2 Educational Chapters (Didactical Considerations)

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Universal Design & Personalization for Smart Homes – Concepts

Abstract

This learning units teaches the concepts of Universal Design and Personalization in the context of smart homes. Practical assignments include the study of personas with disabilities, and the specification of preference profiles for users with disabilities, using the OpenAPE framework notation (based on ISO/IEC 24752-8).

Keywords

Accessible design, Personalization, OpenAPE

1 Preface

The first Learning unit provides the fundamental knowledge of universal design & personalization in smart homes.

The module first starts with an explanation and proof of why there is a special need for smart home devices for the elder generation.

After that the students will be introduced to Universal Design: As every human is unique, there is a large variety of user needs when it comes to interaction with electronic devices, which need to be identified and addressed.

After getting to know how to do proper User research, we will discuss how a website can automatically adapt itself as well as be manually adapted to the user's preference. This adaptability is called "Inclusive Responsiveness".

Finally, we will get a brief introduction to the OpenAPE framework, so that we can experience how a user preference can be described technically.

To strengthen the acquired knowledge, the students will have to complete 2 assignments: In the first assignment, the students are asked to create a persona profile by using the online tool “PersonaGenerator” (https://personagenerator.com) and identify the needs of their persona. The solutions should be uploaded onto the platform, where the course is held. In

the second assignment the identified needs should be met by creating an OpenAPE profile with the desired preferences of the persona. As part of the second assignment, the created preferences should also be embedded into the "Barrierfree Smarthome" App.

1.1 Didactic fundamentals

- Target group: Computer science students with prior knowledge of programming.
- Effort in lecture hours: 60 minutes theory, 180 minutes practice
- Effort for self-study material: approx.. 20 minutes
- Prerequisites: Computer, Android smartphone, tablet or emulator with the already downloaded app "Barrierfree Smarthome"
- Needed background: Basic knowledge in HTML/JavaScript
- Additional information: The students need an account on the OpenAPE Webserver (https://openape.gpii.eu/) and on the Term-Registry Service (https://terms.gpii.eu/).

1.2 Learning Objectives and Competences

There are 3 main learning goals of this learning unit:

- To understand the basic needs of persons with disabilities in interacting with a smart home.
- To know the basic principles of accessible design and adaptive user interfaces.
- To understand the purpose of the OpenAPE framework and how to describe user preferences with it.

2 The need for smart homes

2.1 Why are smart homes so important for elderly people and people with disabilities?

Initially, smart homes were primarily designed to increase security at home and to reduce energy costs e.g., by installing smart meters. Through constantly improving technologies, the concept of smart homes is now expanding its focus on enhancing the overall quality of life. This has especially made a big impact on the everyday life of elderly people and people with disabilities, as their functional capabilities are quite limited. Loss of vision,

hearing or mobility affects the way people function in their daily lives, and naturally, no one wants to have to rely on the constant assistance of others. Smart home tools are designed to adjust the environment to the special needs of the homeowner and grant him the chance of freedom and to preserve his dignity.

2.2 Smart home market in Germany

A decade ago, a smart home seemed like a luxury item and out of reach for many. Nowadays, thanks to advancements in modern technology, assistive systems are more easily accessible to the middle class. In 2019 the revenue in the smart home market was approximately € 3,580 M. According to the forecast, a market volume of € 6,963 M will be reached in 2023; this corresponds to an annual revenue growth of 18.1%. The penetration rate was 19.9% in 2019 and is expected to reach 34.5% in 2023. The average revenue per existing smart home is currently € 163.72. A global comparison shows that the most revenue is generated in the USA.

2.3 Market driver

What are the reasons that the smart home market is trending more and more in our everyday life? There are 5 main factors, that lead to the success of smart home systems:

Digital networking: More and more households have some sort of access to the internet (e.g., through Wi-Fi) and at the same time new, mobile device categories are created and distributed. Therefore, tablets and smartphones are now used as a new operating solution for smart home applications.

Demographic trends: Life expectancy is growing year by year, making society increasingly aging. Simultaneously, the numbers of single households and single parents are also growing. These two phenomena create a potential for digital health- and surveillance solutions.

Home lifestyle: Especially because of the corona pandemic, the importance of one's own home has increased, as more and more people were made to stay at and work from home. This "Cocooning"- Trend has led to a growing willingness to pay for smart home devices and services.

Environmental awareness: The importance of sustainability has steadily increased in the last few years. People are trying to reduce their energy costs by increasing the energy efficiency of their homes, for example by renovating their homes. The Home Automation market benefits from the sustainability trend.

Ambient assisted living (AAL): With aging, there come various issues about health and social isolation. Elderly people want to maintain their dignity and live as independent as possible, this lead to an increase in interest in AAL-Systems.

3 Universal design and variety of user needs

3.1 Definition of the terms "smart home" and "AAL"

Smart home is defined as the intelligent networking of individual components within the house (hardware and services)) and their central control and monitoring via end devices. A smooth interaction of the various components is key to a pleasant user experience. Typical components of a smart home are for example smart heaters, lights, switches, and doors.

AAL (Ambient Assisted Living) is an intelligent system, that assists elderly people in a better, healthier, and safer life. It covers concepts, products, and services, that interlink and improve new technologies. AAL systems can support the older generation in different parts of their lives:

- **At work:** With an improved quality of work, the senior worker will remain active and productive for a longer time.
- **In the community:** Through ICT (Internet Communication Technologies) solutions, elderly people can stay socially active and creative.
- **At home:** Assisted by technology, older people can maintain a high degree of independence, autonomy, and dignity and therefore enjoy a healthier and higher quality of daily life.

3.2 User profiles & features

User profiles provide the basis for the design of the user interface of a product. With the help of user profiles, personas and use cases can be created, which lead to a more focused product development: Which tasks are important for a particular user? What are his assumptions and expectations of the product?

To answer these questions and to create an accurate user profile, comprehensive user research is needed. Some possible ways to access valuable information could be:

- Choosing target groups
- Interviews, questionnaires
- Participatory observation

- Demographic surveys:
  - Public data
  - Market research
  - Field studies
- Workshops with user experts and developers, e.g.:
  - Market researchers, sales, marketing, usability specialists, technical support
  - Designers, programmers, system architects
  - Project manager

Finally, after finishing user research, various information about the features of possible future users should have been collected. They can be classified into different categories, like:

- **Demographic data:** age, income, cultural background
- **Profession:** working experience, working conditions, job position, size of the company
- **Technical Affinity:** computer usage, internet connection, and usage, experience with technical devices, decisionmaker for technical acquisitions
- **Environment:** a place of usage (at home, at work, …), time of use, usage with additional tools/products
- **Lifestyle:** morals and beliefs, usage of media, leisure activities, hobbies
- **Roles:** professional titles, training, relationship to other users
- **Goals:** motivation to use the product (or not), long-term impacts
- **Wishes and needs:** reasons for use, emotional needs, preferences, habits
- **Knowledge:** expert knowledge, product knowledge, knowledge of competitive products
- **Trends in use:** frequency of use, reasons for purchase, brand awareness, loyalty
- **Tasks (user's perspective):** frequently used tasks, critical tasks, special sequence-order of tasks, traditional processing of tasks (without product)
- **Restrictions/impairments:** Access to data while driving, people with vision-impairments prefer speech output for long documents

3.3 User needs

As every human being is unique, there is a big variety of impairments that bring along different kinds of user needs. These impairments can be categorized into 4 groups:

3.3.1 Visual impairment

There are various forms of visual impairments, which range from complete loss of vision in both eyes (blindness) to minor or moderate loss in one or both eyes (low vision). Other visual impairments include heightened sensitivity to brightness (light sensitivity) and the opposite: lowered sensitivity to colors (color blindness).

People with visual impairments require different types of aids to succeed in various tasks: Minor visual impairments like near-sightedness and far-sightedness can be corrected with glasses and contact lenses, while interacting with mobile devices with customizable interfaces like high contrast mode or alternative color palettes support a larger variety of people. Some key needs related to vision when designing for the web are brightness, color, perception, spacing, highlighting, and user customization. In addition, to the customization of the User Interface there are also assisting tools a visual impaired person could use:

- Screen readers that transform the text into speech.
- Refreshable braille displays which put text into tactile feedback.

3.3.2 Hearing impairment

Hearing impairments are sensory disabilities that range from partial to complete hearing loss. Hearing loss is unique to each person and varies in frequency and loudness, which is why there are 5 degrees of hearing loss established:

- People with normal hearing can hear soft sounds below 25 dB, like whispering.
- People with mild hearing loss are unable to hear sounds that are quieter than about 25-40 decibels, which is why noisy environments can be challenging to them.
- People with moderate hearing loss hear sounds lower than about 40-70 dB. They often need to ask people to repeat themselves during conversations one-on-one.
- People with severe hearing loss cannot hear sounds lower than 70-95 dB for example speech and music.
- People with profound hearing loss cannot hear anything below 95 decibels and can only hear loud sounds like drums or an airplane taking off.

To reduce the barriers encountered by people with an auditory disability you basically need to provide important audio information in another form, such as visual or tactile interfaces. Possible solutions and tools are

for example hearing aids, captions and subtitles (spoken dialogue), speech recognition (speech-to-text), visual signs (warning lights), and sign language.

3.3.3 Motor impairment

Motor disabilities affect a person's ability to move around, manipulate interfaces or lift heavy objects. Disabilities in this category include the absence of limbs, full or partial paralysis, or reduced muscle capacity. Common challenges for persons with motor disabilities include for example:

- Inability to use a mouse.
- Inability to use both mouse and keyboard.
- Risk of fatigue when using assistive technologies.
- Inability to physically interact with hardware devices.
- Voice activated software could be challenging for some.

There are many solutions that allow persons with different types of motor disabilities to use the web; most of them work through a mouse, keyboard, or touchpad interaction. Examples include a mouth stick, a head wand, an adaptive switch or keyboard, an oversized trackball mouse, eye-tracking, and voice recognition software.

3.3.4 Cognitive impairment

While there is a range of different cognitive impairments with specific characteristics and needs, all issues with cognition concern the ability to take in and understand information. Therefore, there are quite a lot of common needs when it comes to web accessibility, for example:

- **Recognition:** As for some people it can be challenging to concentrate both on the content and the design of a website, it is important that the website is structured in a recognizable way so that the user can focus on the content.
- **Coherence and clarity in both structure and content:** Structuring a website's design and content in a logical way helps the user to concentrate and focus on the most important information.
- **Multimodality:** A combination of different modalities, for example adding images to a text, makes it easier for a user to understand the information that is presented.
- **No distraction:** The more elements a website is filled with, the more the cognitive load increases. Users who find it difficult to sort out information will find it challenging or even impossible to concentrate on the

content if there are too many elements on a website, such as banners, pop-up windows, etc.

To increase cognitive accessibility there are a few examples of support tools such as text-to-speech solutions that read out the text on the screen, a screen mask that helps to put focus on the text, and a tool for symbol support that provides images that explain words and concepts further.

3.4 Scenarios

A scenario is a concrete description of a hypothetical chain of actions from the user's perspective. Ideally, a scenario should describe what a user is doing, what his motivation is, and what he expects. The scenario is based on a specific Persona and presents its daily life routine.

A scenario can be presented in various formats such as:

- Textual description (analysis phase):
  - Step-to-step demonstration and description of main functions and tasks.
- Enriched with sketches (design phase):
  - Interaction design based on use cases, detailed for every step.
  - Illustrated by sketched user interfaces, images and screenshots.
- Storyboard or comic form
- Video (optionally with actors)
- (Mock-up-) Prototypes

Scenarios should be written in a way of storytelling, so the readers can relate to the persona and understand its actions.

4 Guidelines on accessible design

4.1 The three accessibility guidelines

When designing for digital devices or applications it is important to think of ways to enable access for everyone. The World Wide Web Consortium (W3C) is an international community that develops standards for the web. In 1997, W3C launched the Web Accessibility Initiatives (WAI), which provides guidelines, standards and techniques for accessibility.

The WAI has created three core guidelines for web:

- **Web Content Accessibility Guidelines (WCAG):** This is the most known guideline, as it is an important source of reference for international policies, standards, and legislations. It addresses the information on a website, including text, images, forms, sounds, and such.
- **Authoring Tool Accessibility Guidelines (ATAG):** Addresses software that creates websites.
- **User Agent Accessibility Guidelines (UAAG):** Addresses web browsers and media players and relates to assistive technologies.

Every guideline provides four layers of guidance for UX designers. At first, principles provide the foundation for web accessibility and build the top layer of guidance. Each principle has specific guidelines which provide the basic goals that designers should work towards. With every guideline there comes a set of testable success criteria to verify accessibility for a web application or website. These criteria have 3 different success levels: A, AA, and AAA, whereas A is the minimal level. For each of the guidelines and success criteria, there are a wide variety of sufficient and advisory techniques for meeting the success criteria.

Web Content Accessibility Guidelines 2.0 follows 4 main principles, which provide 12 guidelines altogether:

- **Perceivable:** Information and user interface components must be presentable to users in ways they can perceive. This principle includes four guidelines: Provide text alternatives, alternatives for time-based media, create adaptable content, and develop distinguishable content.
- **Operable:** User interface components and navigation must be operable. It also has 4 guidelines: Make all functionality keyboard accessible, provide enough time to read and use content, prevent designs that can cause seizures, and at last make your website navigable.
- **Understandable:** Information as well as the operation of the user interface must be understandable. This principle has only 3 guidelines, which state that you should make text content readable and understandable, make web pages appear and operate in predictable ways and you should help users avoid and correct mistakes.
- **Robust:** Having only 1 guideline, this principle determines that content must be robust enough that it can be interpreted reliably by a wide variety of user agents, including assistive technologies.

The Authoring Tool Accessibility Guidelines 2.0 has two main parts:

- Part A is about making the authoring tool itself accessible.
- Part B is about the authoring tool helping authors produce accessible content.

Software and services, that authors of webpages use to produce web content are called authoring tools. These include for example:

- Web page authoring tools like HTML editors
- Software for generating websites. For example, content management systems (CMS)
- Software that converts to web content technologies like word processors.
- Multimedia authoring tools
- Websites that let users add content as for example, social networking sites do.

UAAG documents explain how to make user agents accessible to people with disabilities. User agents include browsers, browser extensions, media players, readers, and other applications that render web content. Following UAAG 2.0 improves accessibility through the user agents' own user interface and its ability to communicate with other technologies, including assistive technologies.

UAAG 2.0 follows 5 main principles:

- **Perceivable:** Ensure that the user interface and rendered content are perceivable.
- **Operable:** Ensure that the user interface is operable.
- **Understandable:** Ensure that the user interface is understandable.
- **Programmatic access:** Facilitate programmatic access to assistive technology.
- **Specifications and conventions:** Comply with applicable specifications and conventions.

5 Assignment 1: Persona Presentation

5.1 Intro

You are a member of the founder team of a start-up that wants to build new smart home gadgets for elderly people. Before you start with the production of the gadgets, you need to do fundamental research on user needs and pre-

ferences. For that, you will start by creating representative Persona profiles and possible use cases.

5.2 Tasks

1. Choose one elderly person from the CURE personas. There is a document with linked CURE personas in the course.
2. Use the online tool PersonaGenerator (https://www.personagenerator.com) and create a persona profile for your chosen person
3. Make a presentation on the selected persona with the following content:
   - Introduction to the persona
   - Bad examples: Current smart home features that result in bad usability for the persona.
   - Use case/scenarios: In what ways could the persona benefit from a smart home?
   - Good examples: How does a smart home need to be designed to be most usable by the persona?
4. Upload your PowerPoint presentation on Moodle.

6 Inclusive Responsiveness

6.1 Definition of "responsive"

Adaptability is key for good interaction between the user and website. A website must be both: adaptable and adaptive. While being adaptive ensures that the system automatically adapts its content to some specific features of the user's medium (e.g., to the screen size), being adaptable gives the user the opportunity to adapt the website to his own needs and preferences (e.g., bigger font size).

Adaptability ensures that a website is responsive to the user's input.

6.2 Definition "context of use"

Context of use describes the circumstances under which the user is interacting with a website. There are four main components of context of use: The user himself, the tasks, the equipment, and the environment.

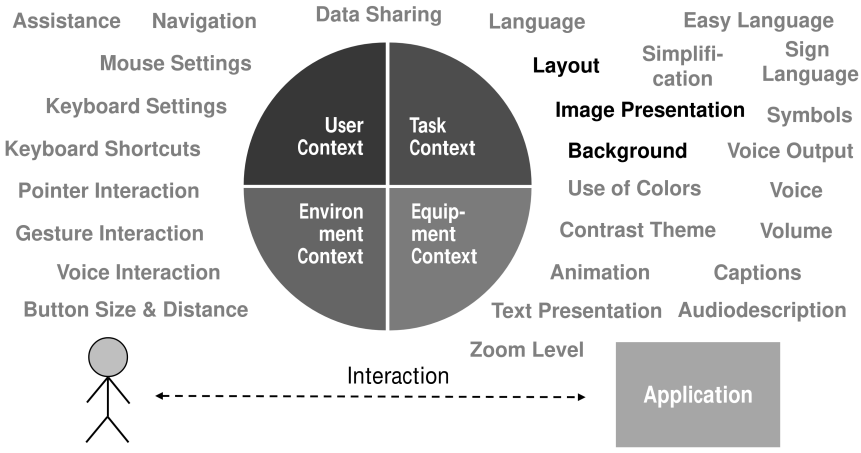

Figure 1: The four main components of context of use.

User Context: What are the user's preferences and needs?

Task Context: What is the user trying to accomplish?

Equipment Context: What input and output devices the user is using?

Environment Context: What situations is the user in?

6.3 Responsive web design (Equipment Context)

Websites can be reached from different kinds of electronic devices, e.g., smartphones, tablets, and computers. One of the main differences between them lies in the variety of their screen sizes. To ensure a pleasant User experience, it is important to adapt the content of the website to the screen

size of the user's device. This can be done through responsive web design, which is based on a dynamic grid, flexible images, and CSS media queries.

In order to display the website optimally on every device, the conditions of the respective output medium are requested in detail through media queries. Whenever a "breakpoint" is reached (e.g., by enlarging the font size), the web browser should instantly switch to a different layout at runtime. Images are dynamically sized by relative units, e.g., percent.

The following adaptions can be implemented with the most recent CSS media queries level 4:

- **Layout & Background:** Most prominent aspect of responsive web design.
- **Imagine presentation:** Choice of image type being rendered, depending on resolution and color mode of the screen.
- **Navigation:** Switch between different navigation mechanisms, e.g., full-blown menu navigation vs. Iconized menu button (sometimes called "hamburger menu").
- **Button size, spacing, and alternate pointing interactions:** Enlarge buttons and other input elements, increase the spacing between them when the pointing device is inaccurate; provide alternatives for pointing when there is no pointing device available; provide alternatives for activation of hovering effects when hovering is not possible.
- **Substitute animations:** For screens, that cannot refresh quickly, animations can be replaced by other means.

6.4 Personalization (User Context)

To meet the needs and preferences of the user interacting with the website, the application is required to allow custom changes by the user. Personalization can go as far as providing full accessibility by accommodating the specific interaction needs of a user with disabilities.

Simple presentation parameters which can be personalized on most websites are for example font size, color, and type. However, when looking at the full range of users with and without disabilities, there are more interaction aspects that should be subject to change for particular users:

- **Line height:** Some users may need to have an extra space between text lines.
- **Speech output:** Some users (e.g., users who are blind, who are dyslexic, who are analphabets, who are reading a foreign language) may want to have the text be spoken to them rather than having to read it. For speech output, they will want to control parameters such as volume, speed, and

pitch. Also, some users may want to have the text highlighted as it is read aloud. Highlighting granularity can be set to word, sentence, or paragraph level.

- **Size and distance of input elements:** Some users (in particular those with manual motor impairments) may prefer to have input elements and buttons increased in size and be farther apart from each other. This will make it easier for them to hit them with a pointing device.
- **Navigation:** Some users with cognitive disabilities may need a simplified navigation tree, with fewer items. Users with motor disabilities may prefer a "button matrix" rather than a navigation menu. The matrix of buttons can be quicker operated switch access interface.
- **Layout:** Some users may not want to switch the orientation from portrait to landscape (or vice versa) even when the mobile device is tilted.
- **Simplification:** Some users may need a simplified version of the content, or specific words and symbols to be explained in simple language.
- **Sign language:** Users who are deaf may prefer to receive information in sign language, and to provide input by signing in a specific sign language.
- **Symbols:** Some users may need text to be translated to symbols, or specific words to be translated to symbols for a better understanding.

There are many more settings a user could set, making the personalization experience overwhelming or intimidating to some users. Also, some settings may not be available across all applications and platforms, which means that they need to be set manually on every single application and device. This process can be very time-consuming, and users would start rethinking whether before using a website whether the effort is really worth it or not.

Therefore, an adaptable application should provide an easy and understandable way for new users to set up an initial user profile. Some possible ways to set up a user profile could be:

- **Step-by-Step dialog:** A dialog guides the user through all settings, that are relevant for them, e.g., choosing a type of disability ("I am vision-impaired") or a type of requirement ("I need to get the screen read out loud").
- **Serious games:** Rather than filling out difficult forms, a user could "joyfully" set up an appropriate interaction profile by playing a game.
- **Pre-defined user profiles:** For the beginning, the user could choose a pre-set personal profile that fits approximately their abilities and preferences. Then, as they get along with the application, they can fine-tune their profile as needed later. Such pre-set profiles can be derived from user research and personas.

6.5 Context queries (Environment Context)

In order to respond to the environmental context, the system is required to sense the situation in which the user interaction is taking place. Typical parameters that drive such an adaption are date/time, location, ambient light and noise, movement, screen positioning, bandwidth, and connection (e.g., cellular vs. Wi-Fi). Since the environmental context is more likely to change during a user interaction session (e.g., ambient light changes), web authors need to embed dynamic adaption mechanisms, which can be a challenge.

Built-in sensors provide a constant stream of situational data, which triggers adaptions on the operating system level. On the web application level, most of these sensor data are not easily available. Therefore, new web APIs allow web authors to query the state of device sensors that provide information on the specific environment.

These are some rendering solutions for different kinds of environmental situations:

- **Night mode for image rendition:** At nighttime, an image may be rendered in a "warm temperature mode" by reducing the amount of blue color that can be unhealthy and delay falling asleep at night. Although a night mode is available on some devices on the operating system level, employing it on a web application level gives the web author more fine-grained control over the scope and effects of color filtering.
- **Seasonal layouts:** Web applications may appear in different layouts, depending on the season of the year. This requires web authors to react to changes in date/time and location.
- **Ambient light-sensitive themes:** In environments with very high ambient light (e.g., in the sunlight), it can increase the ease of reading when choosing a theme that inverses colors (e.g., black on white rather than white on black). Also, in very low ambient light conditions, the user's eyes may be strained when using a theme with a lot of white background.
- **Enlarge input elements when moving:** The web author may increase the size of input elements when they sense that the user is moving, to make up for a potentially shaky environment.
- **Location-based content:** Web content that is specific to a physical location (e.g., a public library) can be presented more prominently when the user is in close proximity.

- **Bandwidth-driven image resolution:** When the connection speed is constrained by low bandwidth, low-resolution images may be loaded to reduce the waiting time for the user.
- **Saving energy on low battery status:** When the battery reaches a low level, the web application could be more energy-conservative by switching to a low-light theme. Note that many devices today have an OLED screen on which black pixels do not consume any energy.

6.6 Task Context

Adapting to the task context is the easiest exercise of the four types of adaptation. Most web applications are made to facilitate a set of tasks from which the user can select. For example, an online shop allows the user to browse the shop items, read their descriptions, put them into a shopping card, and finally check out. There may be supplemental tasks offered such as contacting customer support. Whenever the user – by navigation – selects a specific task or subtask, the web application adapts by changing the content of the web page. This is one of the most basic functionalities of a web application, and it follows right from the first dialogue principle, the suitability for the task. A web application may also react to task changes in a subtler way. For example, on the check-out page, when the customer selects the payment type "credit card", input fields for the credit card number and expiration date (which were previously hidden) become visible on the page.

Applications reach their limits when the user tries to achieve a task for which they are not made. For example, if the user tries to solve complex mathematical operations in a text processing application, it could inform the user that it is not suited for this kind of task, and (for good usability reasons) ask them if it should start a spreadsheet application and embed the spreadsheet in the text document. So, although most web applications handle the basics of adapting to the task context, there is still some leeway in making this adaption even better for the benefit of the user.

7 OpenAPE framework

7.1 What is OpenAPE?

OpenAPE is an open Accessibility and Personalization Extension framework that transfers platform-independent context information from one device to another and infers personalized settings for user interface and device

adaptation according to the user's needs. This shall contribute to improved usability and accessibility in smart environments.

Development goals of OpenAPE:

- Enable a platform-independent mechanism to transfer the context of the use of data from one device to another.
- Provide adaption and UI settings information independent of place (e.g., in every room of a smart home)
- Enable third parties to contribute specialized content.
- Provide specialized content independent of place.

7.2 Use cases

Let us think about a visually impaired businessperson from Germany. In Germany, he is living in his own apartment equipped with different devices like a smart TV, a lighting system, and a smart heating system. He has configured his home in a way, that when he switches to TV mode the TV is switched on and the light is dimmed down. He has also set a preferred room temperature. He can control the status of his home via his smartphone. The smartphone is configured with a large font size and strong contrast.

Now, the businessperson must travel to China. When he arrives in his hotel room, he immediately notices that the air-conditioning system has cooled the room too much. He approaches the control panel at the wall that is connected to the OpenAPE infrastructure. The businessperson authenticates himself via an RFID tag and the panel connects to the OpenAPE infrastructure to look up the user's preferred settings. Among other information, there is stored that the user has configured their smartphone with a larger font size and stronger contrast and that his preferred language is German. Therefore, the control panel reads aloud a short welcome message with some basic explanations. It also increases the font size and contrast and downloads all text labels for the UI in the German language.

Furthermore, it proposes the user's preferred room temperature.

Some weeks later, a deaf person stays in the same hotel. For him, there are no adjustments made regarding font size and contrast. However, since the person has problems with written language, for him the welcome message and all help texts are displayed as sign language videos.

7.3 OpenAPE Context service

A context as a JSON-Format is a list of references to Terms you would like to give values to. The OpenAPE Context service is an online catalog

of contexts. The prefix you should always use to refer to a term on the Term-Registry service is: http://terms.gpii.eu/ and add it with the name of your desired term. The Context service is available at: https://openape.gpii.eu/

```
{
  "default": {
    "name": "Default context",
    "preferences": {
      "http://terms.gpii.eu/screenLockTimeout": 600
    }
  }
}
```

Figure 2: Example OpenAPE context.

7.4 Term-Registry-Service

A term is a keyword to describe an "atomic" aspect of the adaption or of a specific context. The Term-Registry-Service is an online catalog of context-specific preference terms. You can select already registered terms or register new ones. The Registry Service is available at: https://terms.gpii.eu/

There are two terms to be classified:

- Common terms:
  - Generally reusable beyond application and platform boundaries.
  - Example: common_fontSize
- Application-specific terms:
  - Specially intended for one application, not generally usable.
  - Example: myApplication_alarmMode

```
{
  "$schema": "http://json-schema.org/draft-06/schema#",
  "title": "Screen lock timeout",
  "description": "No definition available.",
  "type": "number",
  "minimum": 1
}
```


Figure 3: Example term of the Term-Registry-Service.

8 Assignment 2: Create an OpenAPE profile

8.1 Tasks

1. In assignment 1 "Persona Presentation" you have successfully created a persona for one of the 30 elderly CURE-Profiles.
   Now, you are asked to create an exemplary OpenAPE profile for your previously selected persona. Think about the possible preferences and needs of your persona and provide a solution by setting a specific user context.
   Link to the OpenAPE-Service: https://openape.gpii.eu/
   Link to the Term-Registry-Service: https://terms.gpii.eu/
   Please upload your solution as a JSON-File onto Moodle. Additionally, provide a brief explanation of your choice of preferences and their values.
2. Start the App "Barrierfree Smarthome App" on your Android smartphone. Login into your OpenAPE account and download the context you just created.
   Check, if the settings were set correctly.

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1 Didactical Concept – Handout for Teachers Universal Design & Personalization for Smart Homes - Concepts VPUX-Lab

2 Didactical Analysis

This learning unit teaches the concepts of universal design and personalization in the context of smart homes. Practical assignments include the study of personas with disabilities, and the specification of preference profiles for

users with disabilities, using the OpenAPE framework notation (based on ISO/IEC 24752-8).

Target Group

The target group for the first learning unit is bachelor students of computer science or similar course programs (e.g., media informatics), in the 3rd-6th semester. Some of the learning content may also be useful for students of less technical subjects such as social sciences.

Institutional Requirements

The required resources are all described in the learning unit itself, as the first unit is aimed to teach the students the theoretical part of universal design and personalization. The teachers should ideally be familiar with the basic interaction of the web interface of OpenAPE.

Learning Objectives

Students should deepen their understanding of the basic needs a person with disabilities faces when interacting with a smart home. To meet those needs, basic principles of accessible design and adaptive user interfaces will be taught as "inclusive responsiveness". A first introduction to the personalization framework "OpenAPE" will let the students understand the purpose of the framework and how to describe user preferences with it.

Learning Content

This learning unit provides the theoretical foundation for the practical 2nd learning unit. The following topics will be covered in this unit: Introduction to the module, universal design, guidelines on accessible design, inclusive responsiveness, and introduction to the OpenAPE framework. The content will be provided through documentations but also through video tutorials. To strengthen the acquired knowledge, students will also have to complete 2 assignments in group work: In the first assignment the students are asked to hold a short persona presentation and identify the needs of their persona and in the second assignment those needs should be met by creating an OpenAPE profile with the desired preferences of the persona.

3 Didactical Concept

Methodical implementation

Are special methods used, such as serious gaming, self-directed learning, collaborative learning, etc.? What is the concrete procedure of this exercise (please note in the bullet point)?

Media

The content will be shared as PDFfiles. Additionally, students will access the servers of OpenAPE and the Term-Registry-Service through the web interface. The "Barrierfree-Smarthome" app is provided as download.

Learning Organization

The first learning unit is taught by teachers to their students. Teachers will provide the fundamental knowledge for the 2nd unit. Additionally, the students will have to complete assignments, which can be presented to the class. The class can be held both in the presence and online. For presence classes, a lab with computers and Android devices or emulators is required as students will have to interact with the OpenAPE web interface and the "Barrierfree-Smarthome" app.

Feedback and Evaluation

The solutions to the assignments should be presented in front of the class, whether online or in presence. An open discussion afterward gives feedback on the work and can lead to new ways to approach the task.

Teachers can conduct a survey at the end of the learning unit to give the students the chance to give feedback on the course. Changes for improvement can be made for the next students.

Expert Tips

Teachers should already have an interest and maybe already first interaction with the subject so that they can give real examples of the use of knowledge. Furthermore, a little experience in the use of the respective interface is useful.

The pdf and word files of the learning unit are mostly accessible. So, if new content is added, care should be taken to ensure accessibility. The videos created also have English subtitles for this purpose.