Assistive Systems

Active User Interfaces

Human Computer Interaction Group (HCI)

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Winter Term 2019 / 2020

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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

- Saftey and Support

V. Ethics, Law and Economics

VI. Requirements Analyse and Evaluation

II. Active User Interface

User Interface

Reminders, instructions, communication, information

Active Support – as Assistive System

On the background of:

- Social development
- Self-determined life

Objectives

- Learn about current developments in applied HCI area and understand the application as **active** system
- Become able to associate terms and systems and explain them by example
- Get to know forms of interaction with users and their restrictions
- Understand importance, potentials and risks of different technologies for applications in the field of AAL

Background ICT

or simply: computers

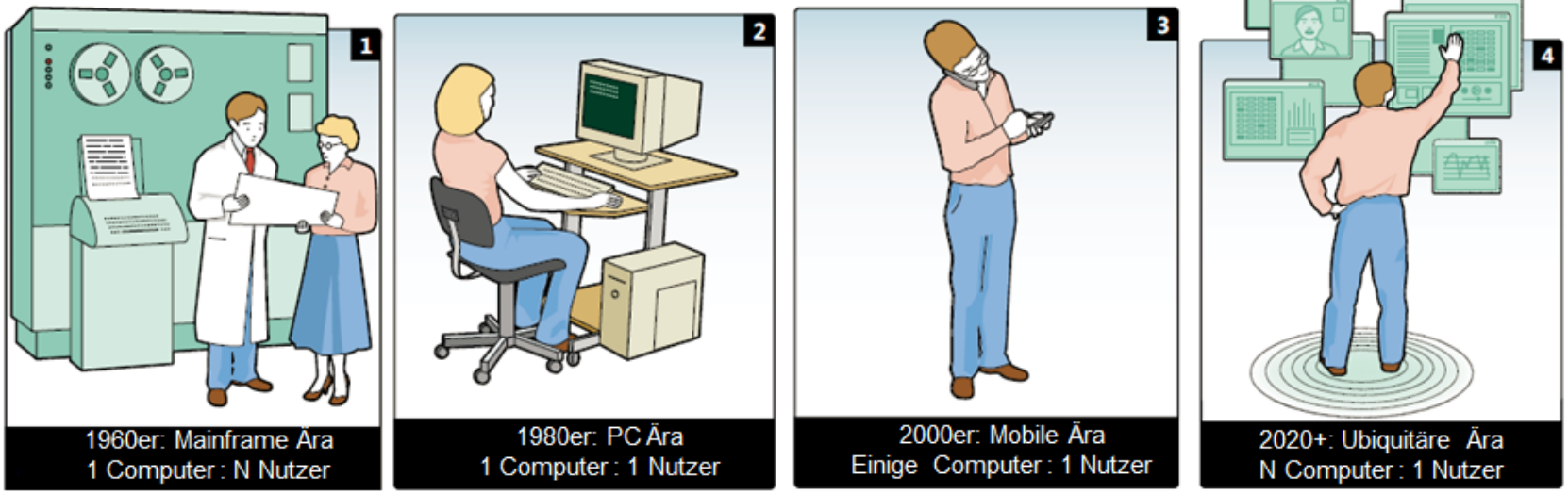
… and the necessary interfaces with humans

Background: Information society

ICT stands for **Information- and Communication technology** (German: IKT) and is an umbrella term for innovations and applications of informatics, electronics and telecommunication

Information society denotes a society based on ICT and reflects the increasing pervasion of all areas of life by ICT

ICT - History



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Source: Die vier Epochen des Computers (Harper et al., 2008)

ICT - History

Mainframe Computing (1960 -)

Personal Computing (1980 -)

Computer Networks (ca. 1990 -)

Mobile Computing (ca. 2000 -)

„Web 2.0“ (ca. 2005 -)

„Cloud Computing“ (2010 -)

„Ubiquitous Computing“

…

„Internet of Things“ (201X -)

„Internet of Everything“ (20XX -)

ICT in Medicine/Health Applications

VC&HCT

Mainframe Computing
(1960 -)

Big central units in intensive medicine
(1960 -)

Personal Computing
(1980 -)

Personal Medical Sensors
(1993 Matsushita Blood pressure computer)

Ubiquitous Computing
(? -)

Ubiquitous Healthcare

(2010 -
e.g. Google Health, Microsoft Health Vault, …)

„Digital Revolution“

Change in society caused by ICT, similar to „Industrial revolution“ in the 19th century

Within only ca. 10 years an almost complete digitalisation of all information, media and telecommunication channels took place

Exponential growth (ca. 25% per year) – „Knowledge explosion“

Current: Open Data and Big Data, Internet of Things (IoT) => Privacy

„Digital divide“

Not all people actively acceded the digital revolution (in job or leisure).
Looking back some 50 years, mainframes were still prevailing. Nobody owned a „personal“ computer.

Many old people are computer laypersons and are frightened by everything looking like computers. Often this fear, to do something wrong, prevents them from even trying computers.

And yet today hardly anything can be imagined without computers being involved.

Terms English -> German

Being able to join in - or have it done by somebody

What if doing/participation is not as easy as it is for the majority („does not work“, “unable”)?

Can part of the population simply not profit from modern ICT solutions?

In the area of disabled people much has already been achieved under the heading of accessibility / „barrier free“ but there still is a lot to do there.

Can ICT itself contribute here (giving access also for novice older users)? This also creates new services (and new market)? => AAL

Multi-modal interaction with users

Extended user interface - HCI

Question?

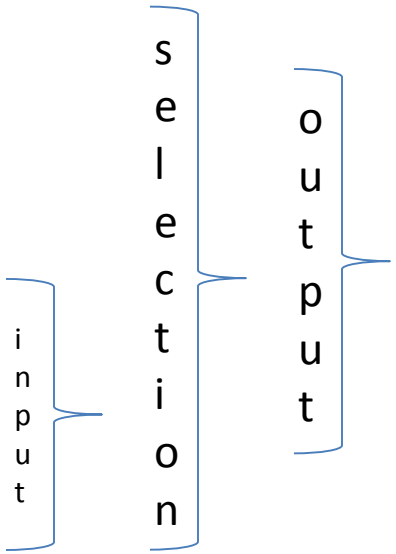
Which interaction channels are mostly used for HCI?

User interface: Input and output

Multi-modal channels for output, selection, input
i.e. the user has alternatives

- Graphical / Text output
- Touch
- Gestures

- Speech in-/output
- (seldom keyboard)



Note for AAL: users are (because of their usual living conditions) ***living alone***, otherwise there may occur additional complications (e.g. who and where is the _current_ user)

Display with input: Touchscreen

Display for text (earlier printer/typewriter), later years graphics, available since long and often used since PCs came up

Combination with input leads to Touchscreen instead of separate keyboard. Saves space, similar to picture. Nowadays standard.

New possibilities but also new interaction concepts necessary

Touchscreen

Touch for selection is intuitive and provides good feedback possibility by displayed text (or graphic)

- Visible, acoustic or tactile

almost always easy and quick to learn.

- The selected item is „evident“. However tactile feedback is not/seldom available
- and already the sleek, haptically not explorable surface is irritating and prevents „a good feeling“ and guidance for the fingers.
- For some users it is not always easy to use the arm in a controlled way without support.
- Furtheron, there are problems with reflections, cleaning aso. (or a screen saver!)

Excursus: irritating touch functions

Touchscreen:
Operating systems offer many operation features, which only make sense to experienced users, for the inexperience user they are surprising

- Long press – context menu
- Sliding, zooming, flicks / gestures
  - e.g. close app by sliding it out of the screen
  - Switch to other desktop
  - Every screen border has a function

Excursus: irritating OS functions

Other OS automatisms, partially vendor-specific services, some very deeply anchored in the OS

- Auto-Updates
- In case of prolonged inactivity:
  cleanup / index services
- Operating Instructions / Hints
- Notifications / Bubbles
- Screensaver, standby

=> responsibility of AS designer to “hide” OS

Exkursus: handling of malfunctions

Especially network problems can influence the processing of functions (on Windows „freezing“ of the user interface), unexpected delays in loops…

It is difficult to explain to the user that something is not available at this moment and why, or that some „effects“ just need to be ignored.

Important: offer explanations and solutions, e.g. to inform support automatically
or at least record the event in the background
-> expect errors and handle them
-> test for pseudo-„realtime/chaotic“ use

Control by gestures

- Control by gestures is intuitive and relatively easy to learn (but hard to perform for some)
- Particularly in the gaming area there is positive experience with old users
- Examples: Nintendo Wii, Microsoft Kinect

Source: Diakonie Bayern

Control by gestures in AAL-/Health context

- Gestures for navigation within Radiology data during surgery (sterile hands)
- Application for ***rehabilitation training***
- Gesture control of home appliances

Control by gestures

It makes little sense to train the user with new, complicated gestures.

Gestures should **use the natural tendency** to signal something (involuntarily):

- Stop – flat hand
- Come closer – inviting gesture
- Pointing
- Shift/Close/Wipe

Limitations have to be considered e.g. in lifting arms (caused by age, disability, context etc.)

Face recognition

Another form of image based recognition allows the (re-)recognition of faces, on the one hand for **identification** but mostly for **locating the face** of a user and the **direction of gaze** to support a more natural communication.

Other possibilities are detection of lip movement (support for ASR) or of facial expressions. Currently these are seldom used (camera, viewing angle, complexity).

Speech output
(TTS = Text To Speech)

- Speech is a **very natural** communication channel, available without further foreknowledge and which is easily understandable.
- Speech output addresses the person and creates **“Personality”.**
- Nowadays very fine voices in many languages.
- Application mostly hassle-free, but possibility for **repetitions/queries** needed (volatile information).
- **Attention**: some people are scared by being suddenly addressed by a voice (hearing voices) e.g. people with dementia

Speech recognition
(ASR = Automatic Speech Recognition)

Speech also is a very natural input channel, which is available straightaway

Examples like Siri, Google Now/Assistant, Navigation systems or dictating to a PC show the potential

But does it work in reality? Also offline?

Are there preconditions?

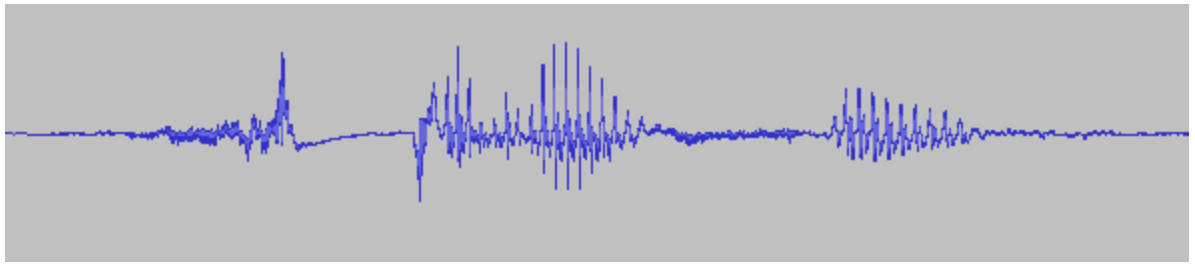
Questions?

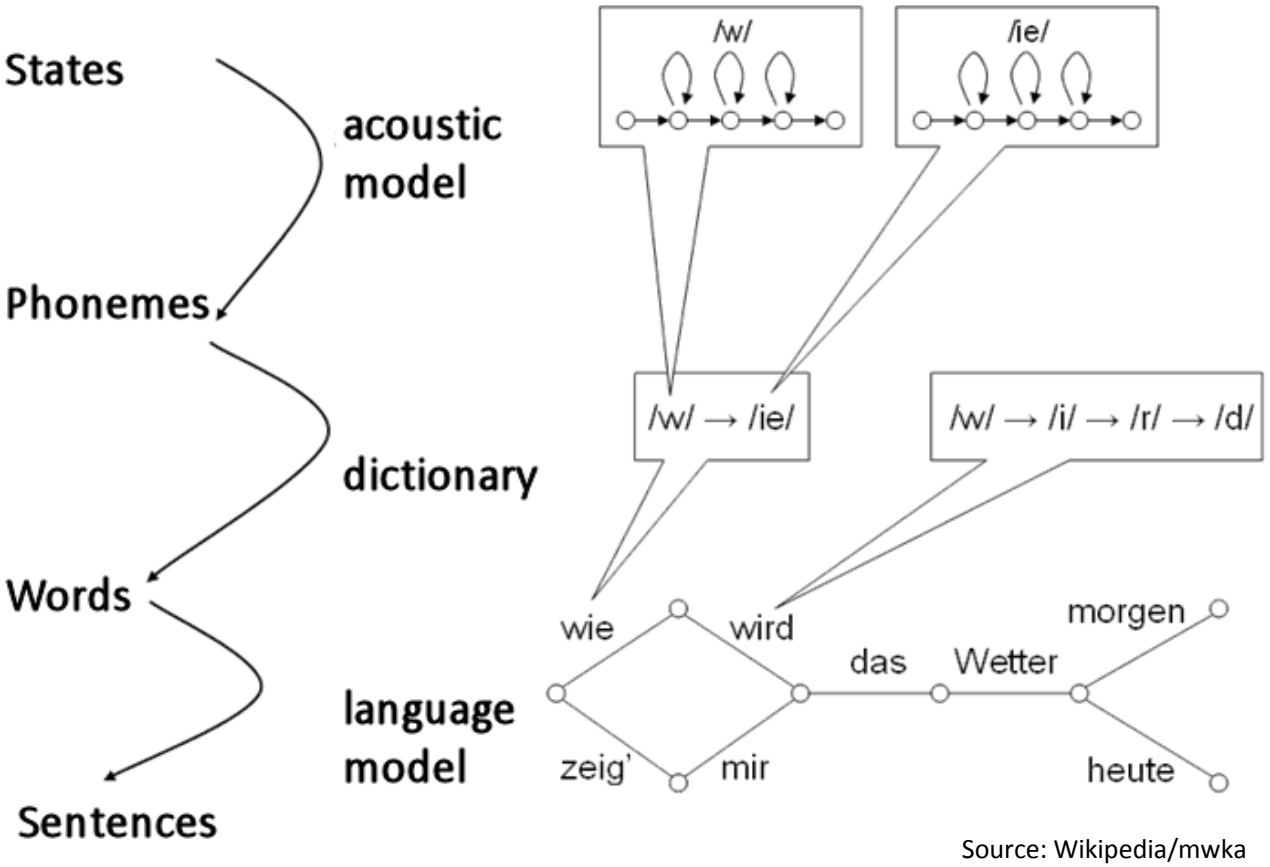
Who uses speech recognition?

For what?

How well does it work?

Speech recognition - Model
The quest for resemblance





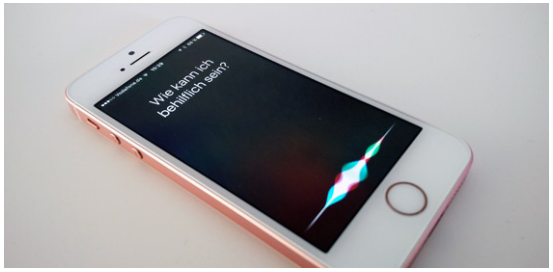
Source: Wikipedia/mwka

Speech recognition: challenges

- For reasons of acceptance **microphones not on body**
- Variable distance and room acoustics influence **recognition rate**, also dialects and voice
- **Environmental noise** causes errors or blocks recognition (street noise, Radio/TV)
- Users often **“speak to themselves”**
- In case of problems users tend to speak louder or involuntarily more distinct (**unnaturally**) or to repeat impatiently or add (curse) words – which doesn‘t help
- Speech recognition often is not enabled/ready or has a context based vocabulary, which is difficult to understand for the users
- Recognition is just similarity/probability based

Voice Controlled Assistants (Privacy concerns)

Apple Siri

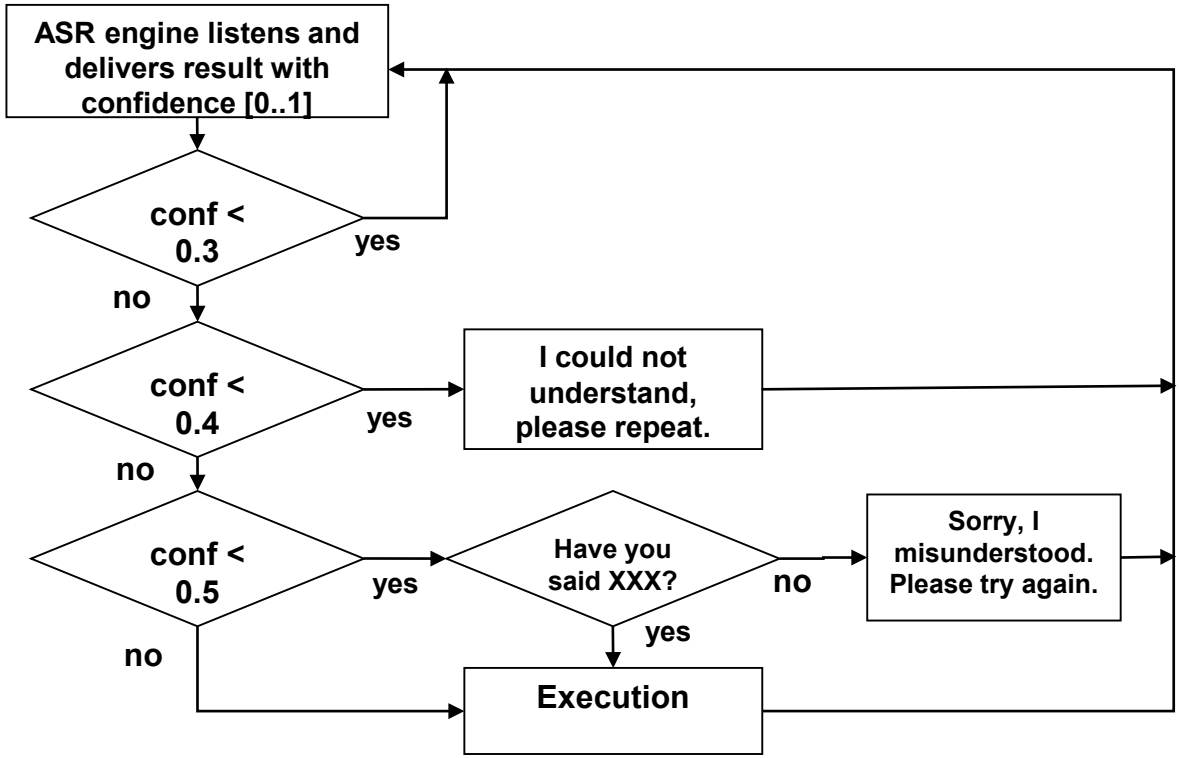


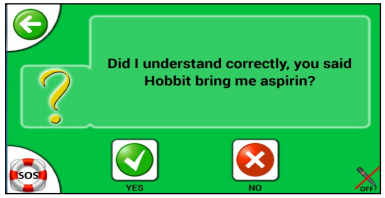
Microsoft Cortana

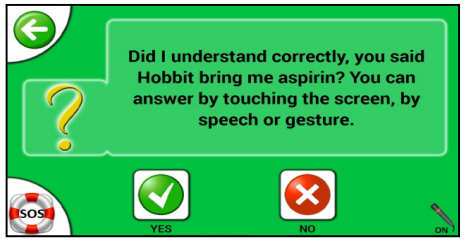
Amazon Echo/Alexa

Google Home/Assistant

ASR Dialogue – can you please repeat?







- Probability based instead of „wrong command“
- Goal oriented, not annoying, allow variants
- noise – speech differentiation difficulty

Speech recognition: variants

- Fixed grammar
  - Selection from fixed set, fillers partially dismissed (wildcards)
  - Similar sounding words less of a problem (unless distinction necessary)
  - Needs lot of foresight of complete necessary vocabulary
- Free vocabulary
  - All known words are accepted
  - Meaning of utterance to be found
  - Key words as anchor
  - Grammatical analysis necessary
  - Similar sounding words more problematic
- Trigger word heads optional recognition -> safer (“Alexa”)
- Processing locally or „in the cloud“

Avatars

- Recent developments allow “animated” characters
- Combined with speech and gesture output
- Can create more “bonding”, might be more “persuasive” (“personality”)
- Used for proposals, counselling, guiding
- Can cause problems because of feeling of being more monitored

Avatars

Source: wcbuddy project

Source: virtask, anne4care.nl, Zorg van Nu

Living well with Anne: https://www.youtube.com/watch?v=wMtmKxs_O5o

Special user properties

- Users are not the typical „consumers” wanting to own or try something until it works
- 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 (speech) impairment

Age specific physical restrictions, which must be considered

Assistive user interfaces: Age related requirements

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.

Terms and definitions: Disability

Disability denotes a permanent and grave impairment in the social and economic sharing and participation of a person.
Often mixture and superposition of **barriers (adverse environmental factors)** and individual **impairments of a person**, which make it difficult to overcome barriers.

Disability usually means a reduced ability to do something.

Question?

What types of impairments may occur due to aging process?

Disability and age
Old != Disabled

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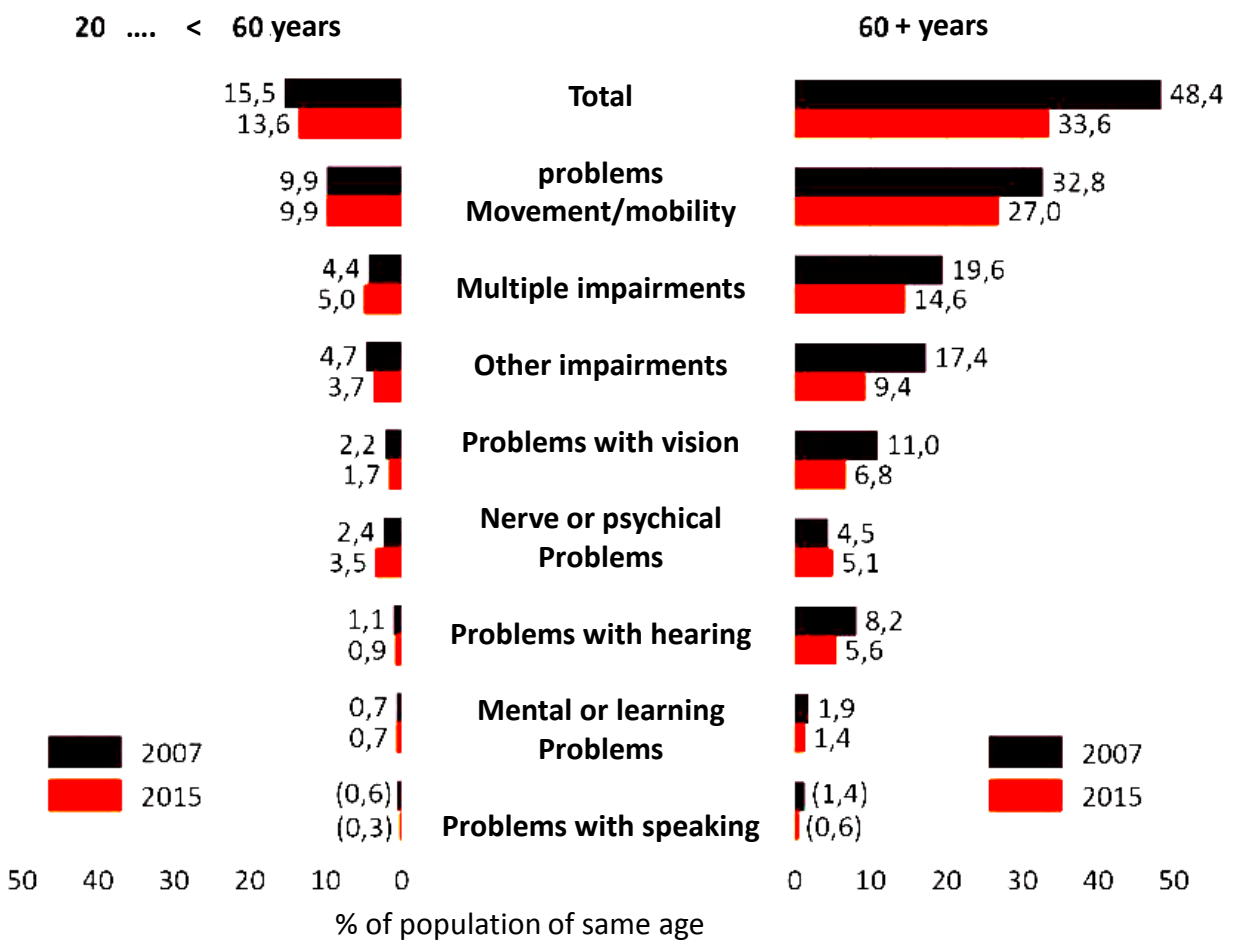

Permanent impairment 2007 and 2015 per age

Source: STATISTIK AUSTRIA, Mikrozensus 4.Quartal, 2007 und 2015

VO Assistive Systems

Prevalence of Disabilities

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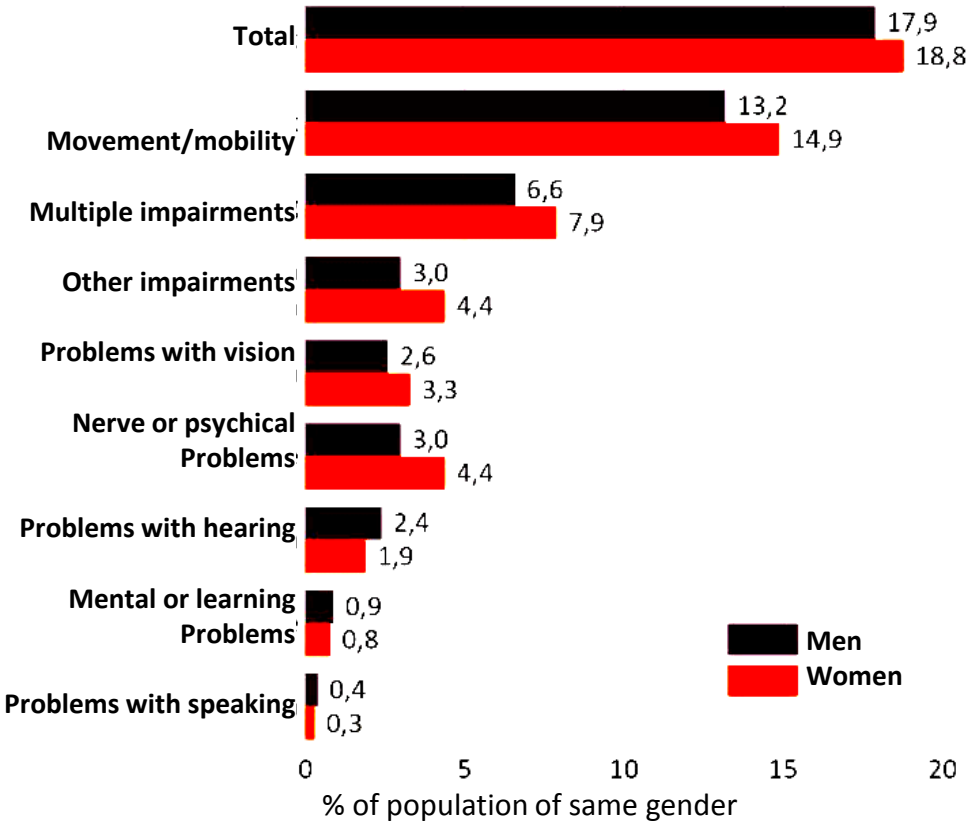


Permanent Disabilities 15+ per gender

Source: STATISTIK AUSTRIA, Mikrozensus 4.Quartal 2015 - Zusatzfragen „Menschen mit Beeinträchtigungen“.

„Ageing“

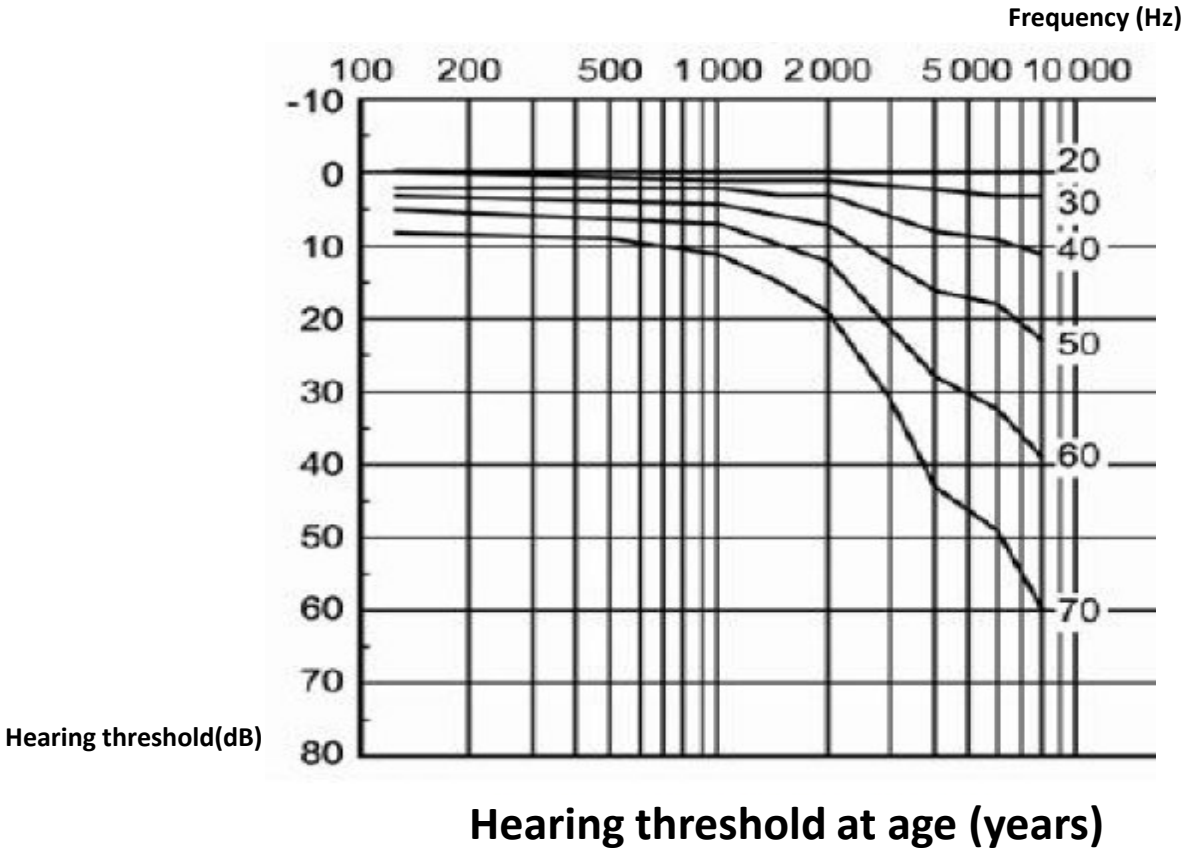
- Ageing is no disease, but a natural process – life is linked with ageing
- The gradual decrease of general performance with (higher) age is normal
  - Ageing is individually highly different
  - Also the decrease in performance leads to restrictions
- Risk for becoming ill and severity of diseases increase with age (age related diseases)
- With old age the probability for having several diseases at the same time increases (multi-morbidity)

Age induced Syndromes: The five big „I“

The five big „I“

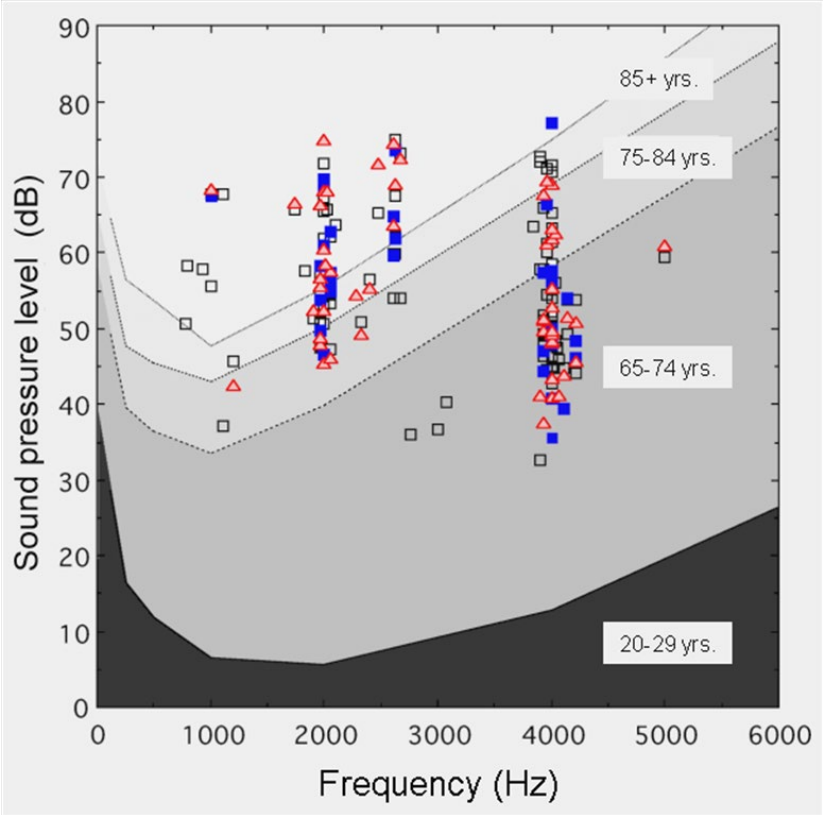
- **I**ntelligence decline (most of all different forms of dementia)
- **I**mmobility, (lack of movement, Arthrosis, paralysis)
- **I**nstability (health e.g. stroke, fall)
- **I**ncontinence (urine or stool)
- **I**mpairment of...(restrictions in sensory organs)

Restrictions with age: hearing



Loss of hearing ability for high frequencies in dB
-> fit/adjustable frequency and volume of sound

Hearing: effects – e.g. on operating appliances, detect alarms…



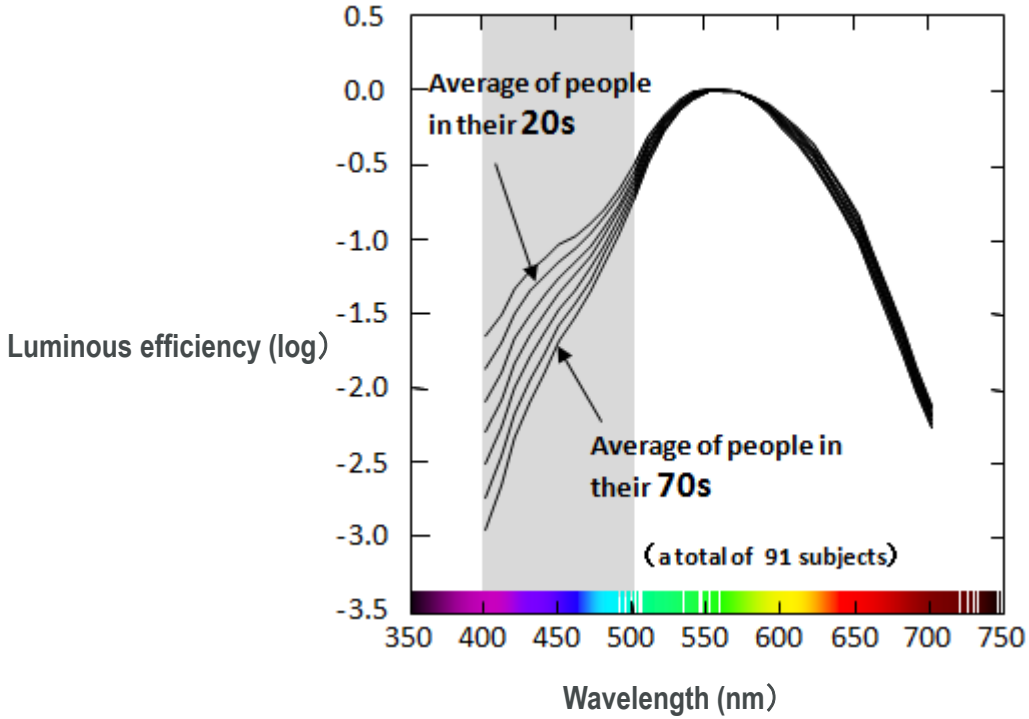
Source: Kurakata, AIST, Japan

Warning

Termination

Feedback

Restrictions with age: Vision – colour perception



Source: Sagawa, AIST, Japan

-> adapt colour contrast (dyschromatopsia!), not only colour for displaying information

Vision ability for accomodation / presbyopia

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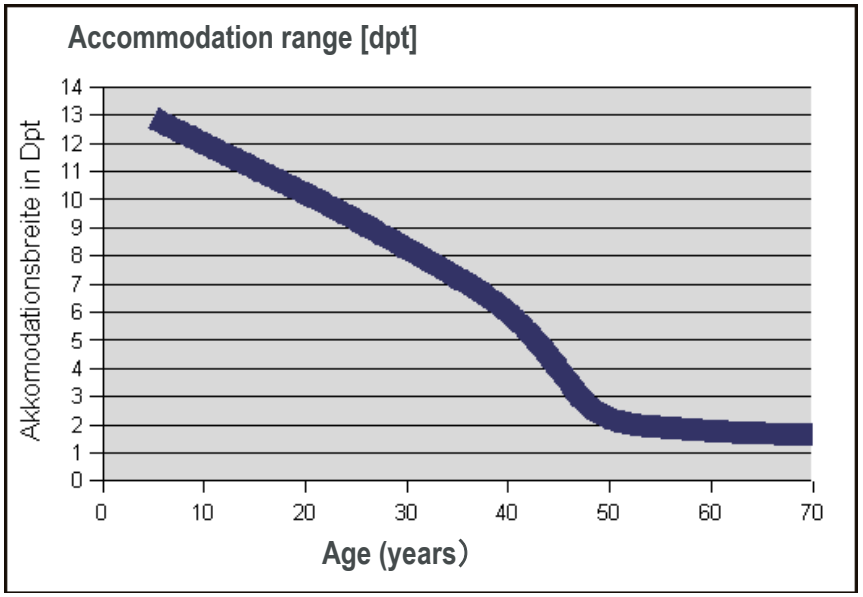
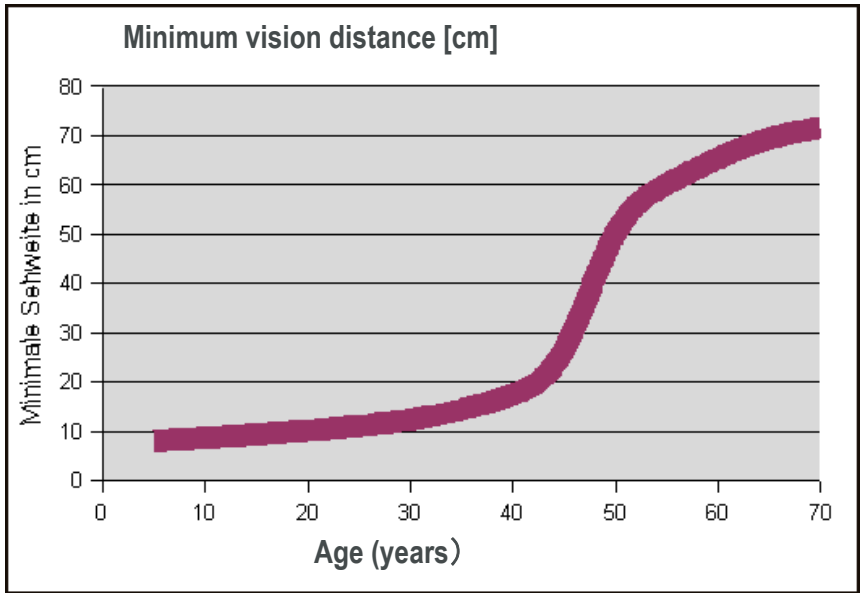
Accommodation range [dioptres] and minimum vision distance [cm] with age

*)dioptre = reciprocal focal length in [m]





-> problem of distance, big symbols and text

Age related restrictions: Eye diseases

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Age related Macula Degeneration (AMD)

Die-off of retina cells
ca. 2 Mio. affected in Germany
usually not treatable
Cause 32% of new vison losses in Germany

Cataract (dt: Grauer Star)

Opacity of eye lens (protein/pigment accumulation)
Treated with artificial intra ocular (fixed) lens
Most frequent eye surgery in Germany, ca. 650.000 IOL per year

Age related restrictions: Eye diseases

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Glaucoma (dt: Grüner Star)

- Damage mostly by high inner eye pressure
- If detected early well treatable
- Cause of ca. 16% of new vision losses in Germany

Diabetic Retinopathy

- Caused by long lasting/badly treated Diabetes
- Damages retina
- Causes ca. 16% of new vision losses in Germany

Age related restrictions: Eye diseases

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Macula Degeneration

Makula-Degeneration
Beeinträchtigung der Sehschärfe, der Lesefähigkeit, des Kontrastempfindens, des Farbsehens

Cataract

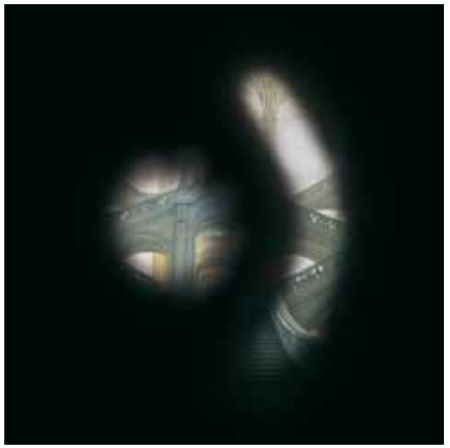
Grauer Star (Katarakt)
Das gesehene Bild verliert an Schärfe, verschwommenes bzw. verschleiertes Bild

Diabetic Retinopathy

Diabetische Retinopathie
Verschwommenes und verzerrtes Sehen, blinde Flecken, totaler Sehverlust

Glaucoma

Grüner Star (Glaukom)
Erhöhter Augeninnendruck, Pupillenexkavation mit Substanzverlust des Sehnervenkopfes, Gesichtsfeldausfall



-> difficult to see a sharp and complete image

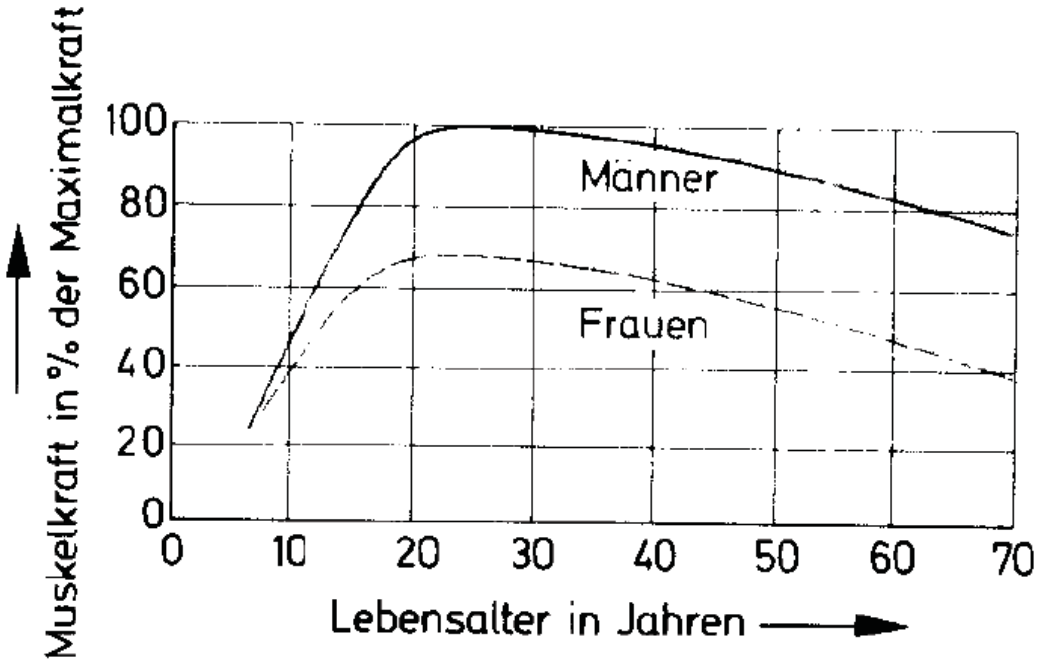
Age related restrictions: smelling

Reduced perception of taste, loss of appetite, preference of very salty or sweet food

Partly reduced ability to control body hygiene, social isolation

Missing perception of dangerous situations (smoke, gas)

Age related restrictions: motoric/force



Source: Lange, 2005

Force of muscles with age in percent of max.
Men (upper line) - women

Age related restrictions: motoric

Source: neue Verpackung 09/2010

-> little effect on HCI, maybe activation force of buttons

Age related restrictions: hand, dexterity, fine motoric skills

- Shaking/tremor makes accurate positioning difficult
- It can become difficult to extend the arm towards touchscreen
- Reduced sensibility reduces feedback in touchscreen interaction
- Big elements and haptic feedback („pressure/trigger point“) important

Age related cognitive restrictions, which must be considered

Cognitive restrictions

- Statistically growing number.
  - Ca. 8% of 65+ people and
  - More than 30% of 90+

- Dementia - chronic disease of brain, going along with gradual decay of cognitive, emotional and social abilities (especially most frequent form Alzheimer‘s-Dementia)

- Active Assistive Systems potentially useful

Dementia – the disease of the 21st century?

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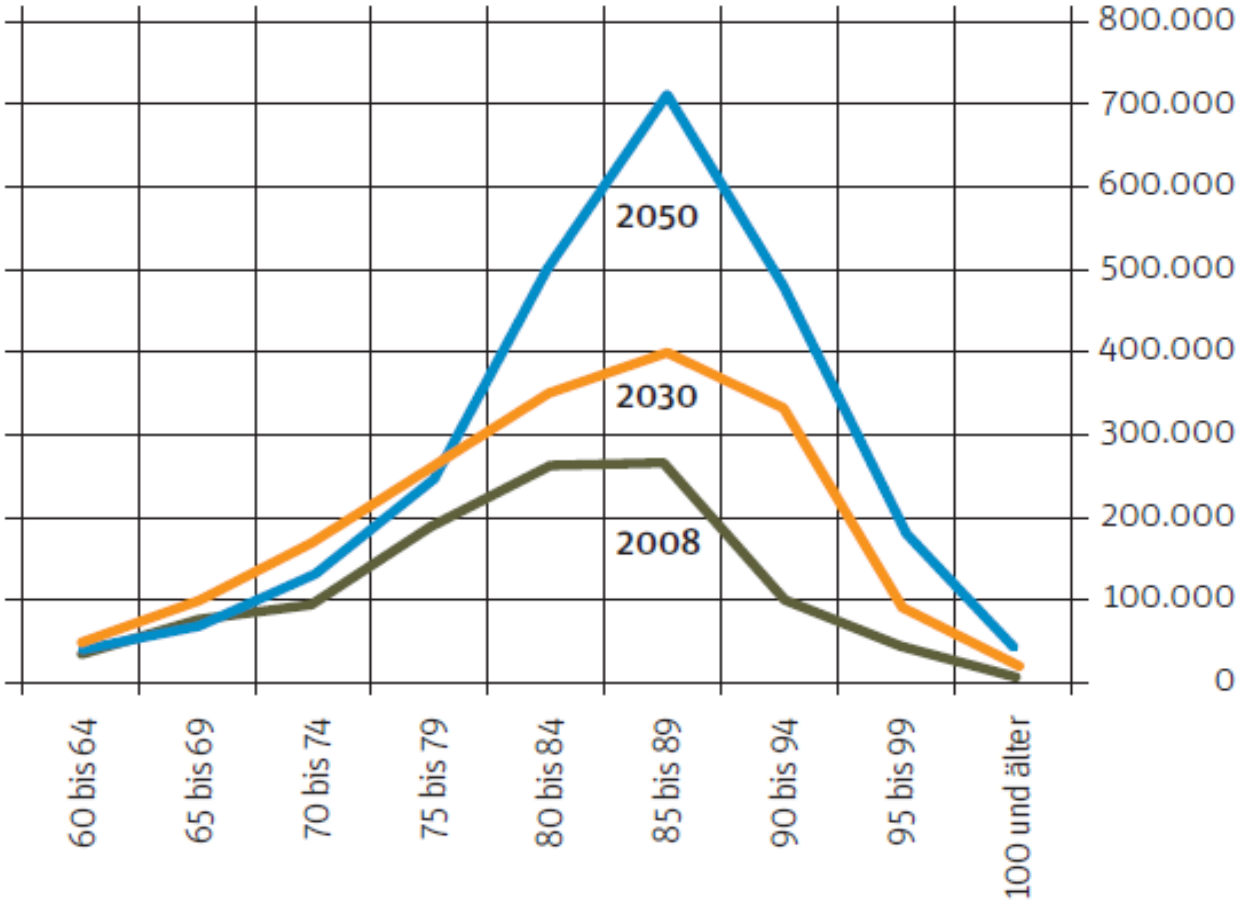
Prognosis of the number of Dementia patients in Germany until 2050 per age



Dementia: symptoms

- Weakening memory (especially short time memory)
- With progressing disease progressing memory loss
- Difficulty in speech communication
- Difficulty in recognition of persons and objects
- Later also motoric symptoms

Dementia: change in communication behaviour

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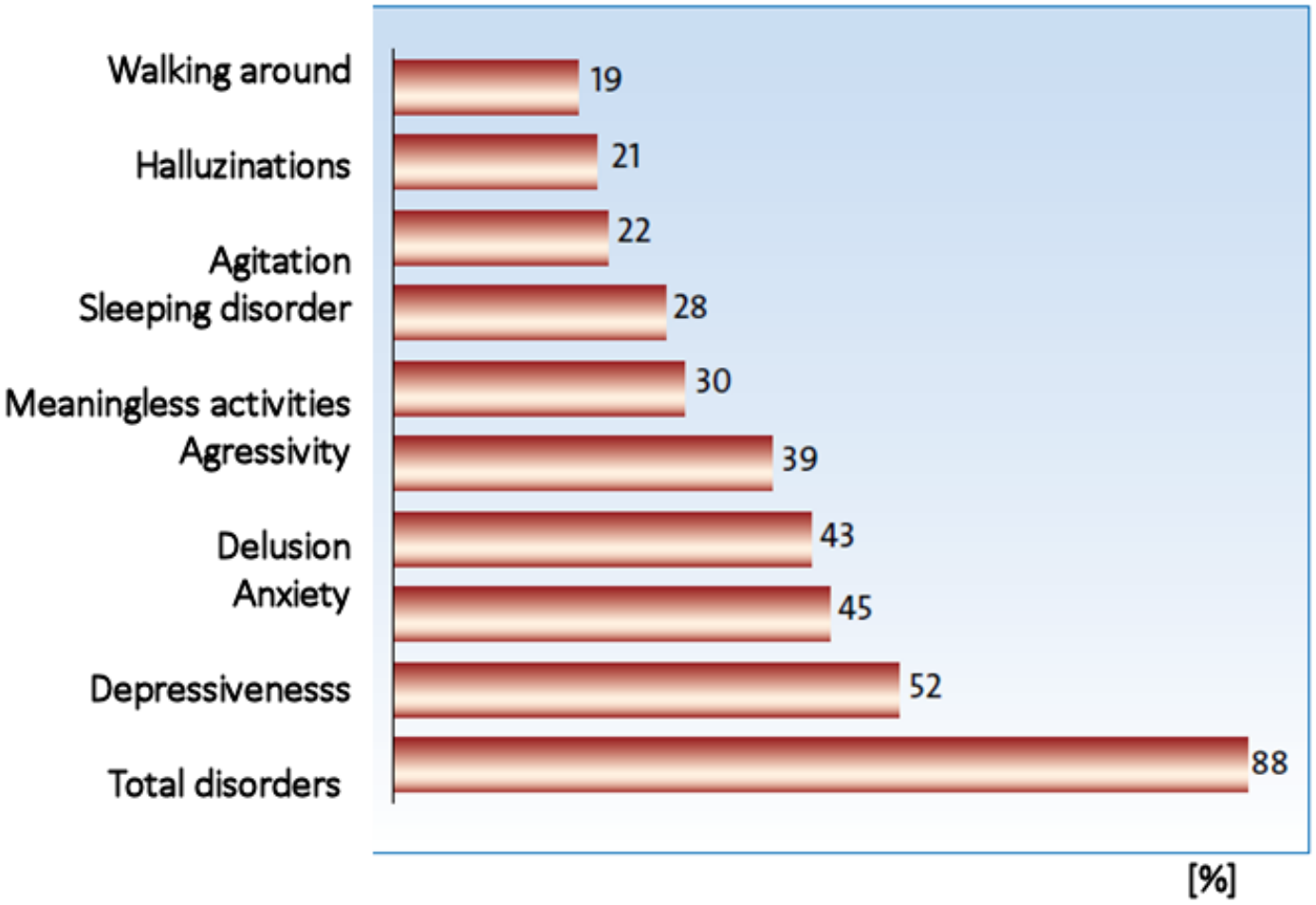
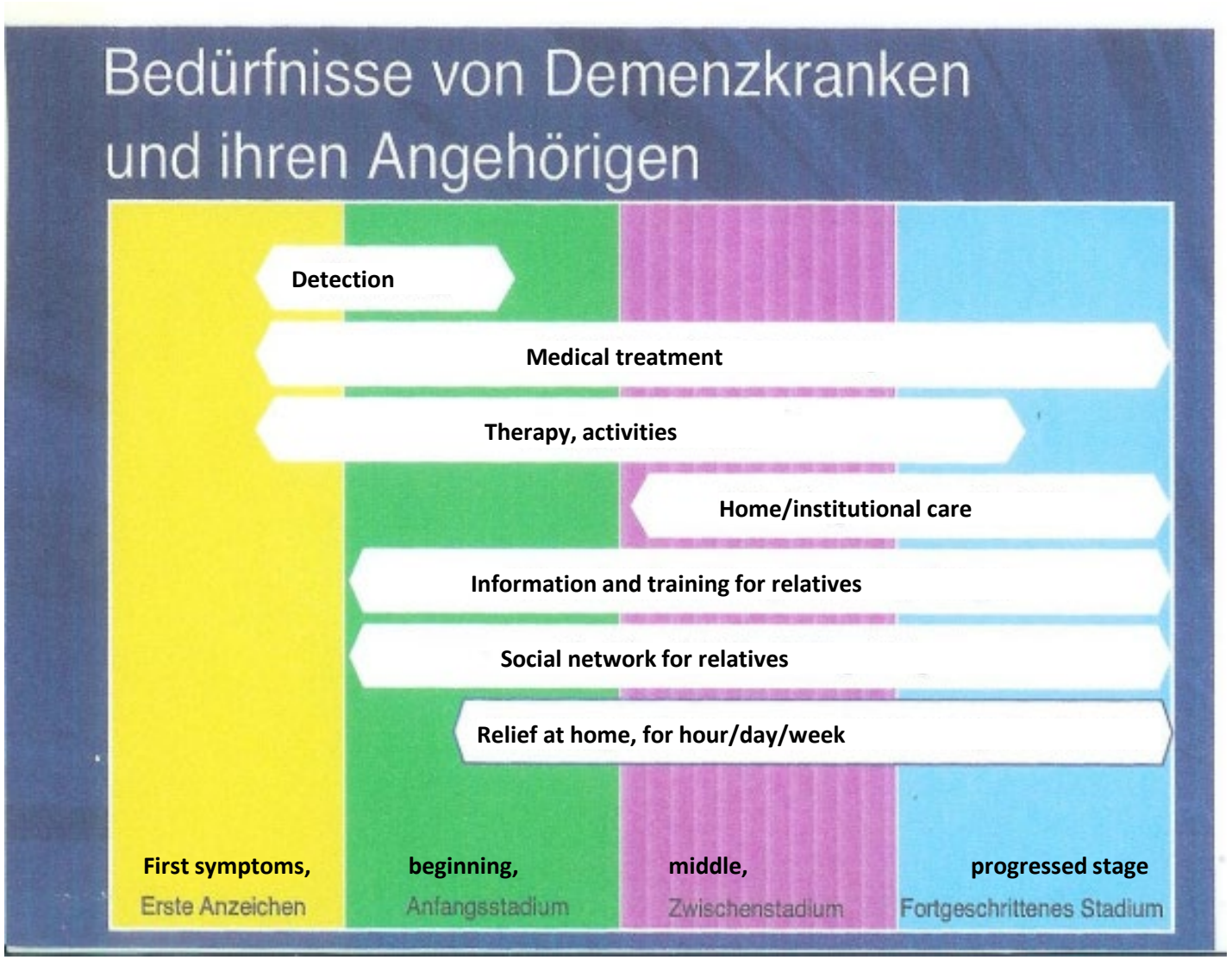
- Problems with memory (names, denomination, ..)
- Decrease of spatial and temporal orientation, increasing loss of sense of reality
- Difficulties in inter-personal communication (understanding, frustration)
- Decline of importance of oral communication
- Influence on social interaction (outburst of emotions, unrest, withdrawnness)
- Increasing importance of non-verbal communication, emotional approach

Dementia: change in behaviour



Source: Frölich L, 2006

Dementia: Need for assistance



Classical forms of therapy

Non medicinal therapy

- Psycho-education of relatives
- Reality orientation training
- Validation
- Music therapy
- Animal therapy
- Snoezelen (stimulation of senses, e.g. care oases)

Medicinal therapy

- Treatment with so called Anti-dementiva
- Support of stimulus transport in brain
- (possibly) slowdown of progress of disease, mostly if detected and treated early

Reality orientation vs. Validation

Reality orientation-Training (ROT)

- Nurture temporal and spatial orientation
- Big clocks, mirrors, name plates, coloured markings
- Inner withdrawing shall be prevented

Validation approach (=appreciation)

- Take emotions and statements of PD seriously
- Non-verbal communication
- Avoid excessive demands and isolation
- Emotional approach

Functions of assistive user interfaces and examples

Assistive user interface: Application per function

- Communication (telephone, Email)
- Information (weather, news)
- Reminders (appointments, medicine)
- Entertainment (radio, music, games)
- Training, vital data
- Instructions, recommendations

Commonalities with classic user interfaces

- Stationary system
- User interface – in/output
- User comes to system
- User enters commands

Use of finger instead of mouse

Additional:

- Central unit instead of several (PC, mobile)
- The computer behind „vanishes“
- System provides active support

Advantage of a stationary device

The use of mobile **tablets** has been tested successfully many times

- Advantage: take with you, convenient operation position
- Disadvantage: easily forgotten somewhere, charging forgotten, must be carried and held

Stationary device can be placed where it is easily visible and is always „in its place“, therefore better familiarisation and more use

Examples from projects

Example: Tablet solution for old users

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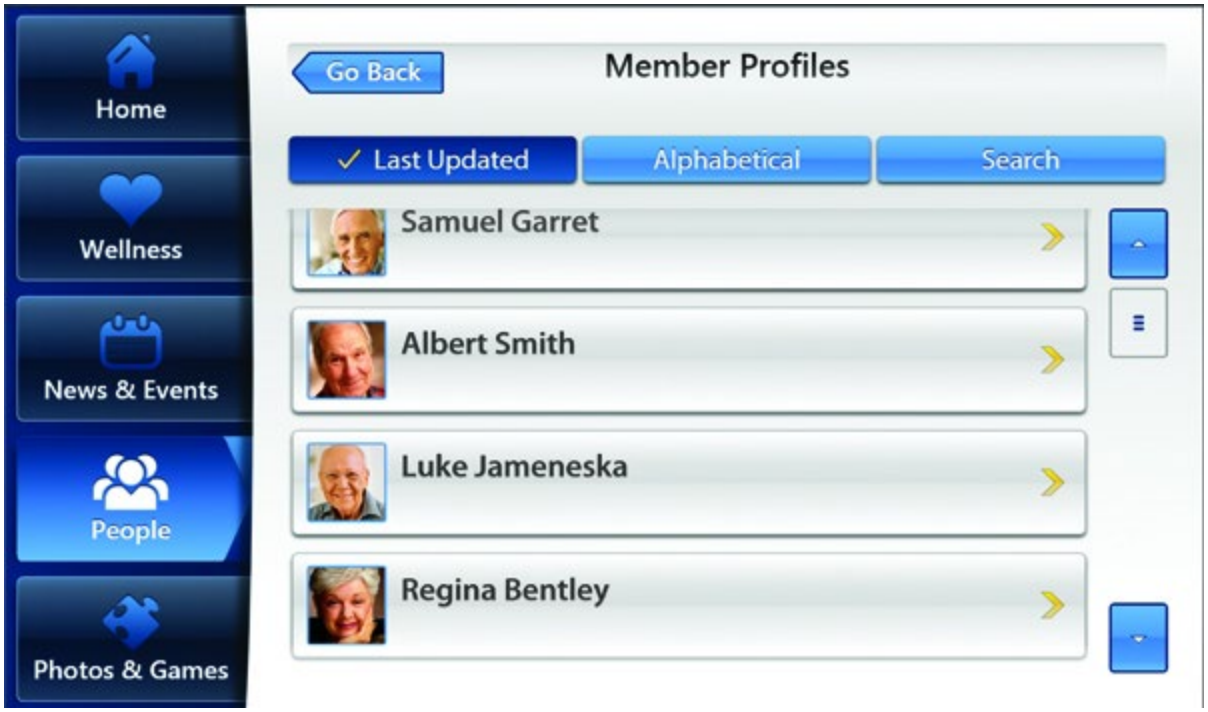
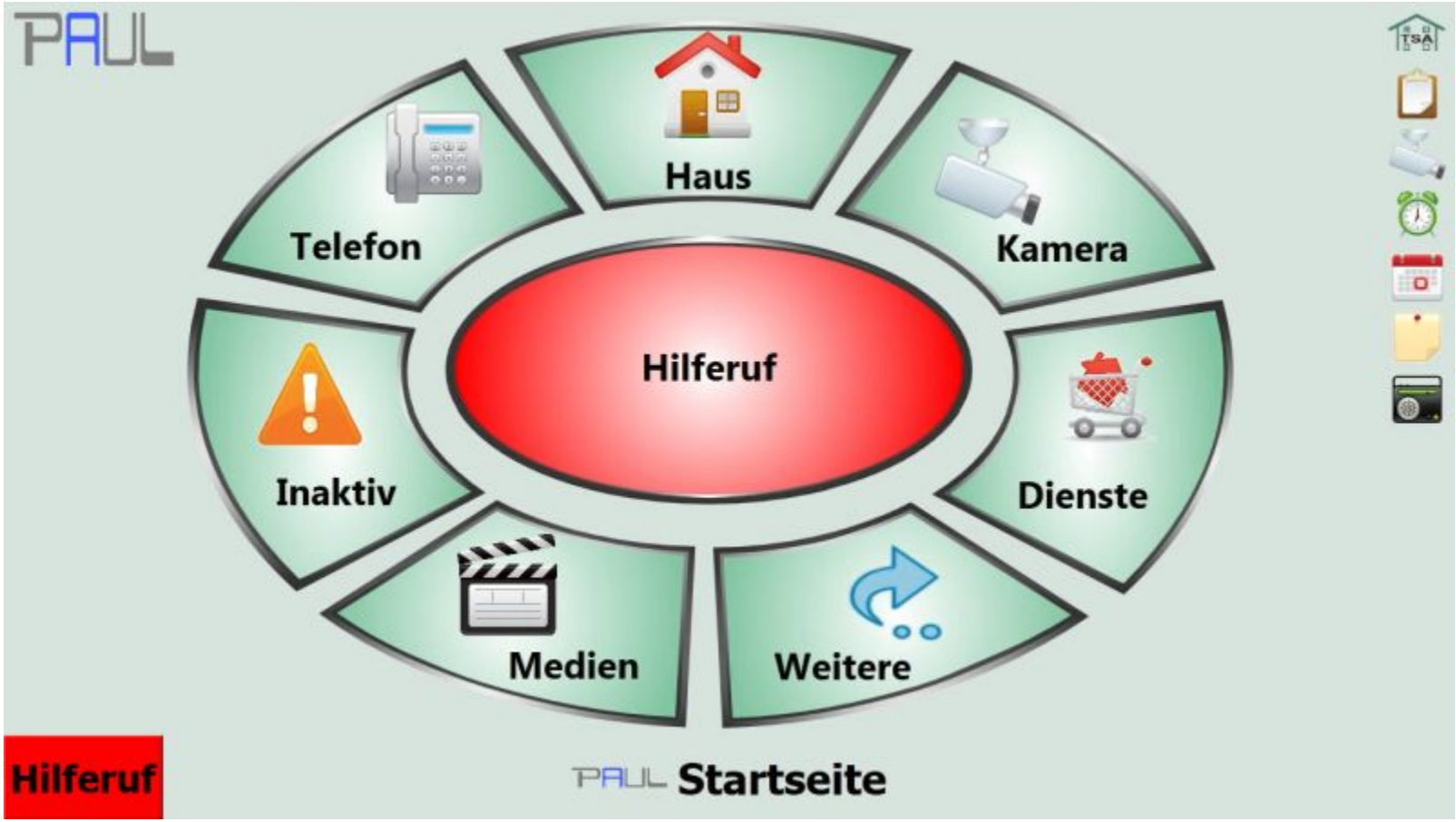


Source: careinnovations.com

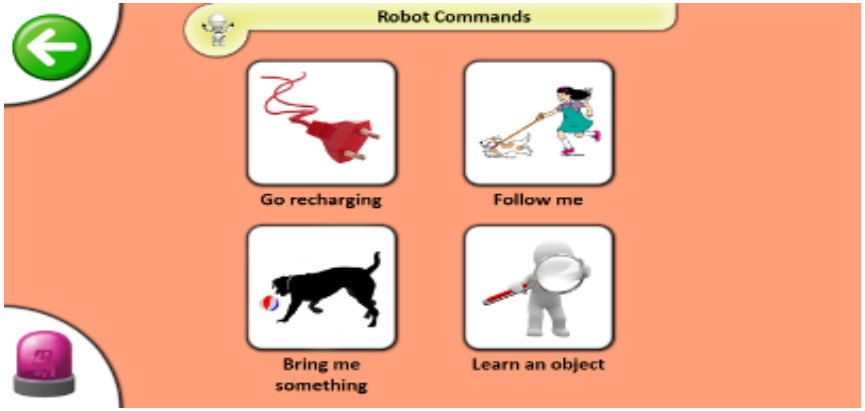
Example: Tablet solution for old users



Source: TU Kaiserslautern, CIBEK GmbH http://www.cibek.de/ , http://www.meinpaul.de/

Siehe kurzes Video

Examples from robot projects



Question?

What differences and similarities do you see?

Examples from projects

Differences and commonalities:

- Only text
- Only images/icons
- Combinations text and image
- Size, recognisability, readability

Important: adaptable to very individual abilities of users

Finger size and hearing/vision as criterion

eldy - Alternative for classic User Interface on PC

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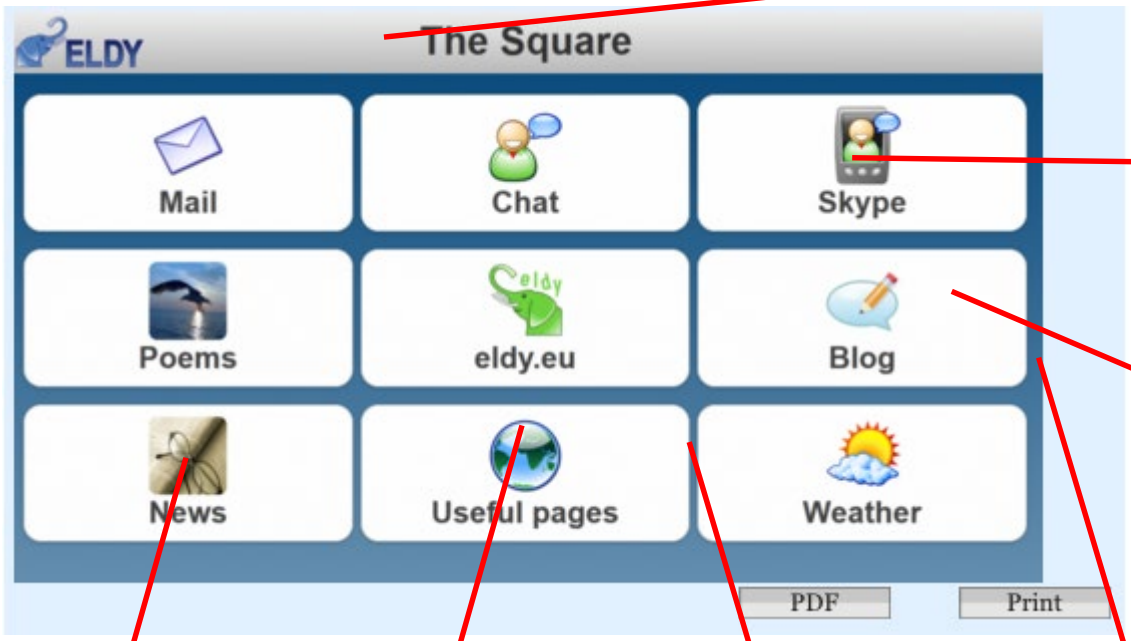

Additional speech

Every page is titled

Good contrast

Feedback from activation of elements

No hidden elements (pop up)

Sufficient space

Big elements and text

Graphics and text

Source: eldy.eu

Example: Support for Relatives

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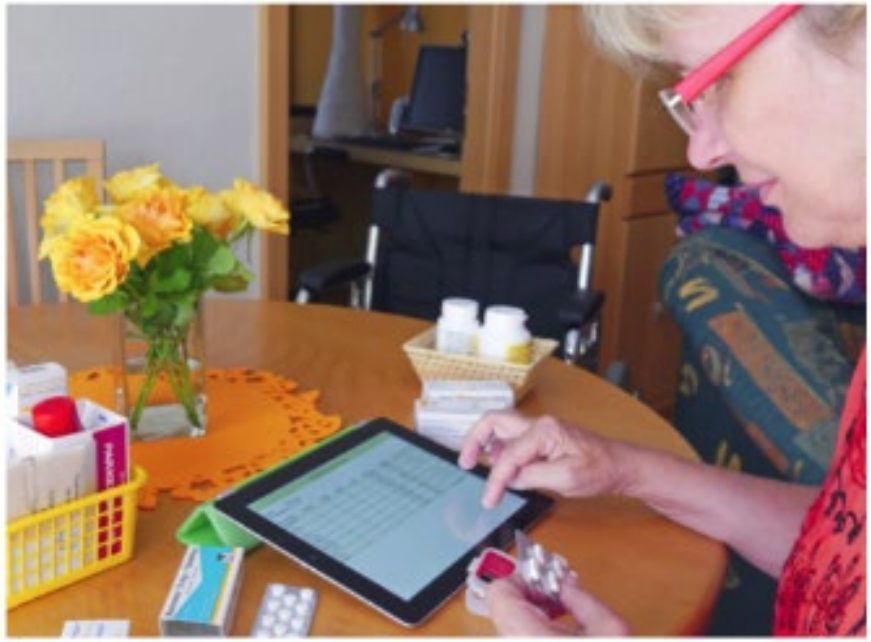
TOPIC (The Online Platform for Informal Carergivers)

http://www.aal-europe.eu/projects/topic/

Support for caring relatives



Here the users are mostly younger and have experience with computers -> „normal“ tablet

Example: Huge interaction area

Source: Microsoft Surface

Mostly for institutions, for therapy

Technical support for dementia

Background and examples for support

Dementia: benefits of Assistive Systems

(early) detection from behaviour patterns

- Recommendations
- Instructions and management
- Temporal orientation
- Spatial orientation
- Assistance with communication and contacts
- Identification of persons
- Finding/identification of objects
- Safety (wandering)

Application in addition to other measures and therapies

Dementia – Loss of competences

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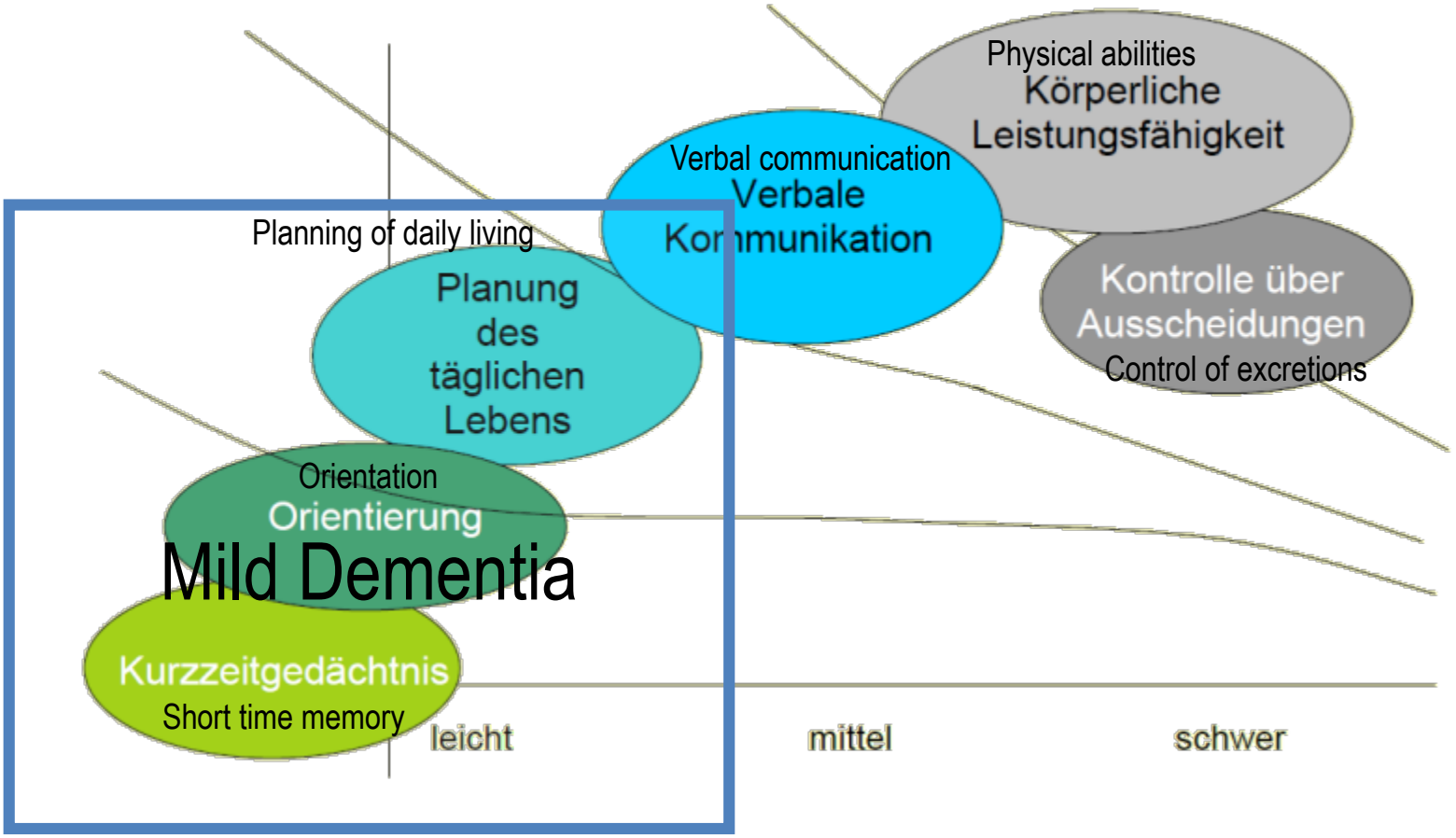

Source: Heike von Lützau-Hohlbein, Deutsche Alzheimer Gesellschaft

Dementia – Fields of action

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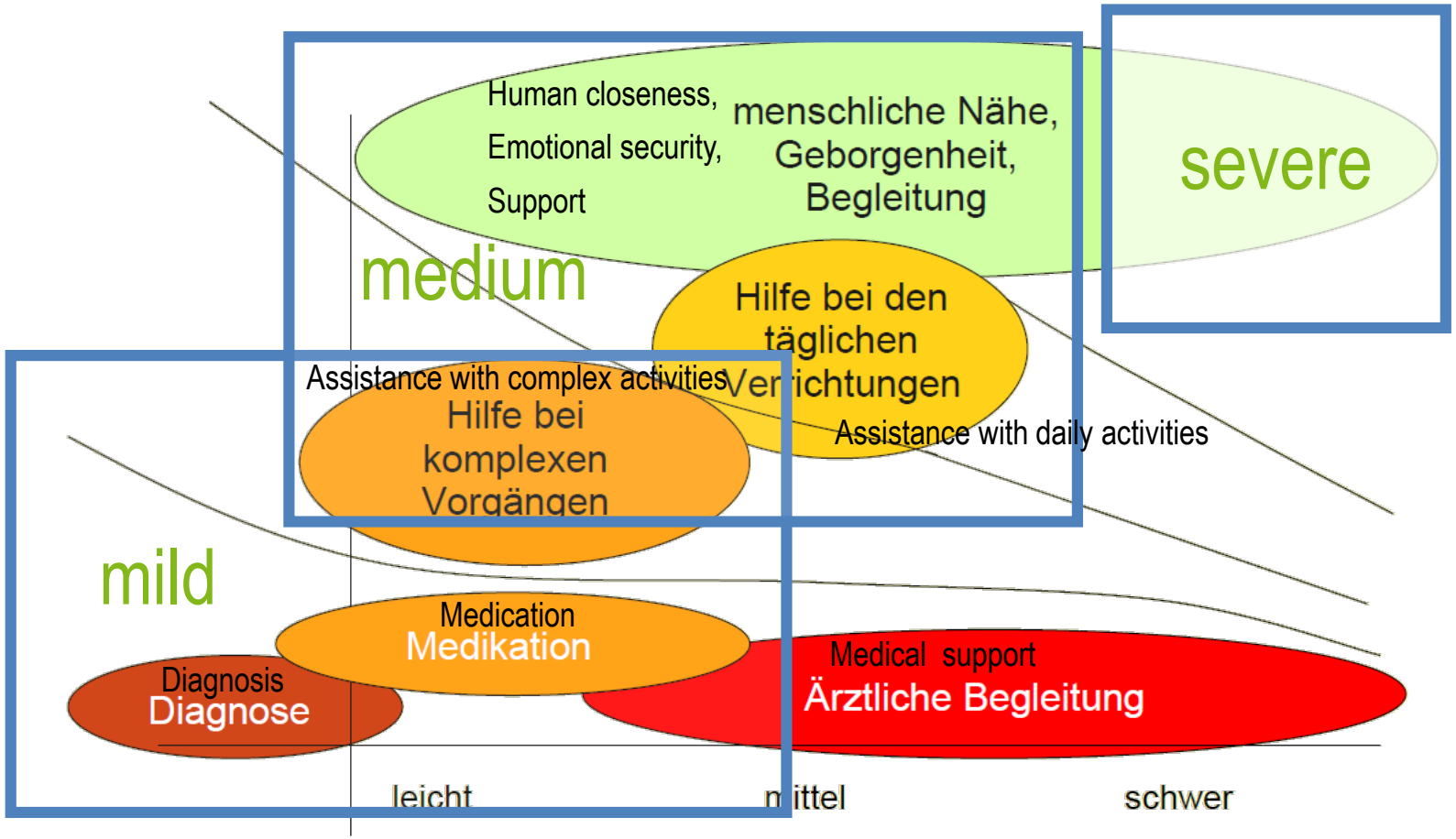

Source: Heike von Lützau-Hohlbein, Deutsche Alzheimer Gesellschaft

Technology and Dementia – application areas with severity

Examples of application areas

- Early detection

Light dementia / „mild cognitive impairment“ (MCI)

- Help with orientation
- Help with remembering/reminding, coaching

Medium and severe dementia

- Safety systems
- Activation
- Nurturing of memory and biography work
- Emotional approach

Active technology: Information and instructions „goal oriented“ as support, simplification/minimisation of information, alarm in emergency

Perspective of those affected

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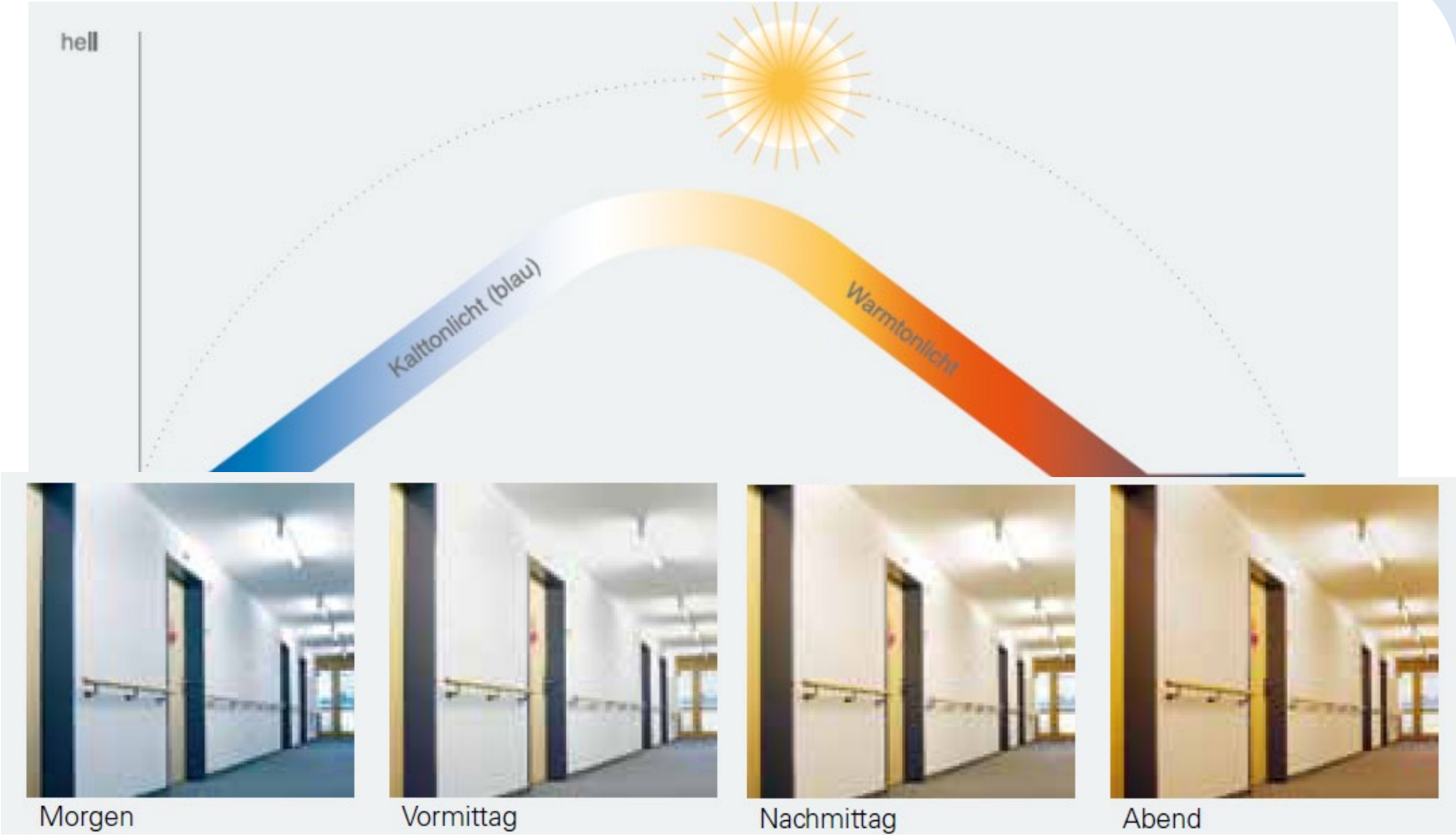
Wish item #	Wish item Name	Description of opportunity	Score
1	Oral / personal histories	Promoting reminiscence via activities or devices	11
2	Social participation	Assisting people with forming new or continuing old relationships with friends and family	9
3	Conversation prompting	Supporting the act of conversation with others, for instance, reminding a person of previous statements	7
4	Encouraging use of music	Promoting the enjoyment and use of music, either as a specific activity or through passive enjoyment	7
5	Encouraging community relationships	Promoting activity and relationships with or within the local community	7
6	Supporting sequence of activities	Supporting activities of daily living involving sequences of actions	3
7	Exercise / physical activity	Encouraging people to be physically active through physical forms of activity (for instance, walking)	3
8	Encouraging access to outdoor space	Encouraging and assisting with access to outdoor space. Assisting with orientation in outdoor space	2
9	Sharing experiences of care and caring	Providing social support to carers, providing support with physical care tasks or creating opportunities for emotional care	1
10	Encouraging creative activities	Supporting and encouraging people to take part in hobbies, pastimes and creative activities	1
11	Pottering in the home	Promoting participation in small household tasks within the home and/or garden	0

Source: Sixsmith, A. et al., (2007), Developing a technology 'wish list' to enhance the quality of life of people with dementia, Gerontechnology, vol.6/1, 2-19

Examples from projects and products

Daytime rhythm: Circadian Light



Source:
Derungs Licht AG

Change of light colour from morning to evening

Orientation in time of day and season

Source: ATDementia

Orientation in time of day and season

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In „modern“ form on touchscreen instead of watch device

The design is not always easy to choose. Possibly different pictures matching the season.
Find links to memories of earlier days.

Orientation in time: Perspectives Interactive Calendar for Dementia

VC&HCT

Benutzeroberfläche von Mylife

Source: Projekt MyLife

Anja Wilbrandt, Berliner Institut für Sozialforschung, BIS

Memory aids

Object localisation tools

Source : ATDementia

Speech memos

Speech memo with proximity switch

Illumination - Perspectives

Battery operated orientation light with movement detector

Bildquelle: Osram

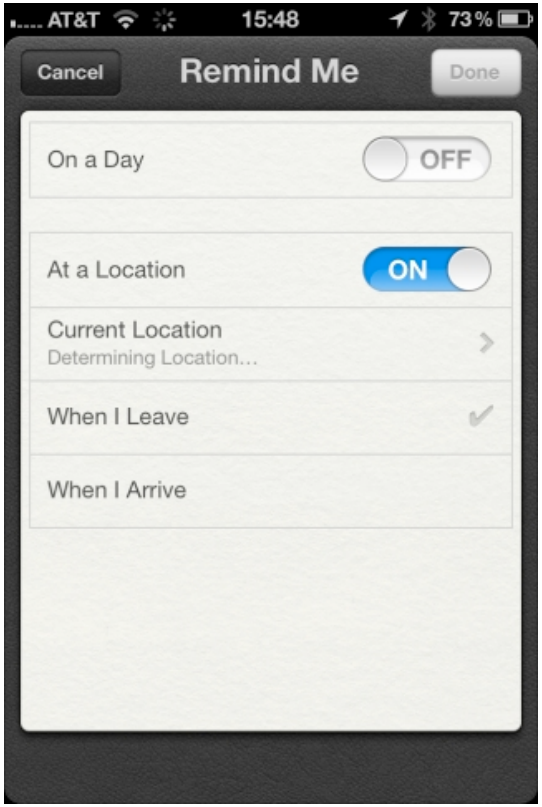
Spatial orientation: better recognition of environment with light.

Memory aids: Perspectives
Context sensitive aids

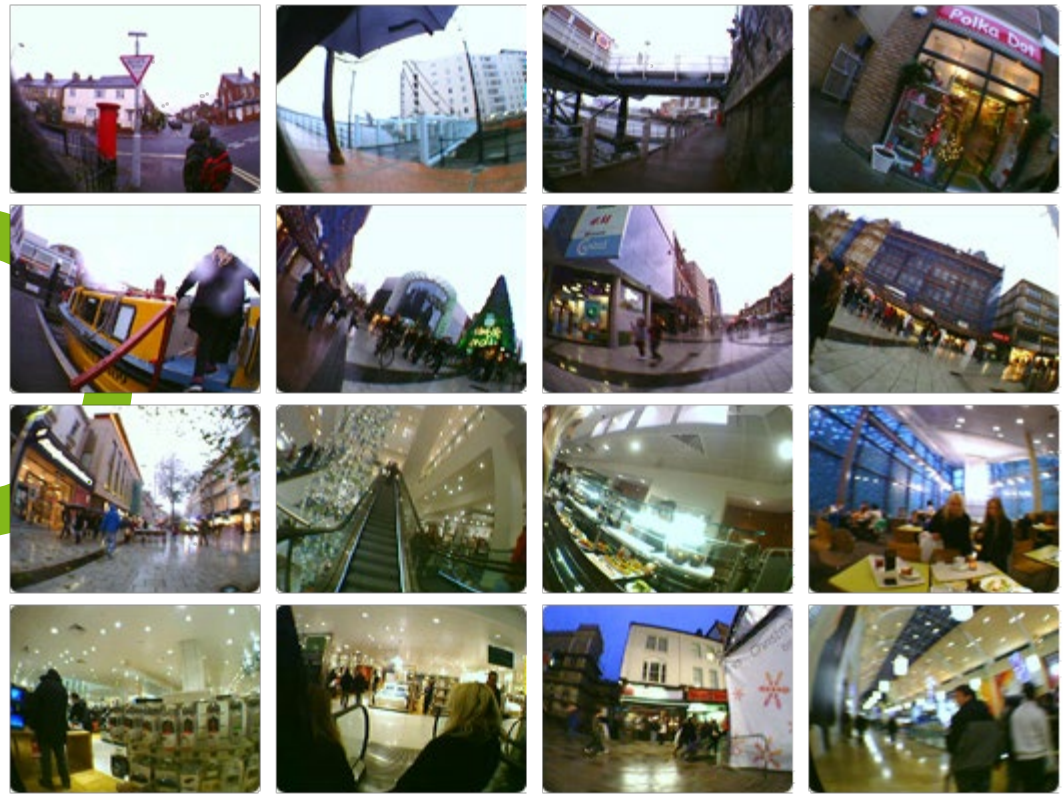
Example:

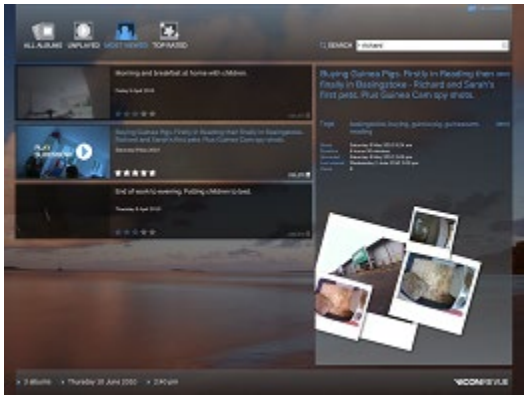
Reminders Application

On iPhone



Memory aids: Perspectives
Life-logging Systems

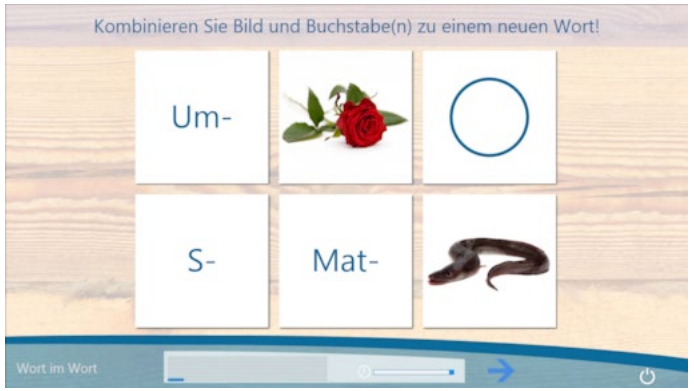




Brain Training

„Fitness“ exercises for memory, logical thinking, faster recognition
and concentration for home use

Source:
memofit brain company



Biography work, therapeutical games,
Activation by pictures, music, riddles/puzzles

Quelle:
memocare brain company

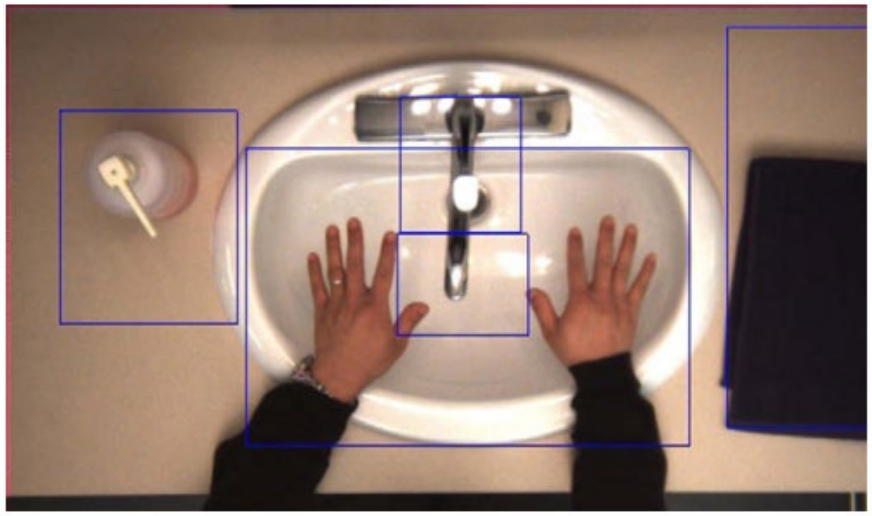
Orientation aids: Perspectives
Navigation support

Source:
Universität Ulm,
sfb transregio 62 (companionTechnology)

Perspectives: Support for complex activities - coaching

Support for complex actvities in daily life
Requires precise detection of situation (by using video surveillance), artificial intelligence
Most probably >10 years until available

Cooking, hygiene



Source: Hoey, Poupart et. al., 2010

Stationary/institutional support: Special localisation systems

In institutions by transponders

Outdoors by GPS, mobile network

Also combinations

Geofencing or Localisation

Example: doro „demenz.watch“ / Johanniter

Raphael-Armbanduhr mit eingebautem Transponder für Radiofrequenz-Identifikation, spritzwassergeschützt.

Uhrendummy mit Patentverschluss als Armband oder Fußband. Offen frei verstellbar, geschlossen fest und sicher.

Raphael-Schlüssel für den Patentverschluss. Durch Magnettechnik einfache Handhabung und große Zuverlässigkeit.

Raphael-Melder einfach installieren und in Betrieb nehmen. Die Erfassungsreichweite beträgt 0,5 m - 7 m. Meldet auf beliebige elektronische Benachrichtigungssysteme.

Example: Martin Elektrotechnik „Schutzengelsysteme“

Typical difficulties

- Battery runtime of GPS-receiver/transmitter
  - High effort for carers
- Configuration / usage, interface for carers
  - Understanding / set-up of functions
  - General technological competence of relatives
- Stigmatisation
  - Clock is not a normal clock

See also Pflederer et. al. 2013, case K

Legal complications: consent

Alternatives / questions

- Permanent localisation or only on demand
- Localisation or navigation support (e.g. TalkMeHome)
- Training of frequent routes / places
- Localisation in rooms
- „Geo-fencing“ or active alarms
- Access to location information?
- Integration into services?

- Legal situation

Perspektives: Activation and remembrance

Source: Gaver et. al., 2011

Emotional Approach - Robotics

Source: AIST, Tsukuba, Japan

Simulation of simple animal behaviour

Seal „PARO“ – good experience + sceptisism

Communication aids, Interaction, Entertainment

Photo switch module for telephone

Source: Doro AB

Entertainment software

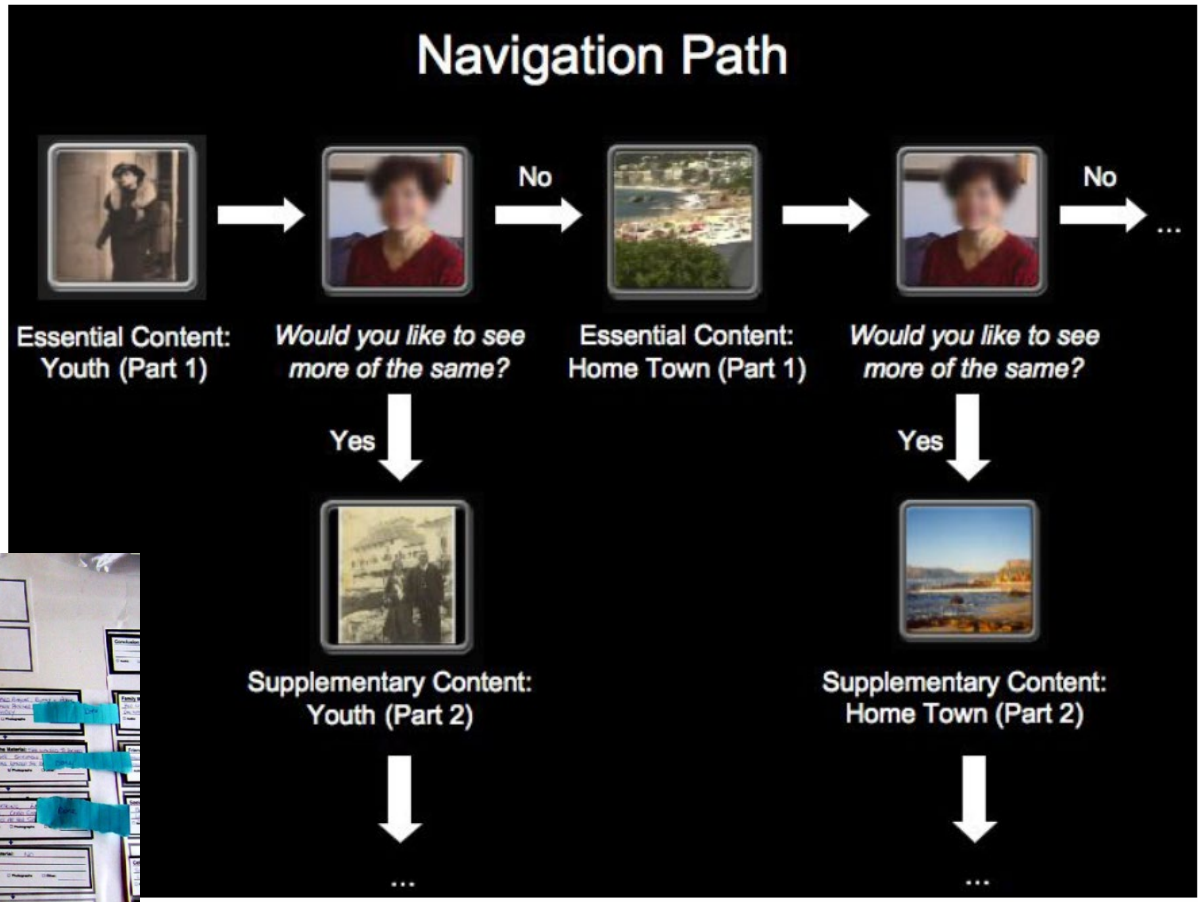
Source: Plejaden

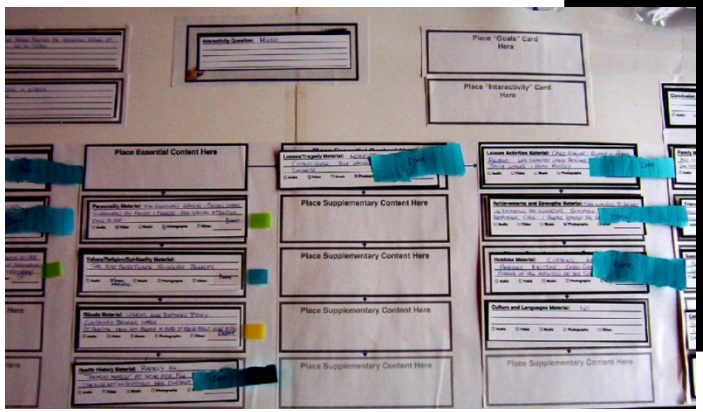
One button radio

Source: Bath Institute of Medical Engineering

Perspektives: Remembrance

Source: Cohene, Becker 2007: „Memories of a life: a design case study for Alzheimer's disease"





HFU Project InterMem: Pre-Prototype

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HFU Project InterMem: Pre-Prototype

VC&HCT

Supporting relatives

Even simple aids can help relatives to make their life easier resp. reduce their burden.

Example: automatic alarming in case of nightly wandering/leaving bed can significantly improve the sleep quality of relatives.

Technology and Dementia – a Contradiction?

Source: Heike von Lützau-Hohlbein, Deutsche Alzheimer Gesellschaft

Technology

- is to be seen related to disease and phase of life
- often applied when time is running short
- As such neither good nor bad, the form of usage is important

Needs-based application is helpful when assisting people with dementia

Technology and Dementia – a Contradiction?

Source: Prof. Dr. Richard Pieper, Universität Bamberg

Adequate care for PwD in future only possible with technology

The ethical problem is therefore the justification of the non-use of technology

The discussion about technology and dementia is dominated by questions of safety vs. autonomy and the problems of surveillance by technology

Sources of Information

Heeg et. al.: „Technische Unterstützung bei Demenz“, Verlag Hans Huber, 2007

Technische Hilfen für Demenzkranke – Beispiele aus der Praxis, Sammlung von Günther Schwarz, eva Stuttgart (2010), online accessible

… and in practice?

Source C. Pflederer, B. Radzey, S. Heeg (Demenz Support), 2013:

- Missing awareness and missing information sources about technical aids
- Missing consulting offers and poor access to technical aids
- Need for support and care in local place

Peculiarities of active user interfaces

Active user interfaces

The overview given so far shall depict the boundary conditions and showcase widespread approaches for solutions.
Out of this background application possibilities of active user interfaces (mostly) tablet based can be derived.
The base types of user interfaces are passive, which means they are „operated/used“ by the user which assumes activity and demand/interest (=„autonomy“) of the user.
Partially already periodic calls or reminders can stimulate interest.

Active by networking and integration

Active systems use **sensors and triggers** and time to **get themselves active**, which means addressing the user to suggest or finalise tasks in a defined way, and they consider context.

As opposed to singular applications they combine proven ideas and system knowledge in one device and therefore can be more flexible and versatile and grow with demands.

Activity, autonomy, animism, presence…

As opposed to „inanimate“, passive tools, AS are more autonomous („agents“).
AS are to a certain extent autonomous and „co-operate“ with the user. They appear „animated“.
It is normal, that this causes a certain empathy (not only with robots).
For atypical consumers, which are „dependent“ it is important, that AS act autonomously and therefore create „presence“, i.e. they get noticed and stay in mind.

Active user interface

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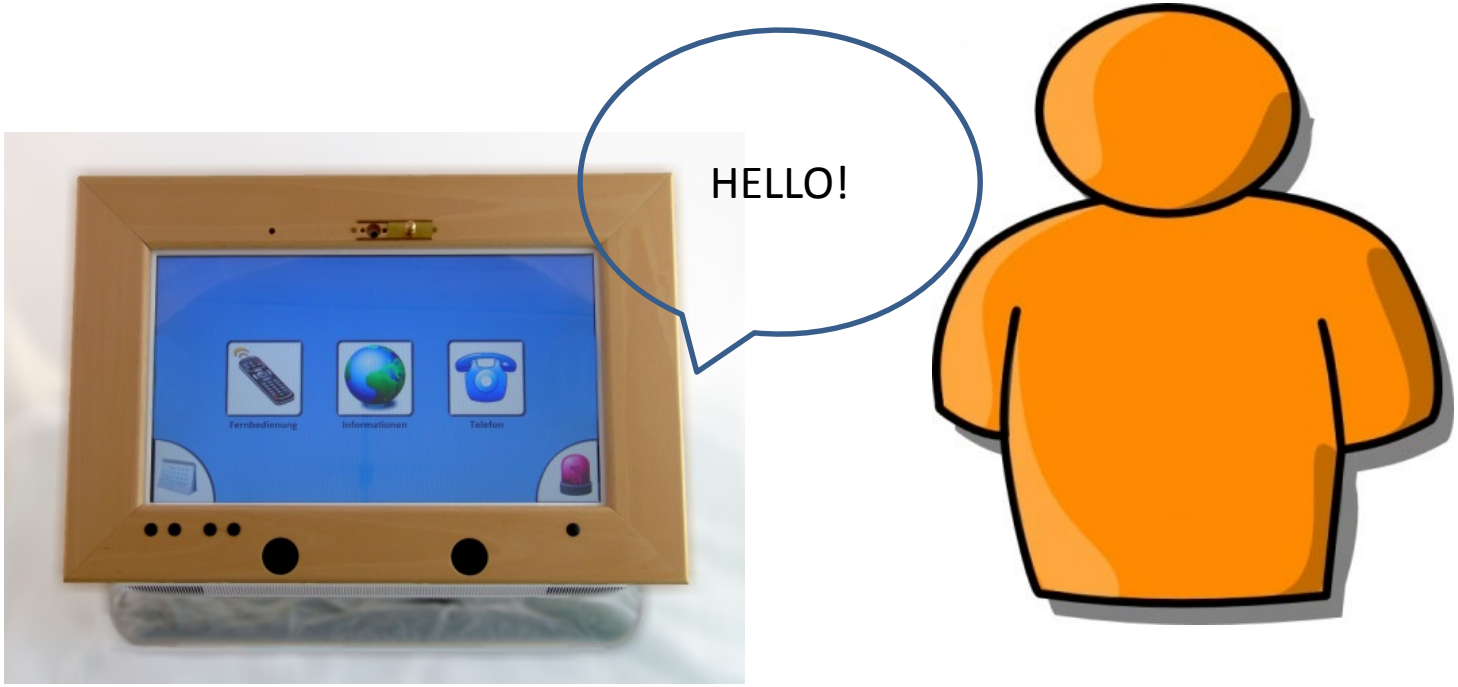
Important: „we establish contact“



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

Related terms

Affective Computing:
Interpreting the emotional state and adaptation to it (instead of always staying passive in same way)
Persuasive Computing:
Influence the assessment and decision taking of humans (instead of neutral fulfilment of commands)
Both are ethically sensitive areas.

Lots of literature from social science.

Areas of application

Of course where users do not themselves act autonomously (because they can‘t or do not want or dare).

- Simple interface to information, communication (no need to ask someone for help)
- Reminders (no need to remember everything myself)
- Instruction (enabling me to do it myself)
- Entertainment (offered vs. to be looked for)
- Training (in an enjoyable way)

Support at age and mild dementia. Never as only solution or replacement of regular personal care!

Conditions

Every action needs a **trigger** and a **stop condition**
(„sense – decide – act“ logic)

This can be

- Point in time (time of day)
- Span of time (duration)
- Sensor data (e.g. position, movement)
- User action (confirmation, presence)
- Number/count (repetitions)
- External events (remote connection)

Trigger time

Typical example are **calendar based reminders**. At a given time a reminder message is issued – via speech, display etc.

Important goal: the user should confirm but also be able to ask back

Important active condition: the user should be close, or has to be called

Condition: confirmation

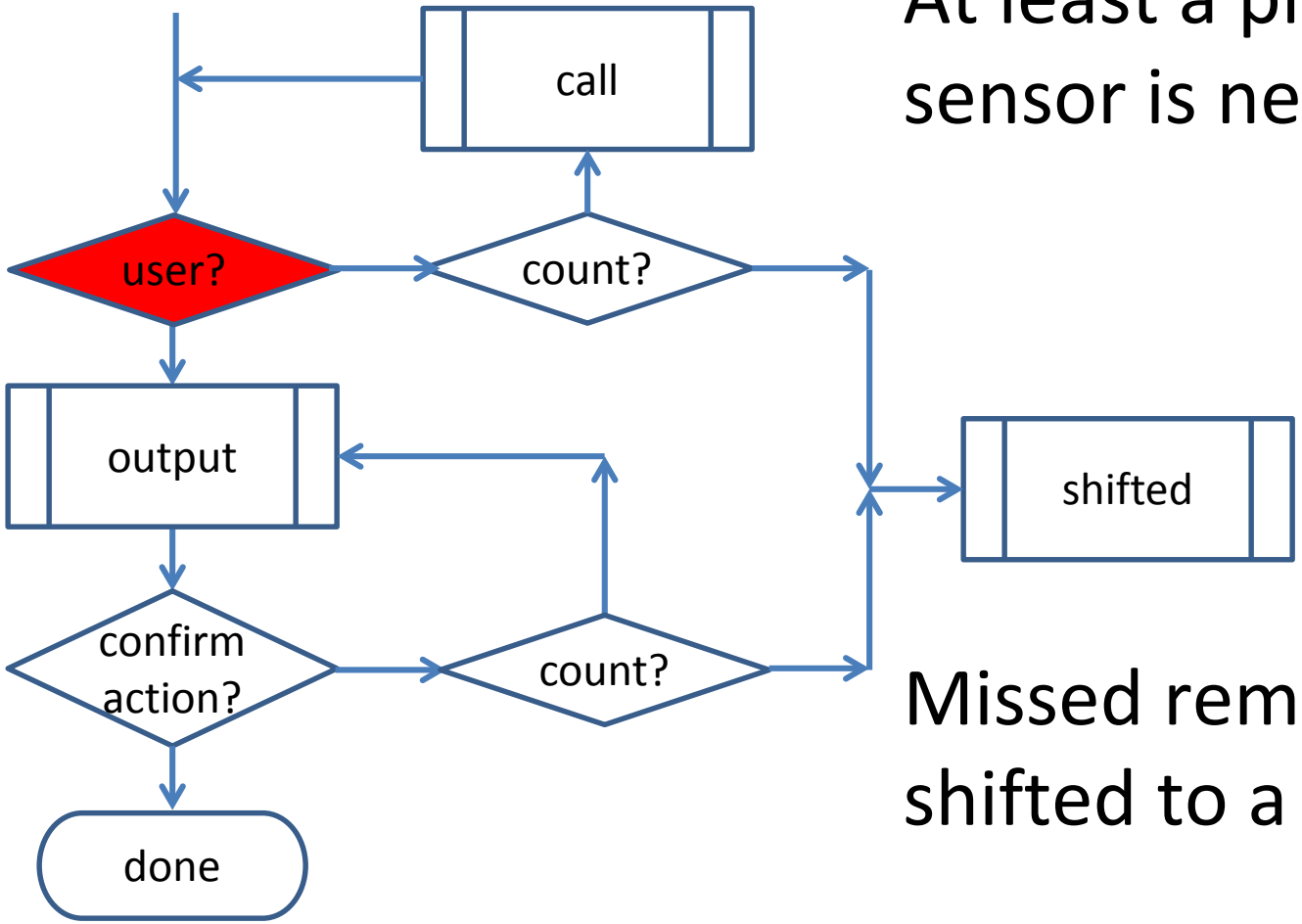
What can happen?

- User not close enough
- User doesn‘t notice the reminder
- User ignores reminder

What to do?

- Wait until user is close enough
- Call the user
- Ask for confirmation
- Repeat
- Shift to missed reminder

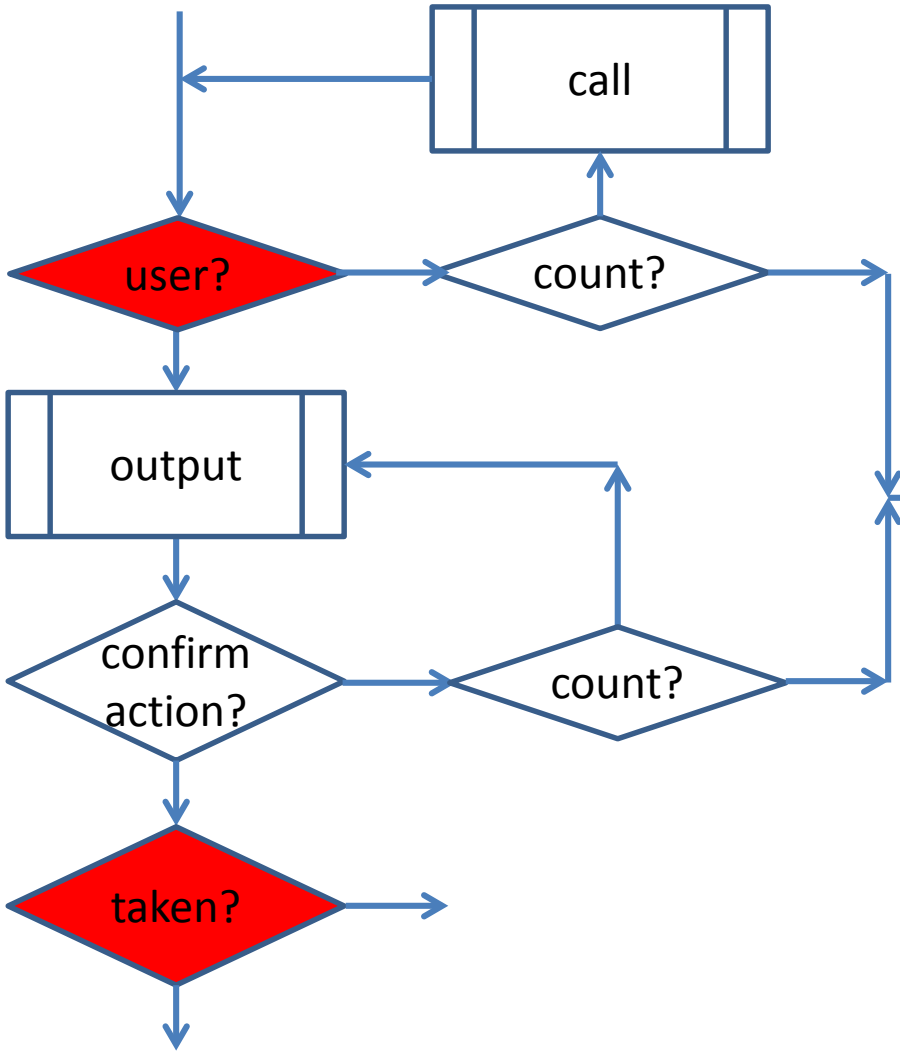
Active interaction:
= 2 independent protagonists



At least a presence sensor is needed

Missed reminders are shifted to a later time

Active interaction
Reminder to do something



For medicine a sensor can detect taking out of the pills from storage

- How to proceed?
- Is exact dosage important?
- Do we log usage?

Monitoring of daily routines Adaptation

Active systems **„detect“** that the user is overactive or less active than usual and usage of AS declines.
They then offer entertainment, information or a call (advantage of integration). Or, they trigger an emergency call, or they just log.

It is difficult to find the **„right“** amount of activity, without becoming annoying.

The reaction of the user can deliver information for the monitoring and for further decisions (also for carers).
Long term adaptation.

Attention and understanding

Complexity increases if the user is not so receptive e.g. in case of dementia.

- The user can be frightened by a voice suddenly speaking out of nowhere
- Attention has to be achieved first, then the actual message can be transmitted (several steps)
- Understanding, not only confirmation is needed
- Repetitions needed, advance information
- Accustomisation by frequentness

Application: temporal orientation

Base (analogue clock) display, always on

Especially for dementia patients

Changing colour of background and symbols

Extra symbols

Mixture with appealing „eye-catchers“

Application: manifold offers = motivation

In the „background“ an additional set of functions which can be offered, which can be activated both, by the user or the system:

- Telephony triggered by images of persons with additional possibility for text chat
- Newscasts, weather or news in hobbies
- Vital data, therapy, physical exercises
- Games with computer or other person (remote), therapeutic game (memory)
- Radio, music and videos
- Images, videos, facts for work on memory

Applications: examples of offers

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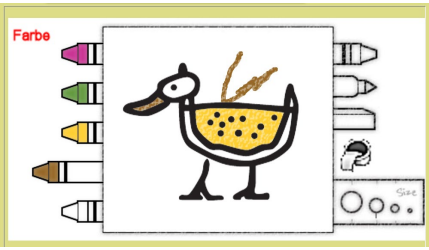

Application: requirements

- Big, clear display/messages without frills
- Adapted to preferences and abilities
- Suitable for touchscreen, multi-modal
- It should be interesting, fun, and stay challenging
- System for rewarding and motivation, not „marks“
- Recognition of/awareness of UI shall be furthered
- Communication to outer world shall be promoted
- Every form of activity shall be encouraged
- As system and for secondary users some monitoring of activities shall be implemented

Current restrictions

With the current state of technology no convincing example of an **active use interface** with practically applicable implementation of active elements is known.

Often such systems are „studied“ (e.g. instructions for washing hands) or particular aspects (e.g. speech recognition) are worked on, or „normal“ interfaces are slightly adapted (simplified).

Outlook

In the longer term it would be useful, if a database with (free or licensable) games, photo and video material sorted by theme, year and place would become available.

Rules for „user behaviour“ and for the adaptation of the AS should also be developed and available.

In future it to avoid that each project develops everything again from zero. Better: re-use results.

In any case carers should be always involved in all measures.

Current trends and possible designs

Programming technologies

Still user interfaces are often implemented as closed, natively executable programs (e.g. C++, native – binary compiled). This leads to a high dependence on OS platform and high effort for changes.
Background are the performance bottlenecks experienced in earlier days especially with „embedded“ solutions and the application of special OS specific or external GUI libraries (e.g. Qt) and lack of other good tools.

On the sensor level often only direct processing of HW events is implemented, no generalised interface in SW.

Programming technologies

Of course it still makes sense for some system parts, e.g. in the „embedded“ area without GUI, to implement time critical processing (where hardware also is specifically built) e.g. in C or C++.

But also there the „special hardware“ nowadays often only consists of a USB stick, within which the time critical calculations are already performed and the stick would work on several OS – if not the executable program had to be adapted.

Programming technologies

Meanwhile **web based technologies** resp. the **internet browsers** and derived technologies and tools are mature enough to be used in a platform independent way.

- For internal communication but also for integration of external solutions (secure) **HTTP based protocols** are increasingly used in distributed systems but also within applications on the same computer.
- Usual **browsers have become sort of complete OS**, which display and execute web based content, which can be also locally stored

HTML5/Javascript

- Programming in Javascript is fast enough for usual demands of user interfaces
- The graphical and interaction possibilities of HTML5 are nowadays often superior and available in a more compatible way than with special platform-overarching libraries
- Components now often are only offered in HTML5/Javascript format
- Javascript interpreters more and more become outsourced into standalone programs

Classical systems

Classical examples: (traditional approach)

- Sensors are interfaced via RF communication with a proprietary „central“ unit, which is an independent module in the system and which communicates via HTTP.
- Usage of XML as data language
- Games are implemented with Flash instead of as an HTML object
- Embedded browsers are implemented as object

Modern user interfaces

Modern examples:

- The **browser itself is the user interface** (kiosk mode) which runs the user interface and the interfaces to other system parts (only pull, web sockets, W3C standard for web notifications). Chrome e.g. offers an **API to connect to interfaces** e.g. serial/USB interface, Bluetooth but also speech output and recognition

Increasingly apps

Modern example:

- Apps can be developed e.g. with Cordova in a platform independent way. APIs for OS specific interfaces resp. hardware are (not always complete) available. Based on OS components like Webviews for the user interface and/or HTML5/Javascript and a small runtime interface for each OS also native code can be easily included

Modern example:

- Node.js takes the proven Javascript engines out of the browser and uses them as standalone interpreters including a component management and build system on usual OS.
- By integration of Webviews this even results in a „graphical“ HTML5/Javascript interpreter
- Runs on every modern tablet PC

Modern central units

Modern example:

- iobroker is a modular IoT platform
- Supports detailed visualisation
- Many available adapters to hardware
- Generalised bidirectional event interface for sensors and actuators and data on SW level
- Can be extended with node.js and Javascript as wanted
- Errors can be fixed easily

Modern frameworks

Modern examples:

- Additional Javascript based frameworks (jQuery, Angular, Vue..) support „programming“ the user interface and foster clear structures and interfaces with MVC design patterns
- An open, readable code base allows a huge community to constantly work on extensions

Advantages

Result:

- For the user there is no visible difference, especially because integration of web services resp. components is necessary and meanwhile standard anyway
- The user should never have to deal with the underlying platform (OS) or implementation
- The application becomes easier to maintain and is portable, networking gets easier

Summary

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!

Outlook, next parts:

- III Assistive Robotics
- IV Sensors
- V Ethics and law, economy
- VI Requirements analysis and evaluation

Assistive Systems - Literature

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Videos:

- Webcam based finger detection: https://youtu.be/O9DUsRtgigk?list=UUX6mAOuCsyaKIPkYLEHtaSA
- Gesture Recognition Elderly (for assistive robots): https://youtu.be/eIIzgjG2V7A
- Gesichtserkennung mit Augmented Reality: https://youtu.be/VOShaZPedoQ
- Sprechererkennung (Domeo Robot for ASR):
  (lokal: K:\06-Studienbetrieb\7-Vorlesungen\Assistive Systeme\sprechererkennung.mp4)
  Externer download: https://dl.dropboxusercontent.com/u/21565810/Sprechererkennung.mp4
- PAUL, Persönlicher Assistent für Unterstütztes Leben
  http://www.meinpaul.de/index.php/paul-persoenlicher-assistent/infomaterial
- ELDY http://www.eldy.eu/video-tour/
- AAL-UIs (auch mit Avataren) http://www.aaluis.eu/

Literatur / Weblinks

- CIRCA Computer Interactive Reminiscence and Conversation Aid
  http://www.dundee.ac.uk/djcad/research/researchprojectscentresandgroups/circa/
- N. Alm et al. (2007) A Communication Support System for Older People with Dementia, IEEE,
  http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=4198244
- T. Schultz et al. (2013) Technische Unterstützung für Menschen mit Demenz, online:
  http://www.itas.kit.edu/pub/v/2014/scua14a.pdf
- ITA Karlsruhe, Projekt Movemenz, http://www.itas.kit.edu/pub/l/p/movemenz.htm

Assistive Systeme - Abbreviations

VC&HCT

AAL	Active and Assisted Living (Ambient Assisted Living)
AS	Assistives System
ASR	Automatic Speech Recognition / Spracheingabe
AT	Assistive Technologie
GUI	Graphical User Interface
HCI	Human Computer Interaction
IKT	Informations- und Kommunikationstechnik
ICT	Information and communication technology
IoT	Internet of Things
MCI	Mild Cognitive Impairment
MMI	Man machine interface / Mensch Maschine Interface
OS	Operating System / Betriebssystem
PwD	Person with Dementia
TTS	Text to Speech / Sprachausgabe
UI	User Interface / Benutzerschnittstelle