automation and public infrastructures.
 - This year...major European industrial sectors to cooperate in a 2.4 Billion € program aimed to boost innovation and competitiveness on embedded systems.

Source: ARTEMISIA (<http://www.artemisia-association.org>)

■ Implication:

- New opportunities and application areas →→→

Application Areas

- Multimedia and Infotainment Systems

- Social inclusion of the elderly ...scenario in PERSONA –EU Project (Fh-IGD is partner in this project)



- Shared surfaces using video probes (InterLiving Project)



Application Areas

- Health-care and Education



NETCLARITY – EU Project
Goal: Enable the elderly to stay in contact remotely with caregivers

- Fitness and Wellness

 - Inter-sensory Interfaces

Mobility with an Intelligent Space



Source: FUTURE-MAKING SERIOUS GAMES
<http://elianealhadeff.blogspot.com/2007/01/healthcare-is-serious-game.html>

Application Areas

- Other application areas include
 - Lifestyle
 - Sanitary Systems
 - Nutrition Assistants
 - Energy Management Systems

- But new opportunities also reveal new challenges →→→

New Challenges in Aml Environments

- We have identified major **User Interaction (UI)** problems with the device ensemble in these emerging environments:
 - *Embedded and CE devices come with sophisticated analogue or digital interfaces*
 - *Cannot easily be operated by certain user groups (e.g. the less educated, the elderly and the disabled)*
 - *Hard to maintain an overview of the huge functionality and services exposed through these devices*
 - *The growing complexity of User Interaction in Aml environments*
- *Implications:*
 - *HCI design engineers are faced with the difficult task of:*
 - *Integrating the huge functionality offered by individual components into an easy, coherent and more **natural interface***
 - *Providing **personalized services***
 - *Considering **user's world model and context** since it **can affect his/her interaction affordance***
 - *Seeking **new interaction techniques that exploit the more natural communication ability of the user to interact with his/her environment***

A Model for User Interaction Design Decisions

- Design Decisions and Concepts
 - How we arrived at the design decisions considered in our model:
 - Through a study of design decisions presented in other research works
 - Through an analysis of use cases of common scenarios in Aml environments
 - Source: ISTAG Scenarios for Ambient Intelligence in 2010, “Final Report”, Feb 2001, EC 2001.
 - Source: Scenarios defined in the PERSONA - EU Project (<http://www.aal-persona.org/scenarios.html>)
 - Examining existing research effort on the categorization of end-users and user groups
 - Through a survey on existing interaction techniques and advanced I/O devices

A Model for User Interaction Design Decisions

■ Design Decisions and Concepts

- A table showing an excerpt from a survey on existing interaction techniques and advanced I/O devices

TABLE I
INTERACTION DEVICES

Interaction Devices	Interaction table	...
Description	Tangible objects on table, measures position of devices on table	...
Data Format	x/y position of devices on table (continuous)	...
Application Areas	Architecture, meeting rooms	...
Suggested Output Devices	TV Set, Plasma Display, Light Bulbs, Stereo Set, Media Center, Media Player, Wireless Music Station, Smart Board, LCD Display, Surround Sound System	...

Excerpt from the list describing a variety of interaction devices. Here an interaction table is described. One can see the description of the device, the available data format in abbreviated form, application areas and suggested output devices.

TABLE II
OUTPUT DEVICES

Output Devices	TV Set	...
Description	A Telecommunication system with a tuner for receiving different broadcast or video formats including motion pictures and sound Two kinds: Analogue and Digital TV	...
Output format	<Composite video> with three source signals called Y, U and V with sync pulses and in the following standard formats: NTSC (USA), PAL (UK) or SECAM (FRA) [Analogue TV] MP2 audio streams within MPEG-2 progema streams [Digital TV]	...
Suggested Interaction Devices	remote control mouse microphone keyboard buttons sliders, EFS wii remote, table with tangibles	...

Excerpt from the list describing a variety of output devices. Here a TV set is described.

A Model for User Interaction Design Decisions

■ Design Decisions and Concepts

- Following key decisions and parameters for interaction in an Aml environment are defined:

- *Who is the user (end-user categorization) and what are his/her interaction affordances?*

- Parameters to be considered include age, physical and mental conditions, preferred natural communication abilities.

- *What does the user want to accomplish?*

- A cognitive modeling of the interaction intent (goal formation)

- Identifying the subtasks that realize the goal

- Structuring the subtasks in the form of a dialog with necessary feedback loops

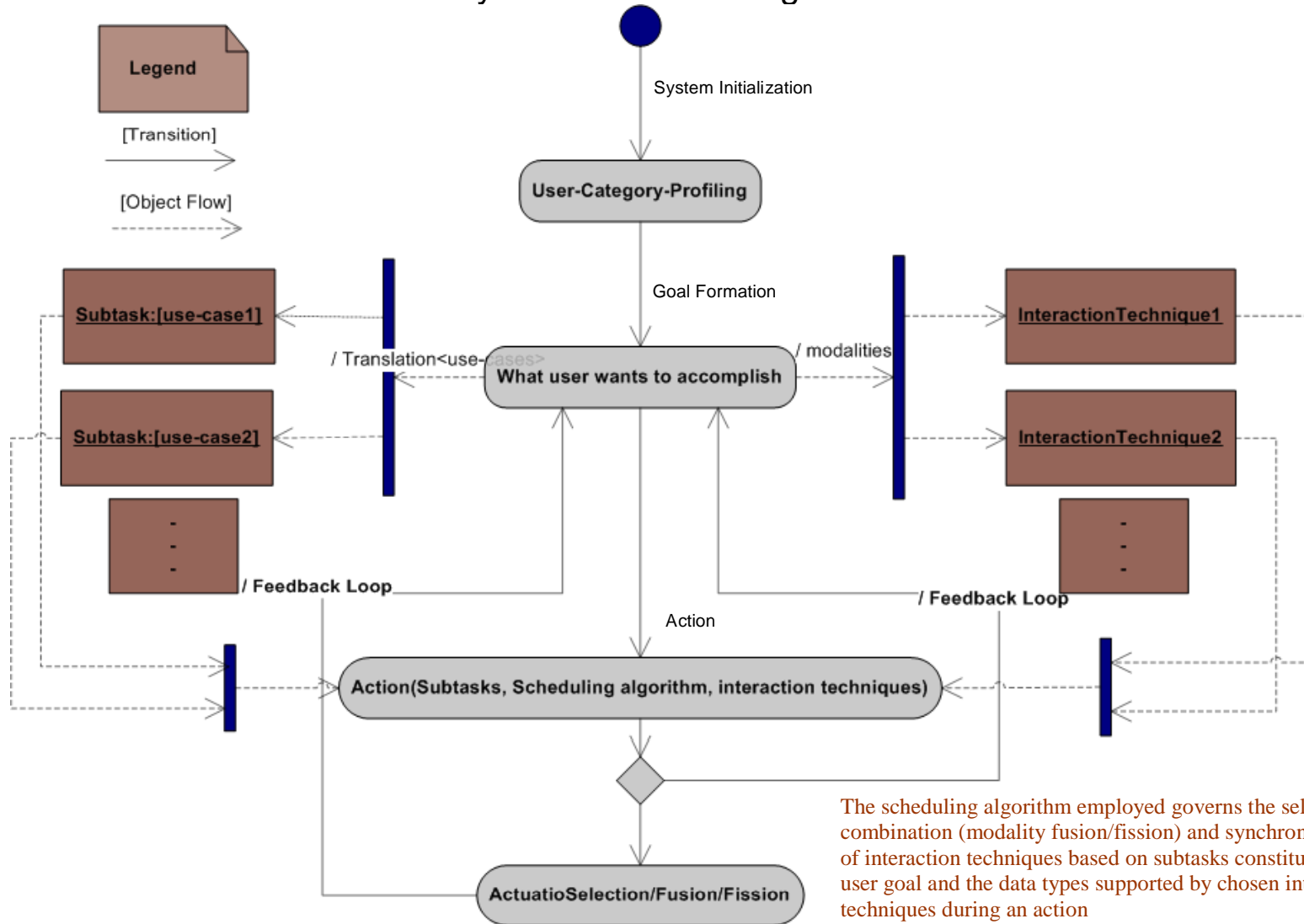
- Determining the commands and features in the device ensemble that realize the subtasks

- *How does the user accomplish the goal and with which modalities (interaction techniques)?*

- *When and how does the system provide feedback to an action in an interaction cycle?*

A Model for User Interaction Design Decisions

- Our Model for a UI Interaction Cycle based on Design Decisions



The scheduling algorithm employed governs the selection, combination (modality fusion/fission) and synchronization of interaction techniques based on subtasks constituting a user goal and the data types supported by chosen interaction techniques during an action

A Model for User Interaction Design Decisions

- Sample Scenario Analysis and Realization based on proposed Model
 - **User Category:** an elderly of the generation 65+
Her Interaction Affordances: speech, tangible interaction, gestures
 - **Her Goal:** To interact with a TV set in the living room preferably using her more natural communication abilities
 - **Available Interaction Devices:** Tangible table, a microphone and headset
 - **Multimedia Appliances:** A setup box, a TV set and HiFi set.



Integrating tangible artifacts and voice for a more intuitive user interaction

Evaluation of specified Model

- Simplicity of model will allow a high level abstraction of the UI problem in Aml environments
- Facilitates an easy pattern recognition in the interaction and the formation of a knowledge-base
 - Temporal relationships between common use cases, interaction techniques and user group could be captured in a database
- For a UI design engineer, it serves as a guide in rapidly prototyping intuitive UIs based on the extracted data and available toolsets.
- Model has generic properties to accommodate emerging interaction techniques and new CE devices as well as embedded technologies in our Aml environments

Outlook

- How can we build on this simplified model?
 - Extend model with reflexive techniques
 - Reasoning interpreters with regards to user group driven issues and preferences
 - Rule-based engines for forward integration of context data
 - Algorithms for modality fusion, fission and synchronization in the UI cycle
 - Integration of inter-sensory interfaces with interaction techniques
 - Semantic modeling of common patterns identified in the interaction cycle as a first step in defining an ontology for user interaction in Aml environments

ThanksGracias!

Any questions?