Assistive Systems

Requirements and Evaluation

Human Computer Interaction Group (HCI)

Institute of Visual Computing & Human-Centered Technology,
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Content

Introduction – Sequence of Course

I. Demarcation and Definitions

- Umbrella term AAL
- Technical Aids vs. Assistive Systems

II. Active User Interface (HCI)

- Active Support

III. Assistive Robots – Movement

- Human Robot Interaction (HRI)

IV. Sensors – are entering the living area

- Safety and Support

V. Ethics, Law and Economics

VI. Requirements Analysis and Evaluation

VI. Requirements Analysis & Evaluation

What is it about today?

Topics: Requirements analysis, test methodology (Wizard of Oz, AAL laboratory, Living Lab, field test), e.g. Video recorded HRI vs. Live HRI;

Problems: Testing with the target group not easy possible, "active" seniors, bias through social contacts that are valued, by long-term attachment of seniors to researchers
various Living Labs / test rooms at institutes

Goals

Get to know typical target groups for AAL systems and understand their needs

Learn about methods for analyzing and describing users and evaluating the results

Methods for assessment of results

Elicitation of requirements

Step 1: capture requirements

Central question:

What does the user want / need?

Complex systems have many variables
Not everything comes to your mind

Usual approaches are focused on function
Complete tests are expensive

Context: User-centered Design

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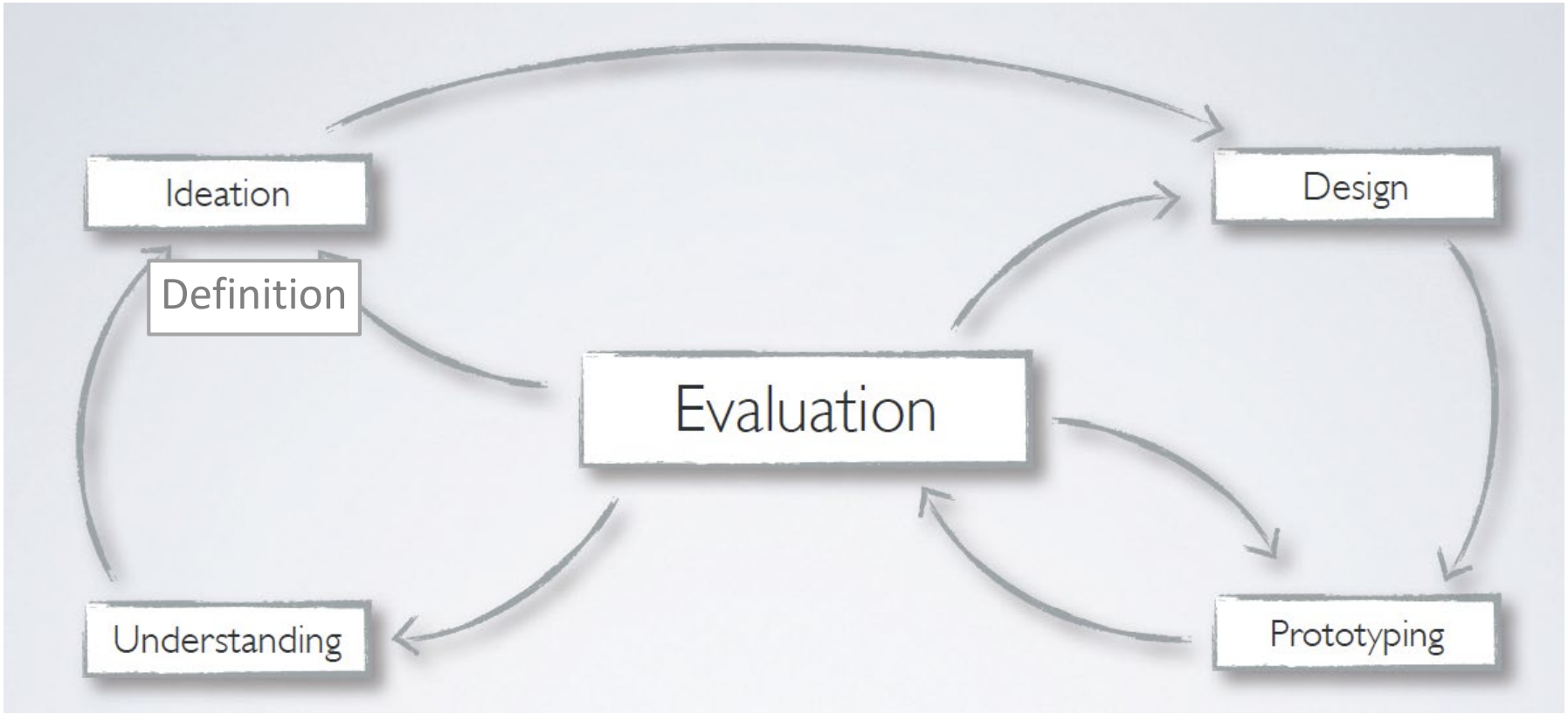
User-centered Design puts

- Needs
- Requirements
- Abilities
- Habits
- Goals

of users into the center of product development processes

Design as iterative process



Quelle: Allie Terrel, Univ. Wisconsin

Introduction: Many AAL target groups

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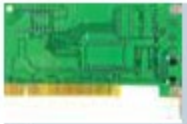

TECHNOLOGIE- UND GERÄTEHERSTELLER

An AAL-Technologien arbeiten viele Sparten – von der Medizin- über die Hausgeräte- und Kommunikations- bis zur Mikrosystemtechnik. Für alle eröffnet sich ein attraktiver Markt. Schätzungen zufolge beträgt das AAL-Potenzial allein in Deutschland mindestens eine Milliarde Euro pro Jahr.

PLANER, ARCHITEKTEN, INGENIEURE UND HANDWERKER

Assistenzsysteme basieren auf einer intelligenten Heimvernetzung. Infrastrukturen für AAL, Smart Home und Smart Metering müssen nachgerüstet, vor allem aber bei der Planung bedacht und beim Neubau realisiert werden. Hierbei ergeben sich vielfältige Chancen für spezialisierte AAL-Fachkräfte.

FORSCHUNG UND WISSENSCHAFT

AAL steht noch am Anfang seiner Entwicklung. Von technologischer Forschung über Effektivitätsstudien und datenschutzrechtlichen bzw. ethischen Fragen bis hin zu sozialwissenschaftlicher Begleitforschung – AAL bringt für Hochschulen und Institute aller Art viele neue Forschungsfelder mit sich.

TELEMEDIZINANBIETER

Wenn Menschen kontinuierliche medizinische Kontrolle brauchen, können Telemedizinanwendungen, insbesondere das Telemonitoring, dazu beitragen, Klinik- oder Heimeinweisungen zu vermeiden. Ein Zukunftsmarkt für alle Anbieter telemedizinischer Leistungen.

POLITIK

Die Politik – von den Ländern über den Bund bis zur Europäischen Union – fördert die Entwicklung altersgerechter Assistenzsysteme auf vielfältige Weise. Daneben ist die Politik gefordert, für AAL günstige Rahmenbedingungen zu schaffen, etwa in der Sozialgesetzgebung.

ARZTPRAXEN, KRANKENHÄUSER UND APOTHEKEN

Die medizinischen Leistungserbringer spielen eine zentrale Rolle bei der Versorgung von Patienten bzw. Kunden mit Hilfsmitteln. Im Bereich AAL entsteht eine Vielzahl neuer Produkte und Dienstleistungen, die kompetent erklärt, vermittelt und verschrieben werden müssen.

WOHNUNGSUNTERNEHMEN

Eine schrumpfende und älter werdende Bevölkerung stellt alle Wohnungsunternehmen vor große Herausforderungen. AAL-basierte Angebote können zur Mieterbindung beitragen und auf dem Wohnungsmarkt von morgen einen entscheidenden Wettbewerbsvorteil darstellen.

KRANKEN-, PFLEGE-, UNFALL- UND RENTENVERSICHERUNGEN

„Daheim statt im Heim" – schon aus Kostengründen sind die Sozialversicherer daran interessiert, dass ihre Mitglieder gesund bzw. mobil bleiben und möglichst lange in ihrer Wohung leben können. AAL-Anwendungen können die Gesundheitsversorgung verbessern und effizienter gestalten.

PFLEGEEINRICHTUNGEN BZW. -DIENSTE

Schon heute herrscht im Pflegebereich eine hohe Arbeitsbelastung. Technische Hilfen wie innovative Dokumentations- oder Notruf- und Monitoringsysteme können Pflegekräfte wirksam entlasten und ihnen dadurch mehr Zeit für die „Arbeit am Menschen" verschaffen.

SOZIAL- UND SENIORENVERBÄNDE

Als Interessenvertreter der „Zielgruppen" kommt ihnen eine zentrale Rolle zu, ihre Mitglieder über die Möglichkeiten von AAL zu informieren. Gleichzeitig sind sie gefordert, ihre Kenntnisse und Erfahrungen in die Entwicklung altersgerechter Systeme einzubringen.

Fotos: Shutterstock

Source: AAL-Magazin

AAL Toolbox

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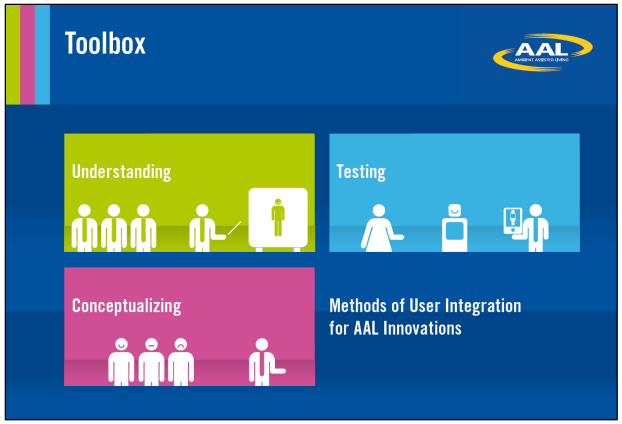
Areas covered: Understanding, Conceptualizing and Testing

http://www.aal-europe.eu/wp-content/uploads/2015/02/AALA_ToolboxA5_online.pdf



Phase	Method	Participants				Effort
		Healthy Seniors	Impaired Seniors	Stakeholders	Consortium	Time & Ressources
Understanding	Persona	●	●	●	●	●●
	Self-documentation	●		●		●●
	Shadowing	●	●	●		●●●
	UTE-Analysis	●		●	●	●
Conceptualization	Walt-Disney-Method	●		●	●	●
	Brainwriting	●		●	●	●
	Storyboard				●	●●
	Selection-List				●	●
Testing	Cognitive Walkthrough	●		●	●	●●
	Paper Prototyping	●		●		●●●
	Wizard-of-Oz	●	●	●		●●●
	Co-Discovery	●	●	●		●●

Analysis of environment

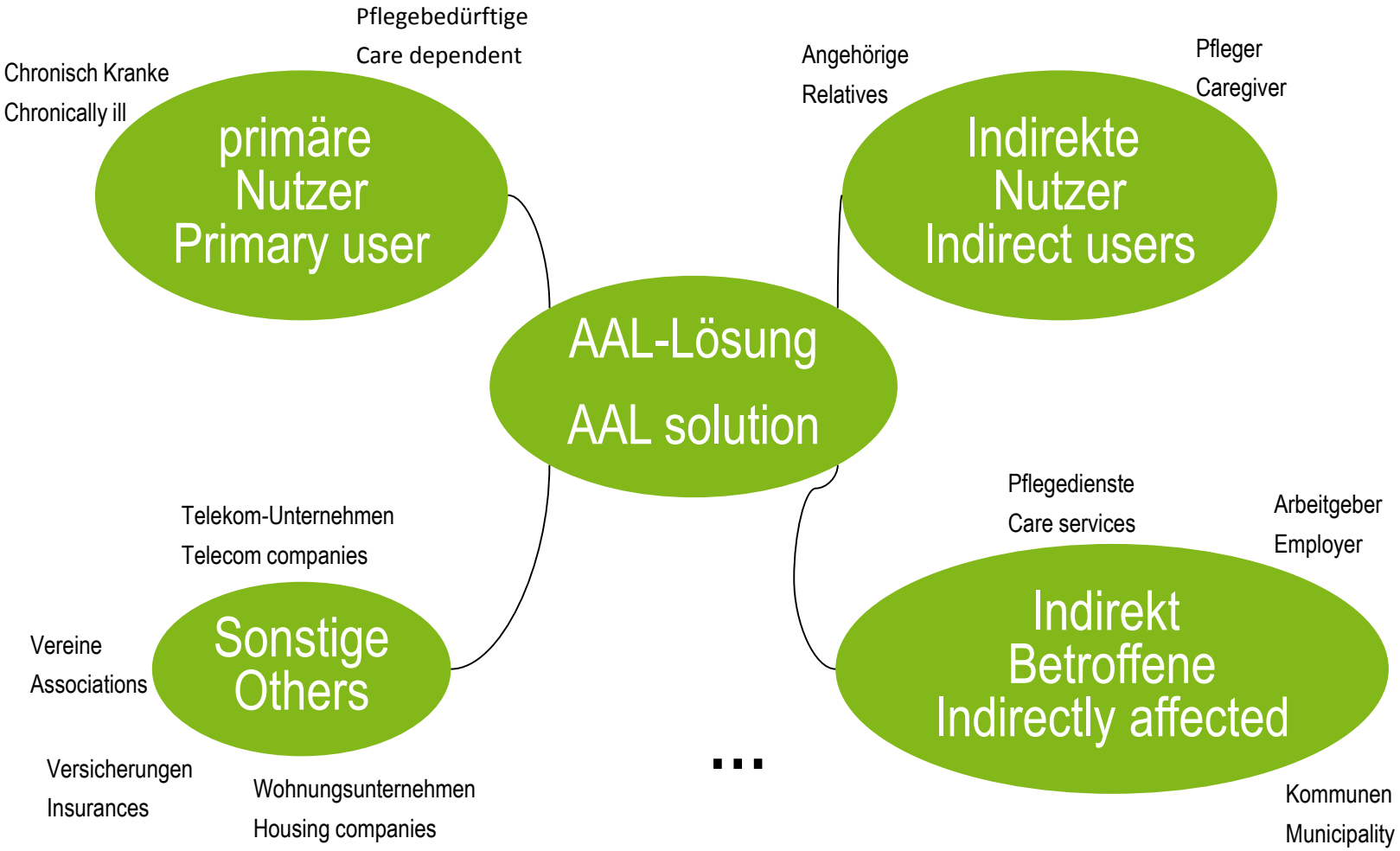
- New projects, products, solutions, changes affect in most cases more than one group of persons or organisations in the application environment (social environment)
  - Application / project environment
  - Groups with demand (*Stakeholder*)
- It is important to consider the perspective of all relevant stakeholders

Analysis of project environment

Step 1: Who are the stakeholders? (elaborate a list). Possible questions:

- Who funds the project?
- Who has interest in the implementation of the project?
- For whom does something change through the project?
- Who can make mood for / against the project?
- Who has expectations for the project?
- Who has to agree to certain parts?

Stakeholder



Analysis of project environment

Step 2: Assessment of attitude, influence and interest for all stakeholders

- attitude: more neutral / proponent / repudiator (maybe not yet clear)
- Influence/importance: low, medium, high
- Interest: high, medium, low

Step 3: For every stakeholder

What are the central expectations?

What are the central concerns?

Context: User-centered Design

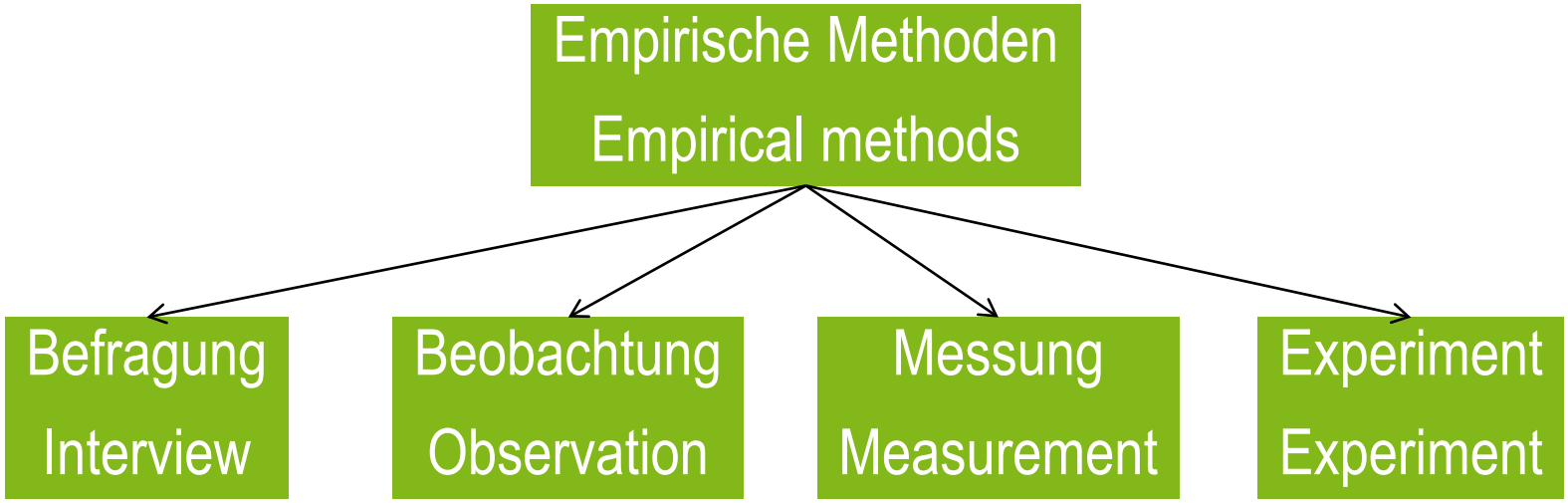
- How do I know how users think, what their goals are, and what tasks they perform in everyday life?
- How to get to the data as a basis for User-Centered Design?
- Which survey methods do you already know?

Collection of requirements
Some methods

Spectrum of methods

Bedarfs- und Anforderungserhebung

Assessment of needs and requirements



Limits of methods in the design context

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Needs and requirements assessment example in AAL research project (AWO/TU Illmenau)

1. Expert interview

Persons, familiar with wishes and needs of seniors

Relatives (3x)

Care staff (4x)

Representatives of interest groups (6x) (e.g. senior board)

2. Focus groups

Implementation with the help of key questions and introductory scenarios

Group composition:

Five groups

Ø age 72 years

3. Questionnaire

Seniors with and w/o need of care

Scope of assessment:

393 seniors

Aged from 43 - 96 years

(Ø age: 75 years)

Limits in design context

- Classic methods are only suitable in limited way for conception / design of ***new*** (technology-supported) approaches
- Limited imaginative power on future visions
- No direct reference to activities and goals in the problem field, but retrospective reflection
- No tight cooperation between developers and users – content related examination of everyone for him/herself

Contextual Design: steps

Contextual Inquiry: Interview and observation in the field

- Interpretation in the team and structuring
- Modelling of results in form of so-called „work models“

Contextual Inquiry

Contextual inquiry is a qualitative method, which combines principles from different areas and transfers them onto design tasks:

- Participatory design (inclusion of users)
- Classic interview techniques (social science)
- Observation methods (ethnography, social science)
- „think aloud“ (cognitive psychology)
- Brainstorming (economy)

Contextual Inquiry: goals

- Collect information about the users in their usual context
- Insight into living environment
- Insight into tasks and goals
- Understanding of framing conditions (expectations, rules, wishes, values, …)
- Understanding of problems and difficulties in the current condition

Experience Sampling

Experience Sampling / Ecological Momentary Assessment (EMA):

Variation:

- (immediate) capture of information in the context by users themselves

- Classic solution: diaries in combination with alarms / pagers

Summary

- In system drafting **(simplified) ethnographic** methods are applied, to learn more about users and their needs
- **Technology supported observation** methods can make important contributions, where a direct observation or participation is not possible
  - Context-aware experience sampling
  - Cultural Probes
  - Technology Probes

Fields of application

- Minimal influence of the investigation on the activities of the users
- Sensible / delicate situations
- Often repeated events
- Mobile activities / dislocated events

Often also in the ***evaluation*** of solutions (in later design phases)

Important to note

As already discussed in the ethic/legal part:
User data can contain personal information and therefore have to be handled with care.

- Information, purpose clearly defined
- Consent
- Protection against access
- Anonymisation
- Right on data (inquiry, deletion)
- Contact person

Cultural Probes

- ***Cultural Probes***: acquiring subjective user experience in the context
- Collection of „***activating tasks***“, which include subjects into the investigation
- Goal of **Cultural Probes** are not scientific investigations but collection of ***inspiring artefacts*** / observations from the environment of users for the design activities

Technology Probes

Technology Probes: Use of prototypes as instrument for investigation

- Provide prototypes for use
- Measure user behaviour (e.g. by logging)
- Use of measured data in design activities

The „Personas“ method

- **Personas** are **fictive users with** fictive details based on real data and facts
- Personas give the anonymous user **a face** – personal details make Personas „tangible“
- Personas increase the **identification** of the developer with the user (empathy)
- Personas direct the focus of the development away from special cases or average users on to **central needs**
- Put **goals of users** and not tasks in the foreground

Personas vs. real users

- Personas are **stereotypes** for a user group
- Personas represent **goals**, **habits** and **motivations** of user groups
- Personas **abstract to a model** and such reduce complexity
- **Real users** have properties and peculiarities, which cannot be generalised

Why Personas?

Focus on **typical user**

- Not on all possible special cases
- Not on fictive average user

Make users **tangible**

- Ease the emphasising with the role of the user
- Disregard own experiences and views

Why Personas?

- **Uniform** user picture
  - Personas encourage a uniform understanding of users in the development team
- Prevent „**bending into shape**“ of the user picture in the development process

Construction of Personas

- Goals
- Views and attitudes / offenses
- Habits and activities
- Abilities and knowledge
- Photo and name
- Demographic data
- Personal details

Always within concrete ***project context !***

Example „CURE Eldery Personas“

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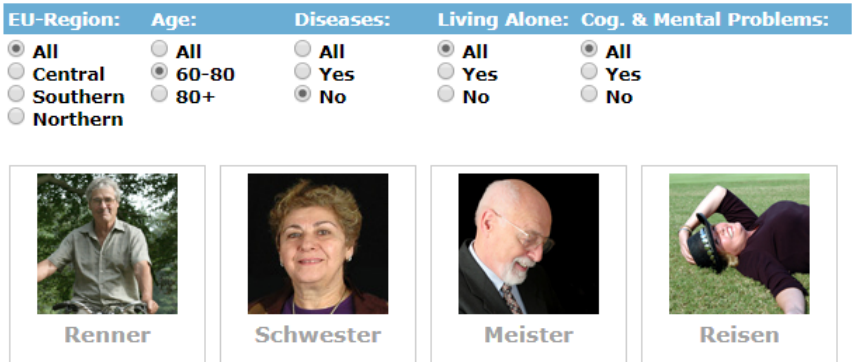
Personas developed for AAL and related projects with elderly target groups
http://elderlypersonas.tech-experience.at/get_cure_elderly_personas/index.html

Online selection of AAL personas:
http://elderlypersonas.tech-experience.at/personas_filter/index.html



Approach : Personas method

Collect data

- Investigation (literature, feedback, ..)
- Quantitative data, e.g. statistics
- Observation, target group interviews, …

Design

- Recognise patterns
- Note interesting details
- Sketch and discuss Personas

Typical errors

- Shallow/ sugary Personas are useless
- Too many personal details hide the view onto the essentials
- Too many Personas
- Personas are developed in the beginning and then forgotten
- Personas usually cannot be re-used!

The “Scenario” method

A Scenario is a ***story***, describing an ***activity*** of a user or user group

“A narrative description of what people do and ***experience*** *as they try to make use of computer systems and applications”* — Carroll, 2002

Why Scenarios?

- Description of **people, who use technologies** are important in the analysis of requirements and the conception of systems

- Scenarios can be developed, before systems have been developed – they are the **simplest form of „prototypes“**

Construction of Scenarios

- ***Setting*** (context, underlying assumptions)
- Acting persons (***agents***) with
  - Goals,
  - Motivation,
  - Knowledge,
  - Abilities
- ***Script***: actions and events

Scenarios and Personas

- **Personas** …
  ….. Are used as **agents in Scenarios**

- **Scenarios** …
  …. Describe the derived (from **goals**, **motivation** and **abilities**) **behaviour of a Persona** in the **interaction** with a (future) system

Advantages of Scenarios

- Scenarios are at the same time ***concrete*** and ***flexible***
  - Stay better in memory than abstract requirements
- Scenarios put ***goals*** and ***needs*** of the users at the heart of the process
- Scenarios foster „***emphasising***“ with the user
- Scenarios are well suited as base for ***Participation***
  - ***(e.g. for first contact for inclusion of users)***

Application of Scenarios

- Distribute ideas and beliefs in the developer team
- Provide design results for externals
- Evaluate ideas with users
- Used in Behaviour Driven Development

Methods for inclusion of users

Inclusion of users: preconditions

- Inclusion requires comprehensive ***information of the users*** about
  - Motivation of the project
  - Project goals
  - Involved people
  - Benefit for affected persons
- The users must be able to **believe in the success of the project**
  - Competences of the project team
  - Reference cases

Participation via „Proxies“ vs. direct inclusion

Advantages:

- maybe more integral perspective
- Multiplying function of experts (low number)
- Maybe easier accessible
- Avoidance of non-generalisable special cases

Disadvantages:

- maybe idealised perspective on processes, missing knowledge
- Maybe corruption by own interests / positions / prejudices
- No boost of acceptance in the group of directly affected persons

Participative Design: Environment, methods, tools

- Interviews, observation, work environment
- Personas, stories, Scenarios, drawings, photos, videos

- *User workshops*
- *Design games*
- *„Mock-up‘s“ and prototypes*
- *Living Labs*

Methods / Activities

Co-Creation „Toolkits“

Games

Photo: MakeTools Inc.

Starting point

Participation in the design process is desirable, but

- How does it work with users with cognitive restrictions (e.g. Dementia)?
- What has to be considered with disabled people? Or with severely ill?

This are „normal problems“ in projects in the area of AAL and Assistive Systems

Problem field: definition of the target group

Goal : representative user group

Example „older users“

- Very heterogeneous target group
- Biological age is a bad criterion for differentiation

Clear, good elaborated inclusion criteria needed

Problem field: acquisition of users

Number of users in the environment is low or access to them is difficult

Possible solutions

- Smaller user groups (→ Methods, e.g. Case Studies)
- Distributed groups (→ Logistics)
- Inclusion of proxies/representatives (e.g. relatives)

Context: mentioned so far

User-centred Design

- **Needs, requirements, abilities** and **goals** of the users and the **context of use** are put in the centre
- Context analysis, ethnographic methods, Scenario-based design support a good **understanding of the problem**

Context: mentioned so far

Participatory Methods

- User included directly in development and decision processes
- Joint design activities (e.g. workshops) ensure that the perspective of the user is not lost in the development process

Context: mentioned so far

Model based development methods

Easy to comprehend formal descriptions

- Close the big gap between (textual) description of the problem solving approach till really implemented system
- Models help, to achieve a uniform understanding and to create formally unambiguous descriptions of systems

Behaviour Driven Development

Method for Agile Development:

- Strong participation of stakeholders
- Focused on fulfilment of requirements of users
- Textual description of behaviour
- Automating case examples by using mock objects
- Successive implementation
- Description not of implementation but purpose, test case before implementation
- Automated checkable specification

Evaluation

Step 2: assessment

(presumable) needs are acquired …

Have the needs been recognised correctly?

The point now is, to determine, if usage brings benefit

- Do the solutions take effect as planned?
- Do the solutions get accepted?

→ Mere function is not sufficient!

Motivation: evaluation driven development

Problems in (AAL-) development projects:

- Users often cannot formulate requirements and goals in concrete terms
- Users often find it difficult to imagine technical solutions
- Developers and users can hardly estimate the impact and acceptance of using future systems

Example: assessment of acceptance and benefit of novel systems

Benefit: do I need it? Is it useful for me?



Acceptance: do I approve it ? Do I want it?

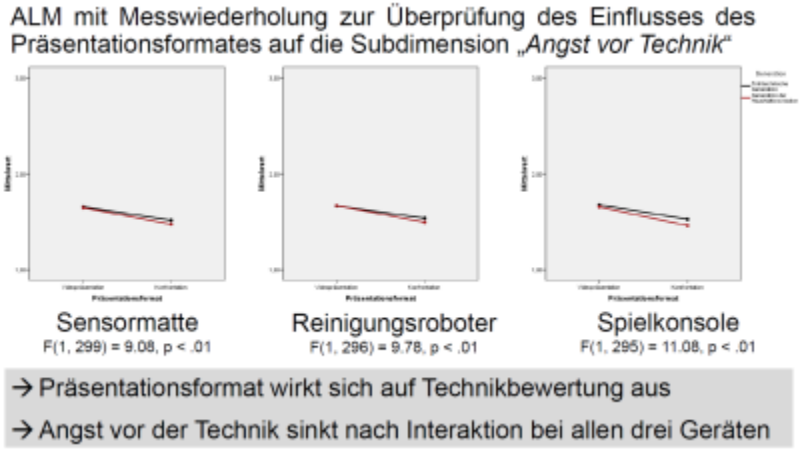
Typically analysis by established instruments, e.g. TAM, UTAUT

(Technology Acceptance Model, Unified theory of acceptance and use of technology)

Importance of the direct technology experience

Study of Classen et. al. 2012
Investigation on the influence of the form of presentation on technology assessment on the examples of sensor mat, game console and vacuum robot.
Comparison of assessment after video demonstration and hands-on trying.

Significant differences in several dimensions of technology acceptance (e.g. fear of technology, usage intention, expected benefit) were found.
“Fear of Technology” reduces after hands-on experience.



Source: Classen, Oswald, Wahl: Technikeinstellung und -bewertungen im mittleren und höheren Erwachsenenalter: Die Rolle von Psychologie und Technikgenerationen“, 2012

Examples of questions conceptually hard to clarify

Usability questions:

Will older users be able to get along with gesture based control?

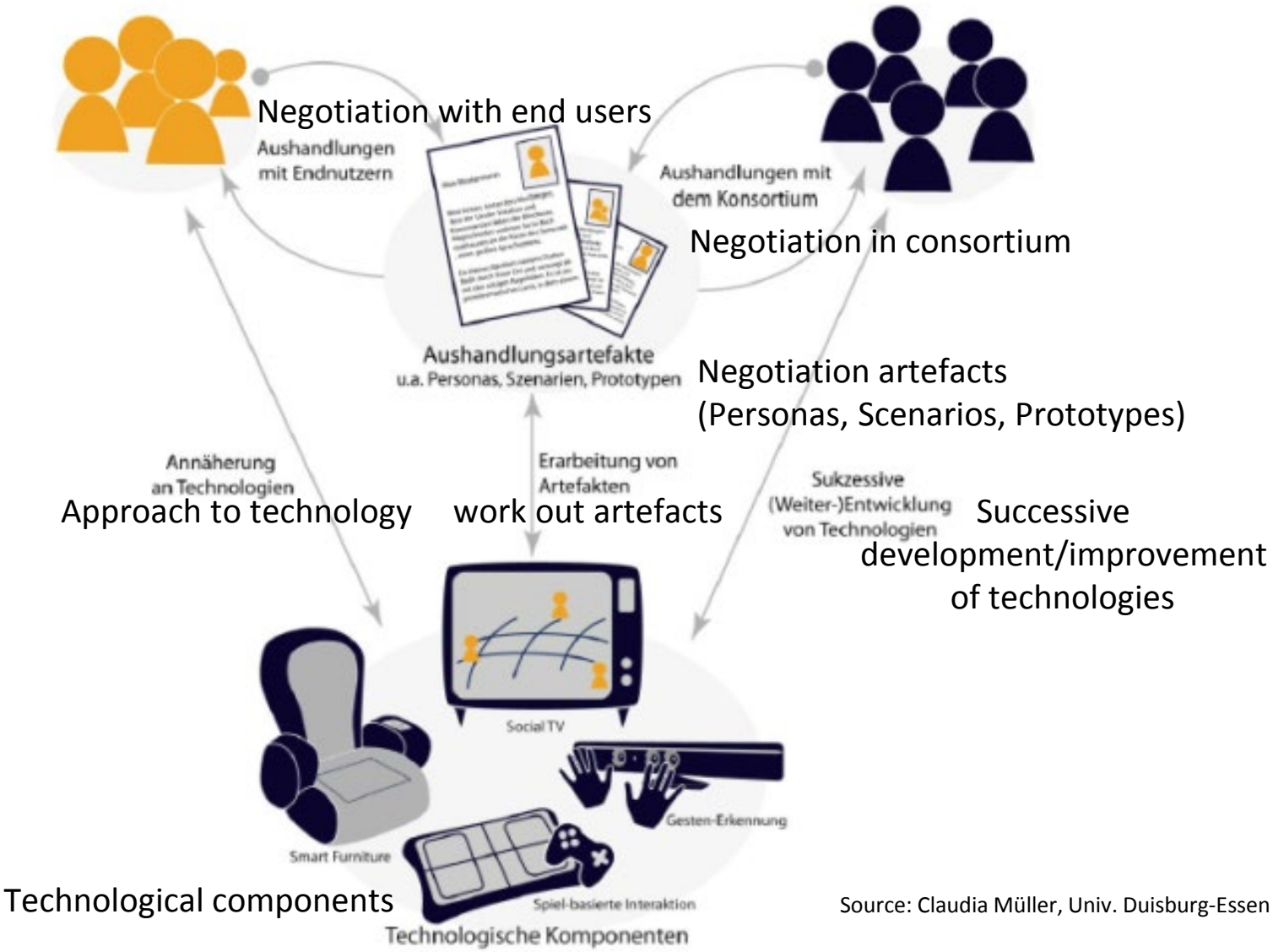
Acceptance questions:

How much acceptance will caregivers and care receivers develop for robots in their household?

Benefit questions:

How accurately can a monitoring system detect specific situations in daily life?

Negotiation processes



Source: Claudia Müller, Univ. Duisburg-Essen

Solution: Prototyping & Evaluation

A prototype is ***a limited representation*** of a design, allowing users to interact with it and to explore and check its suitability

- Prototypes permit early evaluation of ***partial aspects*** of a solution approach
- They form a bridge between abstract system description and the ready made system
- Development effort for a prototype often ***is very small*** in comparison with that for the complete system

Why Prototyping

- For visualisation, for convincing
- Less misunderstandings, more direct interaction
- Better communication also inside the team
- Allows users active participation in the design process
- Inspires reflection

Assessment, evaluation and feedback

Prototypes for evaluation

Examples of prototypes

- ***Scenarios***, storyboards, video scenarios
- ***Mock-ups*** from wood, cardboard, plastic
- Paper prototypes, PowerPoint slide shows
- Software mock-ups („click dummy“)
- ***Operable models***
- ***Functional device prototypes***
- Wizard of Oz
- …

Classification of prototypes: “throw-away” vs. “evolutionary”

Test prototypes

- Develop -> test -> evaluate -> discard
- No re-use in the final design
- E.g. on the basis of expensive universal systems

Evolutionary prototypes

- Stepwise improvement/advancement until the final system
- Especially possible with software

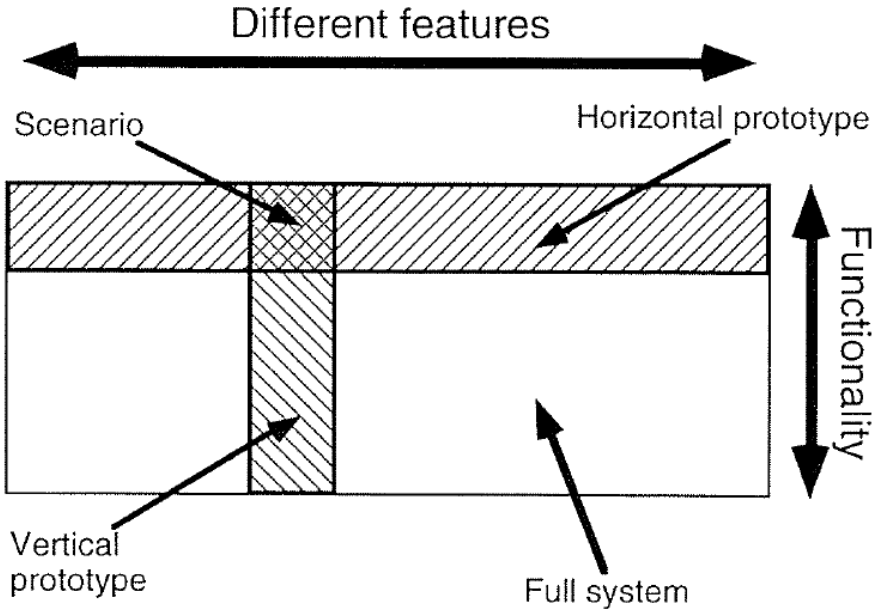
Classification of prototypes: "Wide" vs. "Depth" of functionality

Horizontal prototypes

- Keeps all features
- But reduces depth of functionality

Vertical prototypes

- Full functionality
- But only for few features



Source: Nielsen 1993 Usability Engineering

Classification of prototypes: “Distance” vs. “nearness” to reality

Low-fidelity prototypes

- Not / not fully functional, e.g. may not allow user interactions
- Unfinished / sketchy, e.g. are often paper-based
- Fast to make and cheap

High-fidelity prototypes

- (approximately) fully functional
- Reality-like appearance, e.g. take the user as close as possible to a true representation of the user interface
- High effort, more expensive

Paper prototypes for software

Material:

- Paper in different sizes (scaled)
- Colour pens / colour markers
- Index cards *(for pop-up windows, etc.),*
- Post-its (coloured) (*e.g. for menus, buttons, tables, input fields*)
- Adhesive tape (detachable) (e.g. *for input fields*)
- Scissors, rubber, rulers
- Transparent coloured foil (as overlay*, for marking temporary selection on it*),
- Prefabricated elements (*fitting to project)*
- Paper shall imitate the base shape of the interface

Tools: Software mockups

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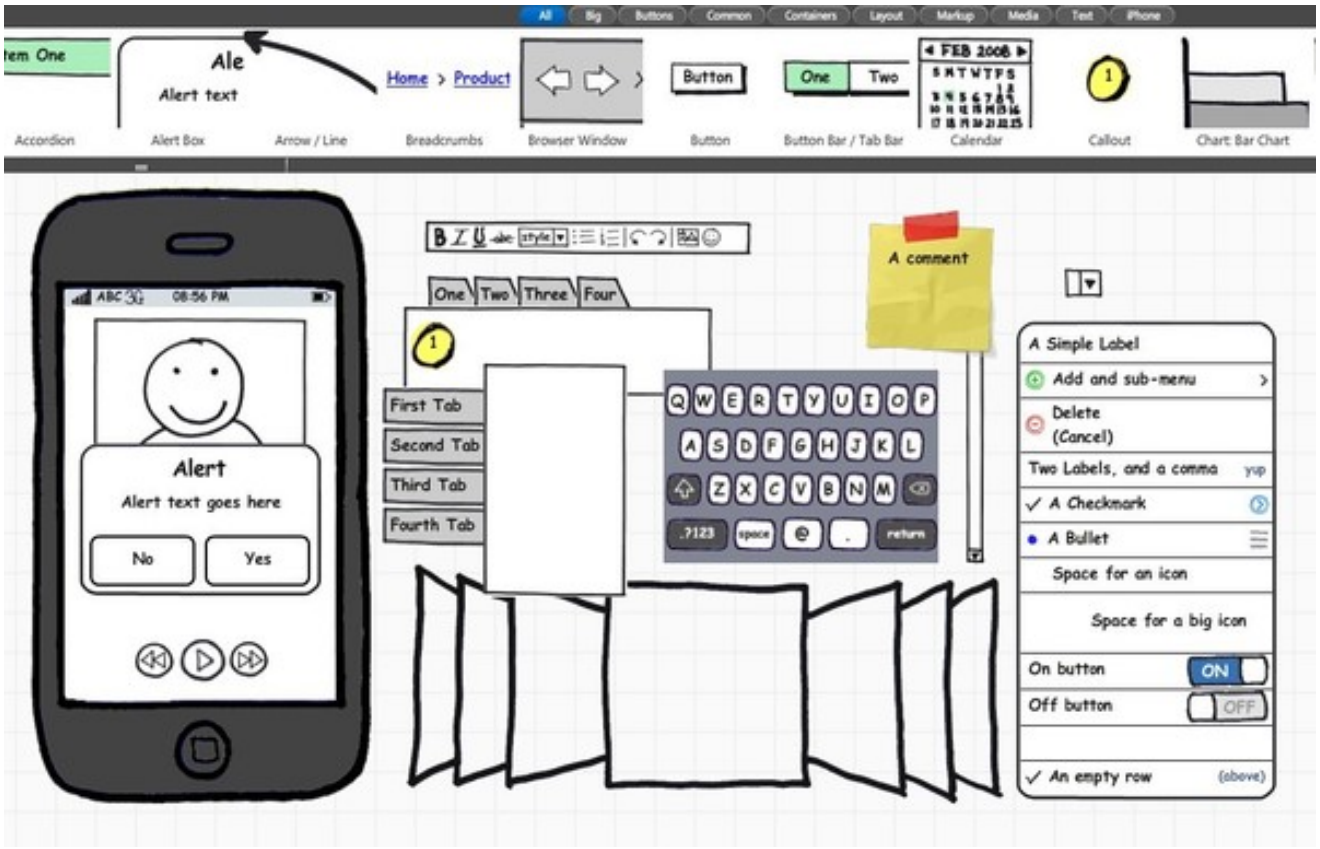
With tool *balsamiq*

Well suited for software on smartphone, tablet, PC



Functional device prototypes

In many cases (e.g. related to benefit / result of novel systems) non-functional prototypes (mockups, paper prototypes) are not sufficient

Solution: (rapid) prototyping

- Device prototype with important (partial) properties of the target system
- Simplified in other aspects (e.g. price, size, runtime, etc.)
- Often on basis of special prototyping hardware and executable models

Wizard-of-Oz prototyping

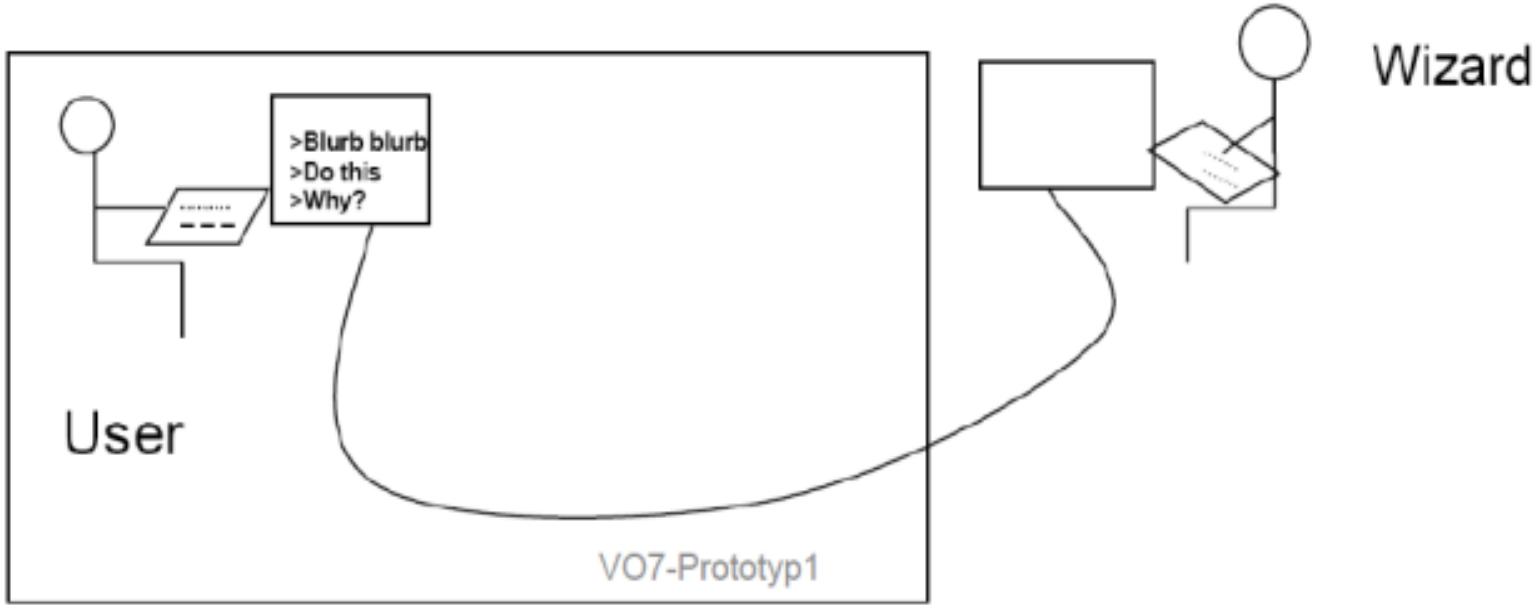
Interaction with „intelligent“ systems (autonomous decision support, speech recognition, etc.) is difficult to realise prototypically.

For early user evaluation the **„Wizard-of-Oz“ Technique** can be used:

- User believes to interact with a computer system
- In reality the returned feedback of the computers is controlled by a (hidden) human

Wizard-of-Oz Prototyping

Typically implemented by two interconnected computers



Wizard-of-Oz prototyping

Advantages

- Evaluation of the user experience for not yet realised (or not yet realisable) systems

Possible problems

- Delayed response (time for answer by „Wizard“)
- Unrealistic behaviour (Wizard „smarter“ or „more stupid“ than later computer system)

Application of prototypes

Prototypes are used in evaluation driven development processes to get as real as possible user experience with the target system (***Experience Prototyping***)

Goals

- Understand user context
- Exploration (idea generation)
- Communication of ideas to stakeholders
- Evaluation

Scenario based tests

- In general in prototypes only **partial aspects of the systems** are realised
- Specific situations / goals of user interaction are in the foreground of developer‘s interest
- Application within the frame of scenario based tests
  - Users get defined tasks / scenarios in advance
  - Users „play“ through the specific situation

Evaluation: established test approaches

Classic laboratory experiments

- Heavily controlled conditions
- Good reproducibility
- Little closeness to reality / Little realism

Classic field studies

- High closeness to reality
- Many influences, few controllable conditions
- High effort

New and alternative approaches for evaluation

Video prototype

To limit the needed effort and to be able to reach a higher number of users or experts it is advisable, to make use of **videos of real or simulated usage scenarios**.

These together with a **questionnaire** can be easily offered on a website or be distributed to experts.

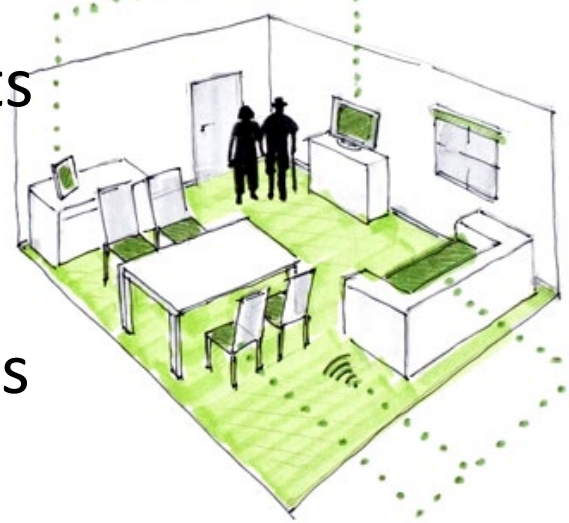
Living Labs

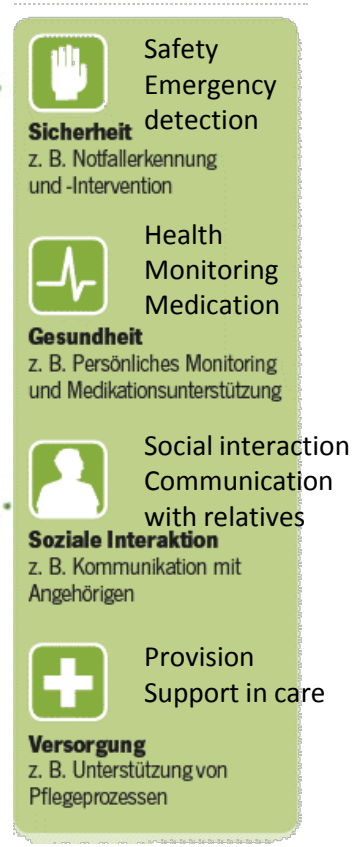
The term ***„Living Lab“*** describes the idea, to make real usage environment to a laboratory

- Real users
- Real environment
- New technologies / instrumented environments
- Not only for single projects, but complete infrastructures

Living Labs in AAL

- Make technologies and usage scenarios come alive
- User and domain experts are integrated into the development process
- Evaluate research results





Evaluation: important elements

- Clear definition of target group
- Selection of method
- Decision for type of evaluation: quantitative, comparative, qualitative, selective.
- From this follows the number of required users and the control group
- Plan in reserves: number of users and time
- Initial definition of measured values considered for evaluation
- Fixing of success criteria before evaluation
- Interviews with users before and after the evaluation reveals important information

Problems of classic phase oriented processes

Estimation of needs, acceptance, solution scenarios

Big creative leeway

Many uncertainties

→

Greater clarity

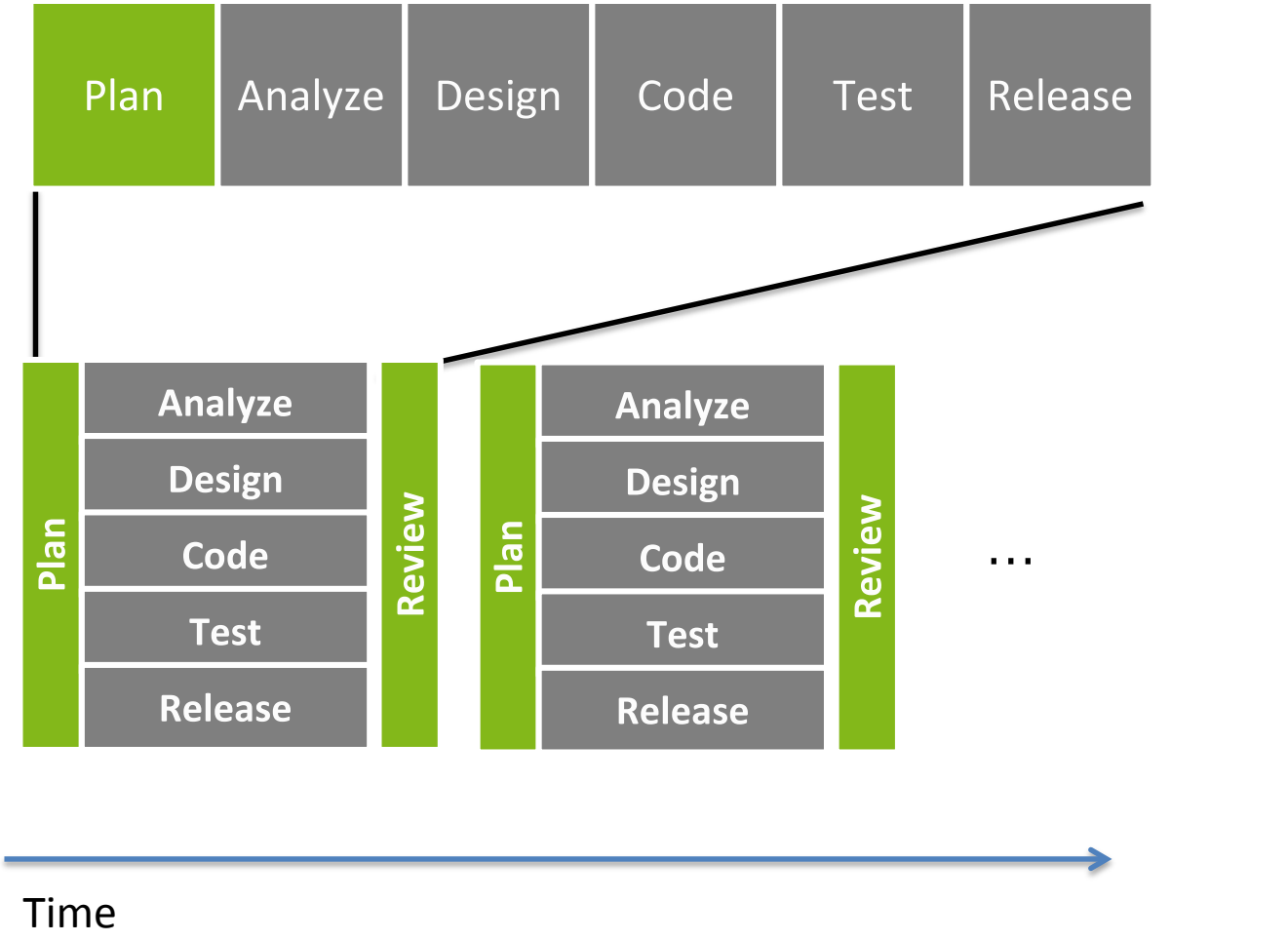
Big steps

Less leeway

High costs for changes

Agile methods: base idea

VC&HCT



Source: scrum.org

Important aspects of agile methods

- Agile methods are based on short, iterative cycles instead of long layout phases
- Agile methods are well suited when requirements are uncertain (often the case with high level of innovation)
- Agile methods create transparency and rely on high self-responsibility in the team
- Agile methods need clear rules and high methodical competence (e.g. on the basis of frameworks like *Scrum*)

Field test – Evaluation in daily use

Field tests – Real Life tests

- **Prototypes tested and found reliable in laboratory** are used by users of the target group in real environment in practical daily operation
- Important is a good **training** of the users and a good **preparation** and sufficient **aftercare** (including evaluation)

It has to be clarified if after use in case of success is feasible (dependency, exit strategy).

Field tests – Real Life tests

Added value:

- Many problems only emerge during extended **24/7 use**
- The **complexity** can not fully simulated in short laboratory trials
- Initial **curiosity** declines
- **Dynamic** environment instead of laboratory environment results in more „events“
- Based on **real users** (which e.g. are not/no longer able to come to the lab)

Field tests – Real Life tests

To be considered:

- Initially unknown living environment (each user!) -> initial check, planning
- Power supply, cabling
  -> often few power sockets, no loose cables
- Fixation(sensors) -> no drilling, damage
- Space for devices, chargers
  -> cleaning, dynamic use of space
- Time for installation/test/removal
- Invasion into privacy
  -> no „raid“ by huge group of researchers

Field tests – Real Life tests

Problems:

- Because users are left alone with devices and often are fragile/vulnerable special care has to be taken
- Many problems only emerge during extended **24/7 use** and are not immediately recognised
- Problems interrupt and distort usage and cannot be solved „immediately“
- Usage often declines (user vs. test person)

Field tests – Real Life tests

Implementation:

- Selection of target group and users
- Preparation by extended laboratory simulation (Stability, safety, maturity)
- Logging of all (relevant) data and documentation of events, problems and changes (check continuously)
- Users write diaries and are interviewed regularly
  - not by technicians but by third persons (who should be already known and own a position of trust, e.g. social worker).
  - This person should also decide whether it is reasonable to continue the test.
- Quick reaction in case of problems (detected by logging) and complaints from user

Literature

Literatur

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Assistive Systems - Abbreviations

VC&HCT

AAL	Active and Assisted Living (Ambient Assisted Living)
AS	Assistive System
AT	Assistive Technology
HCI	Human Computer Interaction
HRI	Human Robot Interaction
ICT	Information and Communication Technology
TAM	Technology Acceptance Model
UTAUT	Unified Theory of Acceptance and Use of Technology

Review

Review

Introduction – Sequence of Course

I. Demarcation and Definitions

- Umbrella term AAL
- Technical Aids vs. Assistive Systems

II. User Interface (HCI)

- Active Support

III. Assistive Robots – Movement

- Human Robot Interaction (HRI)

IV. Sensors – are entering the living area

- Safety and Support

V. Ethics, Law and Economics

VI. Requirements Analysis and Evaluation

What now exactly is AAL?

„Active/Ambient Assisted Living“ (AAL) means **concepts, products and services**, combining and improving **new technologies and social environment** with the goal to increase quality of life for people of all phases of age.

Maybe AAL can be best translated as „**age-appropriate assistive systems for healthy and independent living**“. This does imply that AAL primarily targets the individual in his/her personal environment.

Broschüre, BMBF, 2008

What does it mean … „System“?

Assistive Systems (AS)

- Assistive technology, which is more than ONE single tool != single assistive device aid
- In AAL perspective it is no consumer product!
- Assistive technology, being interconnected (networked)
- Assistive technology, acting in parallel to people and independently
- Assistive technology, which acts situation aware (as opposed to strictly command oriented)

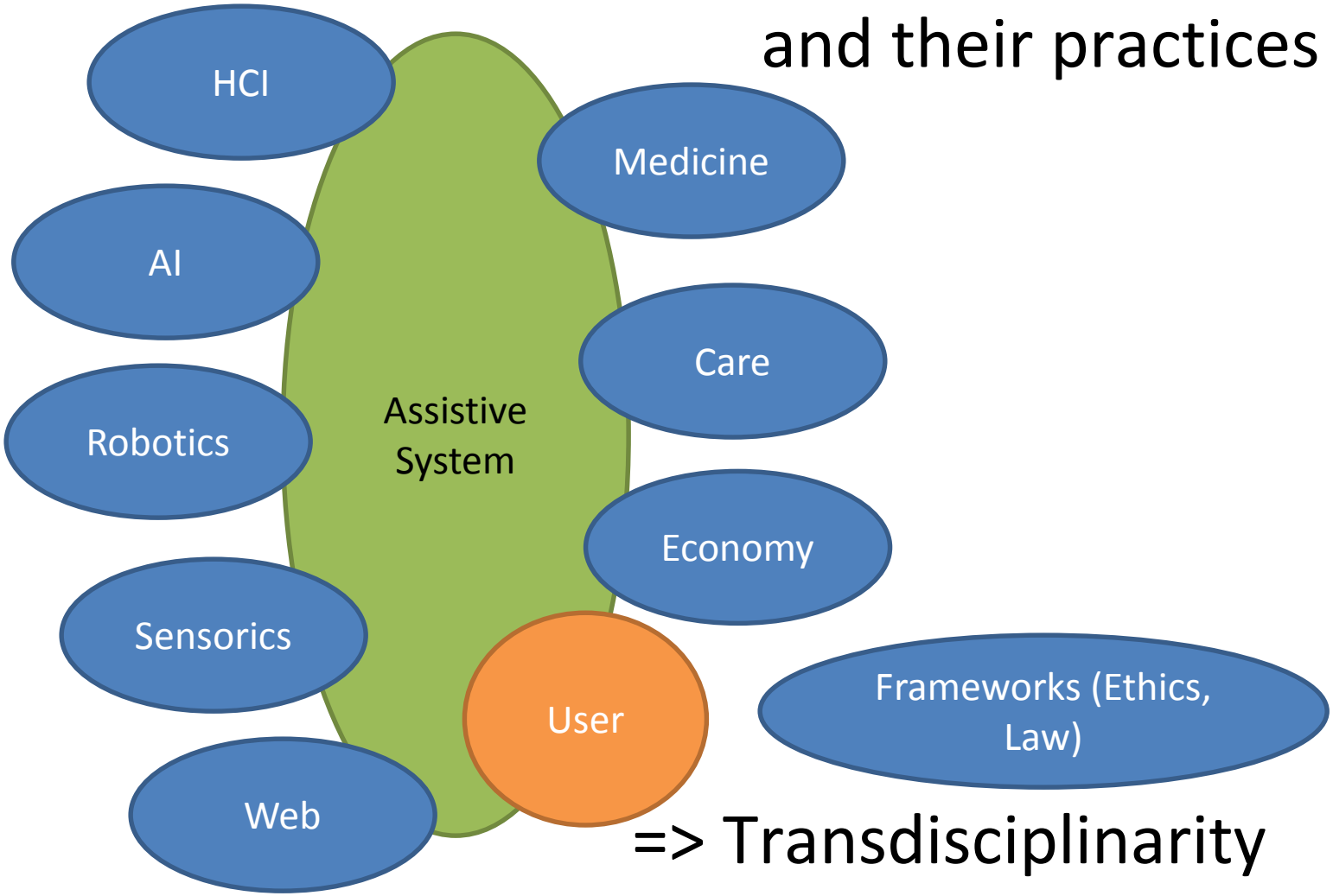
Assistive Systems

Three main focal points in AAL:

- **Active User Interfaces** with assistive function and (Internet/info/communication) services
- **Assistive Robotic** with own movement and manipulation ability
- **Sensorised** „smart“ living environment for support and detection of emergencies

Influence on Assistive Systems

Affiliation with many special areas of knowledge and their practices



=> Transdisciplinarity

Example: Video telephone

- Simple to operate
- Creates social nearness
- Fits better to living environment than a PC – „furniture“

Special user properties

- Users are not the typical „consumers” wanting to own or try something
- Users are inexperienced with touchscreens and speech recognition, show little self-confidence
- User do not understand the limitations of ASR and UI
- Strong tendency, to interpret failure of technology as allegedly own failure
- They tire quickly and easily forget, are less resilient and enduring
- Possibly they have some form of impairment

Activities of daily living (ADL)

Activities of daily living (ADLs or ADL) is used in healthcare sector to refer to older persons' daily self care activities.
3 classes of ADL are important for Assistive Systems:

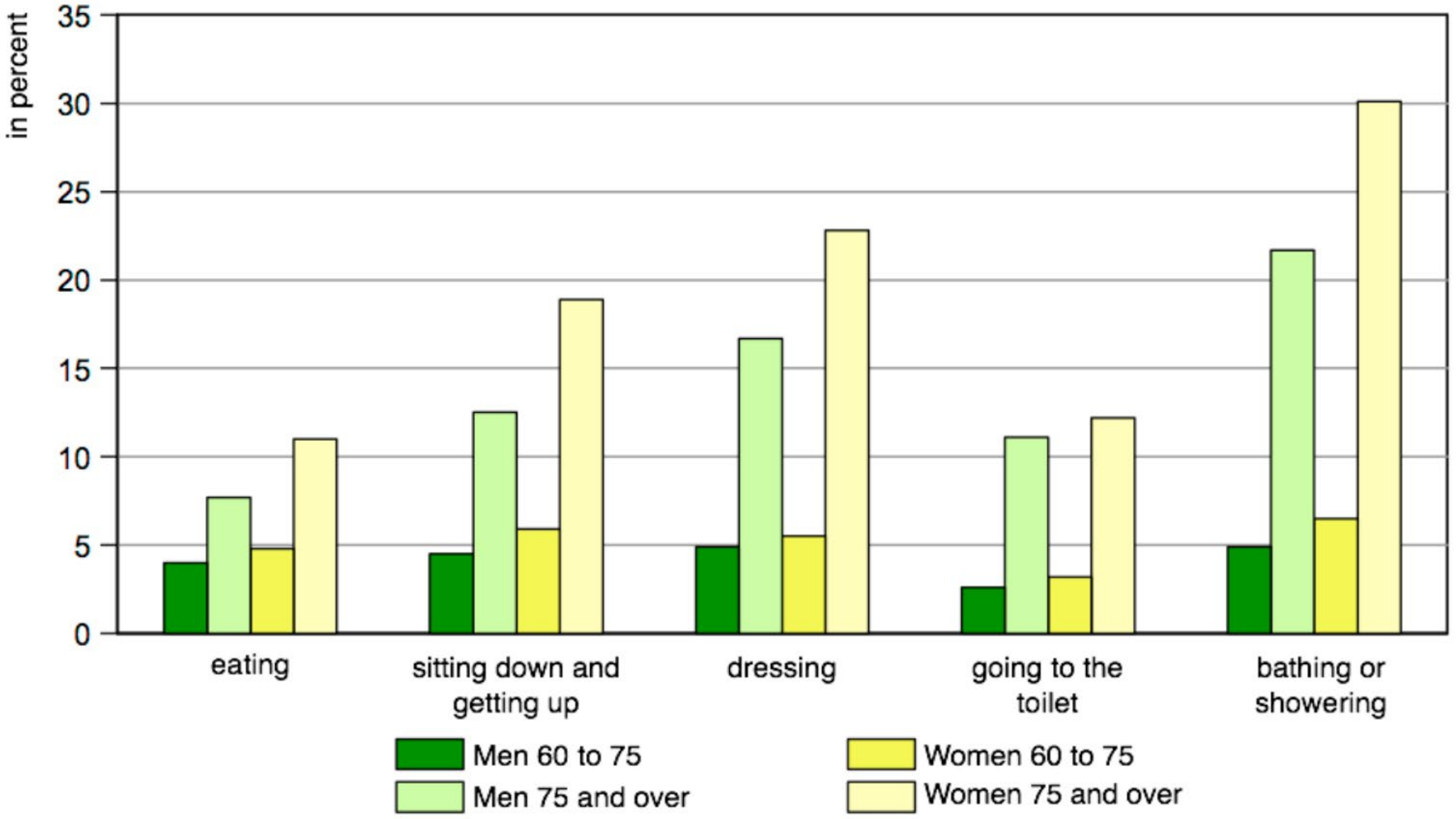
(basic) ADL = Activities of Daily Living. They include the ability to toilet, bathe, dress, eat, groom, and ambulate (walk, climb stairs, transfer bed/chair).

iADL = Instrumental ADL. They include the ability to successfully use the telephone, shop, prepare food, do the housekeeping and laundry, manage medications and finances, and drive our use public transportation

eADL = Enhanced ADL include participation in social and enriching activities, such as learning new skills and engaging in hobbies.

Source: potenziAAL, benefit, 2015

Older people's difficulties with ADLs



Source: Statistik Austria, Österreichische Gesundheitsbefragung 2006/2007, nach potenziAAL, benefit, 2015

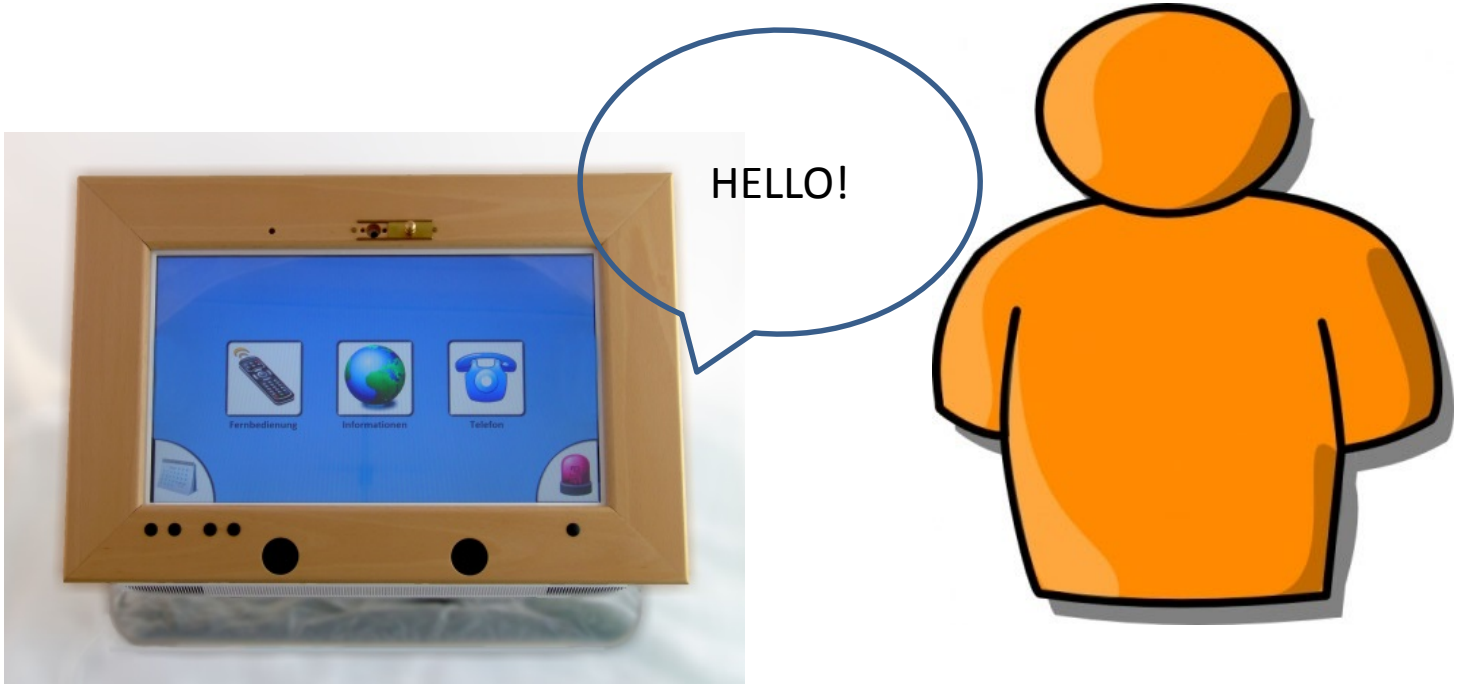
Assistive user interfaces: Age related strings

If we want to deploy active user interfaces we have to take into consideration the age related restrictions.

The system has to adapt to the user to become „tangible“ and not fail already on the first hurdle.

Active user interface

Important: „we establish contact“



and do not only wait until the user does.
We also offer more than one option or solution and adapt as far as possible.

Summary

- **Active user interfaces** use information of **triggers** (Sensors and/or time etc.) and want to achieve something for and together with the user.
- The contact with the user is established **actively**, but the user also can „initiate“ it - but also terminate. Context is important.

- The **goal achievement is actively pursued** - motivation
- The user interface itself becomes a **sensor**

- But: always **only for bridging the gap** until the next personal contact (carer, day care, relatives), **no permanent replacement**!

Assistive Robotics
Add own movement and manipulation

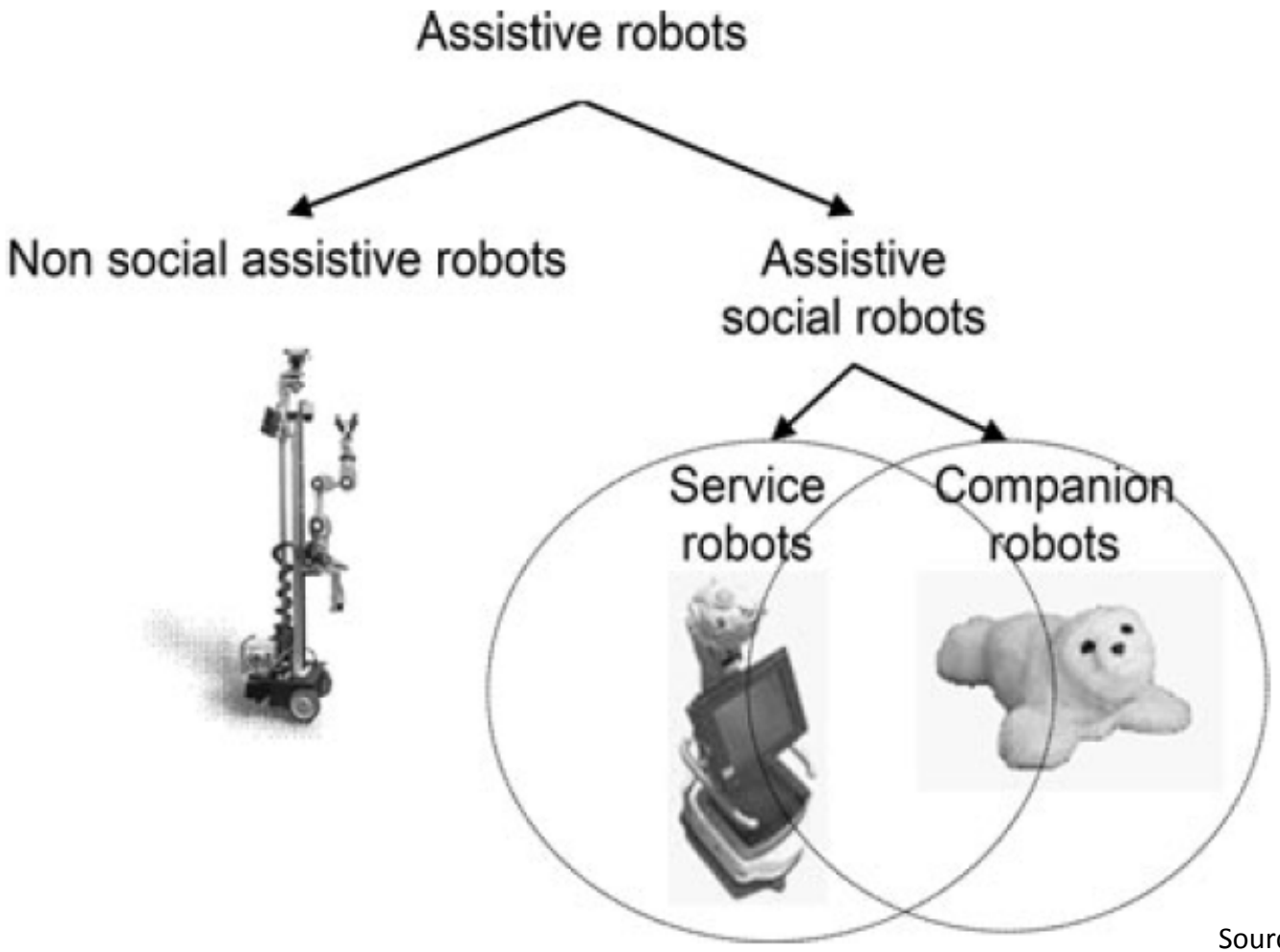
Example:
Assistive Robots

KSERA (NAO)

DOMEO (Kompai)

HOBBIT

Service robots - Assistive robots



„Assistive robots“ is an umbrella term
Social or just „functional“ is the first differentiation
Further differentiation according to manipulation and communication features

Source: M. Heerink et al. (2010) Assessing Acceptance of Assistive Social Agent Technology by Older Adults: the Almere Model, J of Social Robotics, vol. 2, no. 4, pp.361 - 375.

Study on personality modelling

personAAL: Small study with n=13 persons on the influence of personality at same functionality.
Hypothesis: it makes a difference / is recognised

„introverted“ „extroverted“

Sensorised environment
Support and emergency detection

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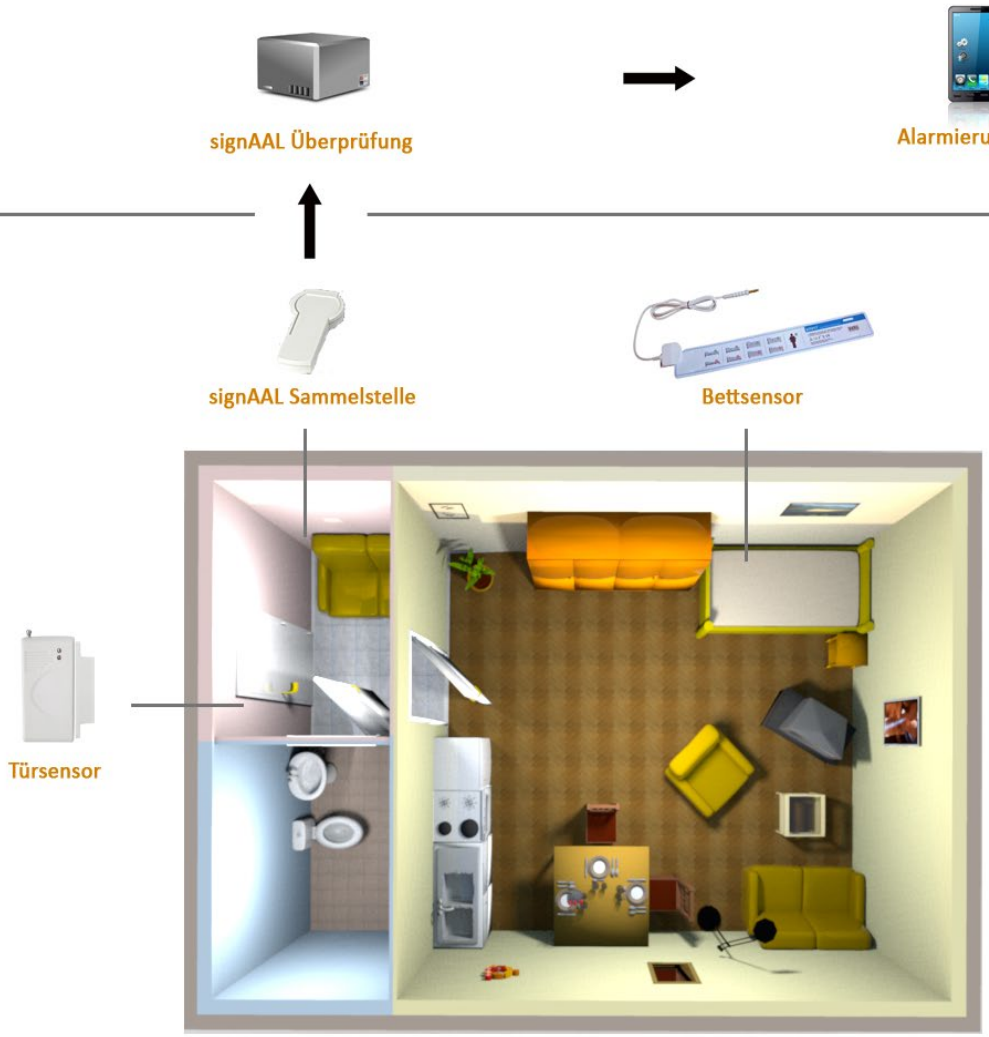
System for detection of unusual nightly activity and support for care staff

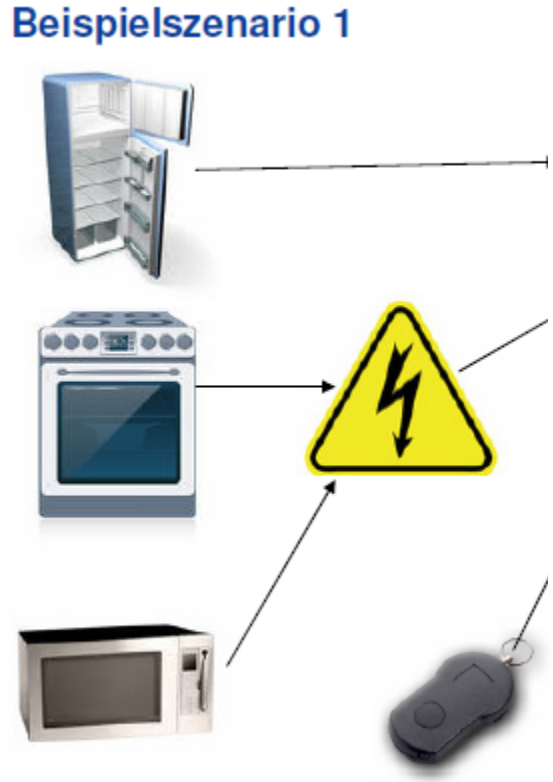
6-months trial in 6+6 flats
Link to care documentation



Source: www.aat.tuwien.ac.at/signaal/

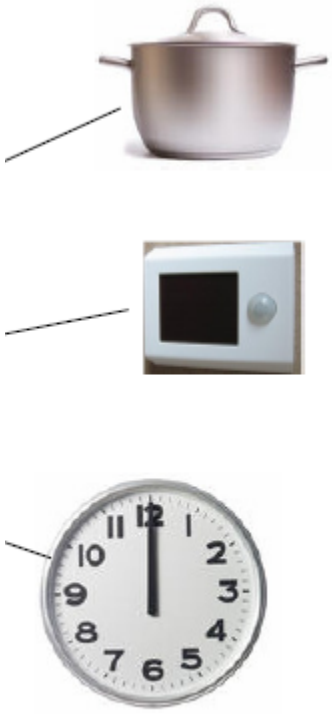
Example scenario: Recognition of situation by system

„Preparation of lunch“



Lunch

Fridge door
Cupboard door
Power consumption (oven)
Movement detector in kitchen
Time of day
Localisation



Source: Fraunhofer IMS

Structure of future domestic alarm systems

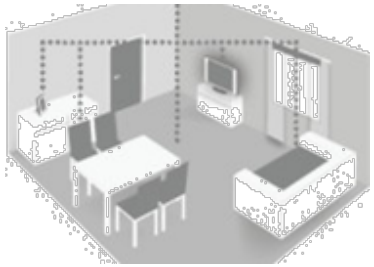
VC&HCT

Reminder functions, orientation assistance safety functions, …

Inactivity, desorientation, sleeping disorders, …

Activities of daily living, …

Building automatisation, networked appliances, vital data sensors, …



Ethics, laws and economy

- Ethical aspects in AAL research projects, products and services, legal parameters for AAL
  - Information, consent, being able to consent, data protection
  - MEESTAR instrument

- Cost-benefit considerations and business models

- **AAL System**: technical system (product or networked system) for an AAL application (e.g. fall sensor, Smartphone application, …)
- **AAL Service**: service on base of an AAL system, fulfilling a user need (e.g. senior alarm service with callback and emergency service)
- **AAL solution**: AAL system configured (and maybe adapted) according to individual requirements

- AT and AAL have an **increasing market potential** based on the demographic change

- There is need even for simple starter products – but first **important questions** on suitable **business models,** fitting **forms of financing** and good **acceptance** have to be answered.

Requirement analysis and evaluation

Understand and verify

- Get to know typical target groups for AAL systems and understand their needs
- Methods for analysis and description of users
- Methods for assessment of results

Exam and exercise

Exam for lecture

In written form:

- Ca. 10 questions on topics handled in lecture.
  - in English (you may answer in English or in German)
- Duration: ca. 30 minutes
- Hints:
  - Try to keep answers short, especially if no description is asked for.
  - It is not the amount that counts!

Next dates: Thu 9.1.2020 & Thu 13.2.2020 (13:15 s.t.), later approx. each 2nd month.

Details and registration in TISS.

Do not hesitate to ask in case of questions (email preferred)

Announcement for UE Assistive Systems

Introduction will be
on Thu 5.12.2019 at 14:15 s.t. in seminar room Zemanek
Details in TISS

Note: ***presence is mandatory*** for UE Assistive Systems !

Our lectures in overview

Winter term:

- Assistive Systems VO (187.A95)
- Assistive Systems UE (187.A96)
- Assistive Technology 1 (187.A59)

Summer term:

- Assistive Technology 2 (187.A60)

By TSC:

- Barrier-free Internet VO (187.A57)
- Barrier-free Internet UE (187.A58)

Contact

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