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D5.2 – Pilot-C Solution Integration and Trials

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Hybrid Broadcast Broadband for All

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D5.2 – Pilot-D Solution Integration and Trials

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Executive Summary

The Hybrid Broadcast Broadband for All project (HBB4ALL) investigates accessibility services on different platforms including the hybrid broadcast-broadband TV (HbbTV) environment as well as internet-based video services for PC and mobile devices. HBB4ALL realizes access services in four interlinked Pilots; Pilot-A: Multi-platform subtitle services; Pilot-B: Alternative audio production and distribution; Pilot-C: Automatic user Interface adaptation; Pilot-D: Sign-language translation services.

One challenge faced by broadcasters and other video content providers is the requirement to provide Access Services in a cost-efficient manner while remaining consistent with the Access Services available on traditional broadcasts and their respective workflows. An additional challenge that the project addresses and is demanded by many users with specific needs is the delivery of personalized Access Services that gives viewers and users the opportunity to customise the Access Service they are using to best meet their personal preferences and needs.

This deliverable reports the progress of Pilot-C "Automatic User Interface adaptation". The pilot deals with the realisation of an expandable online service (chapter 2.4) for Access Service personalisation addressing the topics UI adaptation (Pilot-C) and subtitle personalisation (Pilot-A see D3.2). This deliverable reports the progress in respect to task T5.1. "Definition and Preparation of Operation Phase" and T5.2 "Solution Integration and Trials", which both can be seen as preparation tasks for the operational phase of the project (T5.3). The online accessibility service targeted in WP5 is based on the UI framework that was developed in the EU project GUIDE "Gentle UIs for elderly people" by vsonix together with other partners and which is now further maintained as an open source project. The service was designed in a way that in the future it could also integrate other Access Service modalities as those addressed in Pilot-B ("Alternative audio") as well as Pilot-D ("Sign language"). In this respect the online service addressed in Pilot-C can be seen as a cross-pilot activity.

The necessary Software as a Service (SaaS) platform was developed by vsonix during the second project year based on requirements that were derived in the project's first period. The service platform, which is already available and will be further maintained and disseminated via the website www.accessguide.tv includes APIs (see chapter 2.3) and functions for user and profile management as well as the necessary mechanisms needed for UI adaptation on PC and HbbTV platforms.

It includes an application for the generation of user accessibility profiles for PC, mobile and HbbTV platforms. This application called AccessGUIDE (see chapter 2.1) was redesigned and further implemented by vsonix within this period improving the initial design presented in D5.1 while taking into account the results of the early user tests that took place in January 2015 (see chapter 5.1). The access service includes the functions for UI personalisation targeting the definition of accessible font types, size or colour schemes. Beside UI adaptation it also includes functions for personalized subtitles (see D3.2) as well as a personalized text to speech service (see chapter 2.5) that could be integrated by an application as a screen-reader or for spoken subtitle applications. Based on the AccessGUIDE design provided by vsonix for PC and mobile platforms, PPG has realised an HbbTV 1.5 based version of the AccessGUIDE (see chapter 3.2).

The service components (see chapter 2) that have been realized and provided by Pilot-C are:

AccessGUIDE – PC: AccessGuide serves as the frontend for the UI adaptation service. Its function is to lead the user through a series of quick assessments to establish his preferred UI settings. These user preferences are then passed on to the API, which stores them on the server. Each instance of AccessGuide is

tied to a specific application, so that the user preferences can only be accessed by the respective application they have been established for (its "host application").

AccessGUIDE – HbbTV: The AccessGUIDE for HbbTV is an adaption of the application created by PPG to be used by the two HbbTV showcases provided by PPG and SCREEN.

AccessGUIDE API: The AccessGUIDE API is the JavaScript based interface to the AccessGUIDE Service. The API is used by the AccessGUIDE and third-party applications as well as other sub-pilots directly in order to access the AccessGUIDE service. The AccessGUIDE API represents the client-side part to the AccessGUIDE Service.

AccessGUIDE Service: The AccessGUIDE service represents the backend component of the adaptation functionality. It exposes several functions through a publicly-available HTTP interface that allow application developers to create, store, and retrieve adaptation profile information, whereas storing adaptation profile information is usually done by the AccessGUIDE.

AccessGUIDE TTS: The AccessGUIDE TTS component is integrated into the AccessGUIDE service and provides application developers with an on-the-fly text-to-speech services with speech parameters adjusted to the adaptation requirements of the current user profile. The service is based on the IVONA text to speech library but other text to speech services can be used as well. It returns a URL behind which an MP3-stream of the synthesized speech can be streamed using common HTML5-compliant playback techniques.

The application service for the operational phase of Pilot-C that integrates the different service components is an online course (MOOC) on "Access Services for Media Content" provided by vsonix in collaboration with UAB. The course will be published before March 2016 on the HBB4ALL website and will be freely available to all interested parties that register to the course.

From a technical point of view the online course was already realized using software components and services provided by vsonix (see chapter 4) including an interactive online video player (vPlayer) for the playback of course content with advanced navigation and search functionality, a comment function (vInteract) that allows users to discuss the course content as well as a user registration and login service (vUser).

From a content point of view the online course targets a number of topics related to the realisation and integration of advanced Access Services for online and HbbTV media services such as subtitling or sign language (see chapter 3). In terms of Access Services the online course integrates the UI adaptation and personalisation service (see chapter 2.4) developed in WP5 providing users advanced Access Service personalisation capabilities for the user interface as well as for personalized subtitles.

In addition two showcases have been realised within Pilot-C by PPG (Video On Demand showcase of NPO) and SCREEN (teletext showcase), that both demonstrate the capability of using the UI adaptation service provided by vsonix on HbbTV 1.5 platforms.

The overall achievements of the Pilot related to the objectives in the DoW within the first two periods of the project can be summarized as:

- The realisation of an online accessibility service based on the GUIDE framework providing functions for user profiling as well as a web based API (JavaScript) that can be used by online and TV application developers to use the service.

- Extension of the GUIDE user profiles by vsonix in collaboration with UAB and Screen to support additional parameters for UI adaptation.
- The realisation of an API version for HbbTV platforms by PPG and SCREEN
- The provision of an online screen reader feature as part of the overall service provided by vsonix.
- Provision of a user testing and profiling application (AccessGUIDE) as part of the UI adaptation service. This application is an essential part and allows the determination of user preferences based on a number of accessibility tests. It is designed as a customizable white label service that can be used by application developers to include UI adaptation based on user profiles into their applications. It is provided by vsonix for PC and mobile platforms.
- The integration of the MOOC platform based on online video technologies and components available from vsonix
- The production of MOOC content addressing topics related to media accessibility as a webcast service for PC based and mobile platforms by vsonix in collaboration with UAB, which was responsible for the provision of the content. The course will be available in English, with German and Spanish subtitles.
- The realisation of a teletext showcase provided by SCREEN for HbbTV 1.5 using the UI adaptation framework for the provision of personalized accessibility features.
- The realisation of an HbbTV showcase by PPG based on an existing application of NPO (Netherlands Public Broadcasting).
- The realisation of expert group discussions and early user trials (see chapter 5.1) by vsonix and UAB in order to acquire and refine the user requirements for the UI adaptation framework as well as for the MOOC application
- The organisation of the main user trials for Pilot-C (see chapter 5.2). Those included user experience and accessibility testing of different end user related aspects of UI adaptation for online video and HbbTV applications including tests related to the AccessGUIDE service, the integrated MOOC application as well as tests related to the two showcases provided by PPG and SCREEN.

During the final period of the project vsonix will refine the AccessGUIDE service as well as the MOOC application based on the results of the main user trials. This will be done before the online course on media accessibility is published via the HBB4ALL website. The envisaged date for the publication is March 2016.

Regarding the course content, 50% percent have been produced so far, whereas the rest of the course content will be produced within the first weeks and months of the final project period by UAB in collaboration with vsonix.

Before the MOOC will be available online, vsonix and UAB will prepare the final user evaluation of the MOOC and the AccessGUIDE service based on online questionnaires. Those will be available for all registered MOOC users from the moment the course is available online until the end of the project.

Overall we can say that Pilot-C is well advanced, whereas all objectives defined in the DoW have been met for the first two periods of the project. The technical goals have been met, only minor refinements will be made in the last project year. The last period will now mainly deal with the publication of the MOOC subpilot including the preparation of the necessary content as well as the final evaluation of all related services.

1. Introduction

The Hybrid Broadcast Broadband for All project (HBB4ALL) investigates accessibility services on different platforms including the hybrid broadcast-broadband TV (HbbTV) environment as well as web based video applications for PC and mobile devices. One of challenges faced by broadcasters is the requirement to add Access Services in a cost-efficient manner to audio-visual content delivered via Internet while remaining consistent with the Access Services available on traditional broadcasts and their respective workflows.

A new challenge is the desire to offer viewers the opportunity to customise the Access Services they are using to best meet their personal preferences and needs.

HBB4ALL will test access services in four interlinked Pilots; Pilot-A: Multi-platform subtitle services; Pilot-B: Alternative audio production and distribution; Pilot-C: Automatic User Interface adaptation – accessible Smart TV applications; Pilot-D: Sign-language translation services.

The operational phase of the HBB4ALL project (Task X.3 – Operation Phase for all Pilots A to D, running from August 2015 – July 2016) will gather user feedback and assess the acceptance and quality of services in various delivery scenarios implemented using field user tests and also in complimentary qualitative lab tests. A number of different sub-pilots is scheduled to be carried out in the operational phase.

The aim of Pilot-C is the realization of an online UI adaptation and personalization service that allows the provision of personalized accessibility features for web and HbbTV based media services. The online accessibility service is based on the UI framework that was developed in the EU project GUIDE “Gentle UIs for elderly people” by vsonix together with other partners and which is now further maintained as an open source project. The Software as a Service (SaaS) platform provided by vsonix includes APIs and functions for user management as well as the necessary mechanisms for UI adaptation. It further includes an application for the standardized definition of user profiles for UI and subtitle personalization on PC and HbbTV platforms called AccessGUIDE.

The application service for the operational phase of Pilot-C that integrates the different service components is an online course (MOOC) on “Access Services for Media Content” provided by vsonix in collaboration with UAB. The course will be published before March 2016 on the HBB4ALL website and will be freely available to all interested parties that register to the course. In addition showcases have been realised by PPG (VoD showcase of NPO) and SCREEN (teletext showcase), that both demonstrate the capability of using the UI adaptation service provided by vsonix on HbbTV 1.5 platforms.

1.1. Purpose of the document

HBB4ALL deliverable D5.1 – Pilot-C Progress Report (see [2]) provided an overview of the progress of Pilot-C during the first 12 months of the project timeline. The current document gives an update to D5.1, presenting the status of operational phase preparation.

We start with an overview on the different service components available for the realisation of the MOOC pilot as well as for the showcases provided for HbbTV platforms. Chapter 2 provides an overview of the different service components available for the UI adaptation service and their status of completion; Chapter 3 documents how those service components are integrated in the MOOC pilot. Chapter 4 presents the current status of the sub-pilot preparation with respect to organisational issues, content preparation, functional setup, timing, envisioned users / user groups and the evaluation approach.

Finally, chapter 5 documents the results of the user tests including some early user trials in January on usability and accessibility aspects of the AcessGUIDE application as well as the main user trials that involved tests related to the UI adaptation service but also to the MOOC and the two Hbb4all showcases.

1.2. Acronyms and abbreviations

In this document, when necessary, identified partners within the project are referred to using the abbreviated names initially defined within the Consortium Agreement for HBB4ALL and reproduced on the cover sheet of this document. Abbreviations and acronyms are introduced in brackets in the text after the corresponding full text version.

1.3. Definitions and glossary

Access Service: The provision of additional services or enhancements that improve the accessibility of TV services for viewers with disabilities or special needs.

Accessibility: The degree to which a product, device, service, or environment is available to as many people as possible. Accessibility can be viewed as the "ability to access" and possibly benefit of some system or entity. Accessibility is often used to focus on persons with disabilities or special needs and their right of access to entities, often through use of assistive technology or Access Services.

Accessibility, Linguistic: The degree to which the language of an audio-visual work can be understood by as many persons as possible in the target audience.

Audio-visual Content: All kinds of time-based content consisting of images and sounds

Business model describes the rationale of how an organisation creates, delivers, and captures value. This may be viewed in a narrow sense (economic value, what are the costs, and if there are revenue streams to pay for those). Increasingly, a business model includes social or other forms of value.

Captioning (North America): See Subtitling, Intra-lingual. A form of subtitles primarily intended as an Access Service for viewers with hearing impairments. Captions not only display words as the textual equivalent of spoken dialogue or narration, but they may include speaker identification, sound effects, and music description. Captioning aims to include as much of the original language as possible. However, altering the original transcription may be necessary to provide time for the caption to be read and for it to be in synchronization with the audio.

Catch-up TV A service that allows a viewer to see a TV program independent of when it was broadcast. This is usually a kind of on-demand service on the internet, but may also be achieved via a Personal Video Recorder (PVR) on which the viewer has chosen to record the program, or through a push Video on Demand (VoD) subscription where the viewer receives the program via the internet, their set-top box (STB) or their PVR.

Control, Remote is also known as a remote, controller, or sometimes channel changer. It is an electronic device used for the remote operation of a machine (television set, set-top box, or PVR) over very short distances within the home. The design of such devices needs to consider their usability and accessibility. Blind and partially sighted persons and those with other disabilities often encounter difficulties with remote controls that render them inaccessible.

Dubbing is the post-production process of recording and replacing voices on a motion picture or television soundtrack subsequent to the original shooting.

DVB –Digital Video Broadcasting a set of technical guidelines, standards and specifications to benefit and advance digital media markets world-wide. It was originally European but today is a worldwide alliance of 250-300 companies.

DVB subtitles – bit-map or text captions on digital television using DVB specifications.

EBU: European Broadcasting Union

HbbTV: Hybrid Broadcast Broadband TV is a major pan-European initiative building on work in the Open IPTV Forum aimed at harmonising the broadcast and broadband delivery of entertainment to the end consumer through connected TVs and set-top boxes.

Impairment, age-related is a collection of sensory and cognitive impairments. In the general sense, it covers matters such as the deterioration of sight and hearing, memory impairment or memory loss. In the report, we look not only at persons who are elderly but also at the challenges facing children whose intellectual maturity has an impact on their ability to read subtitles. In principle, there can be other impairments that are related to stages in the person‘s life.

Impairment, cognitive affects the individual‘s ability to think, concentrate, formulate ideas, reason and remember.

Impairment, dexterity is reduced function of arms and hands that makes activities related to moving, turning or pressing objects difficult or impossible. This does not influence speech communication itself but makes it hard to make a phone call or use a wide range of other equipment.

Impairment, hearing is a generic term including both deaf and hard of hearing which refers to persons with any type or degree of hearing loss that causes difficulty working in a traditional way. It can affect the whole range or only part of the auditory spectrum which, for speech perception, the important region is between 250 and 4,000 Hz. The term deaf is used to describe people with profound hearing loss such that they cannot benefit from amplification, while hard of hearing is used for those with mild to severe hearing loss but who can benefit from amplification.

Impairment, visual (or vision impairment) is vision loss (of a person) to such a degree as to qualify as an additional support need through a significant limitation of visual capability resulting from either disease, trauma, or congenital or degenerative conditions that cannot be corrected by conventional means, such as refractive correction, medication, or surgery. The loss may cover visual acuity, significant central or peripheral field defects or reduced contrast sensitivity.

Internet Protocol Television, IPTV is a system through which internet television services are delivered using the architecture and networking methods of the Internet Protocol Suite over a packet-switched network infrastructure, e.g., the internet and broadband internet access networks.

Language Condensation Captioning is rarely a verbatim transcription of what is said in the soundtrack, but an edited version to convey the original sense of what was said while making sure that the viewer is comfortable reading the final result. As a result, the difference between the verbatim transcription and the final result involves language condensation.

Metadata is data about data, in this case information about television programs. This can be in the form of program listings or guides, or technical data delivered with the program to accomplish an Access Service.

Metric is a criterion or measure of success in reaching a particular objective or goal.

Metric, Quality is a measure of the perceived quality of a television picture or sound or associated service.

MOOC, a Massively Online Open Course; a course of study made available over the internet without charge to a very large number of people.

Multiplex or mux is also called a virtual sub-channel in the United States and Canada, and Bouquet in France. It is a group of TV channels that are mixed together (multiplexed) for broadcast over a digital TV channel and separated out again (de-multiplexed) by the receiver.

Over-the-top TV Over the top Television allows you to view content that is available over the internet. It is delivered via your broadband connection to your flat panel display or computer screen and so bypasses the traditional broadcast or IPTV providers of TV services - hence the term ―over-the-top.

Personal video recorder, PVR is a consumer electronics device or application software that records video in a digital format to a disk drive, USB flash drive, SD memory card or other local or networked mass storage device.

Play-out centre is the location from which a broadcaster dispatches a television channel either directly to a transmitter network or indirectly through a contribution system to one or more transmission networks.

Program Guide, Electronic, (EPG) an interactive program guide to provide users of television, radio, and other media applications with continuously updated menus displaying scheduling information for current and upcoming programming.

Program Guide, On-screen as distinct from program listings and guides on other platforms such as the Web, mobile phones and in print media.

Re-speaking is a means to provide real-time captioning for live events including television programs. It involves a captioner / subtitler re-speaking or dictating the captions that are transcribed using speech recognition trained to the specific re-speaker's voice and automatically formatted for display.

Set-top box is a device that enables a television set to receive and decode digital television broadcasts.

Short-form video is video in bite-sized chunks, unlike long-form video such as television programs and motion pictures.

Simulcast Simultaneous broadcast of a program on two or more distribution networks

Smart phone is a mobile phone that offers more advanced computing ability and connectivity than a contemporary feature phone.

SMPTE The Society of Motion Picture and Television Engineers, SMPTE is a technical society for the motion imaging industry.

Spotting The offline determination of subtitle timing (i.e. when subtitles need to appear) using a proxy or copy of the associated video content.

Stakeholder is a person, group, organisation, or system who affects or can be affected by an organisation's actions. In the case of television accessibility, the stakeholders are all those who have an impact on, or are influenced by the planning, production, exchange, delivery, use and enjoyment of television.

Subtitling is a generic term for the production of text as an alternative form of the audio content of audio-visual content. The term 'subtitling' is often interpreted as the process of translating the dialogue component of audio-visual content into text and displaying the text on the screen overlaid on the video image. [See also Captioning and Subtitling, Intra-lingual].

Synthesis, Speech is a means by which human speech can be created synthetically, rather than have to use recordings. It is used for car navigation systems, point-of-information kiosks and is being introduced as a means of offering audio captioning.

Tablet or Tablet PC is a device equipped with a touchscreen as the primary input device and designed for personal use.

Teletext is a television information retrieval service developed in the United Kingdom in the early 1970s. It offers a range of text-based information including closed subtitles and closed captioning. This service is typically available on page 888, but the actual page number depends on the broadcaster and country.

Terrestrial Television is a mode of television broadcasting which does not involve satellite transmission or cables — typically using radio waves through transmitting and receiving antennas or aerials. The term is more common in Europe, while in the United States it is referred to as broadcast television or sometimes over-the-air television.

Transcription is the representation of the sound track of a TV program in written form.

Transcription, Verbatim is a word-for-word representation of the sound track of a TV program in written form.

Translation Subtitles see Subtitling, Inter-lingual

Vertical Blanking Interval, (VBI) also known as the vertical interval or VBLANK, is the time difference between the last line of one frame or field of a raster display, and the beginning of the first line of the next frame. It is present in analogue television and can be used for data casting (to carry digital data), since nothing sent during the VBI is displayed on the screen; various test signals, time codes, closed captioning, teletext, CGMS-A copy-protection indicators, and other digital data can be sent during this time period.

Work, Derivative according to US copyright law is a work based upon one or more pre-existing works, such as a translation, musical arrangement, dramatization, fictionalisation, motion picture version, sound recording, art reproduction, abridgment, condensation, or any other form in which a work may be recast, transformed, or adapted. In the case of subtitles and captions, both of these services can be regarded as derivative works. The question about their use or re-use by third parties or in new contexts is whether the original agreement contemplates such exchange and use of access services.

World Wide Web Consortium, (W3C) is an international community that develops standards to ensure the long-term growth of the Web

2. Service Components

In the following we will give an overview on the service components that have been implemented and are used in Pilot C by the MOOC subpilot as well as by the HbbTV based showcases provided by PPG and SCREEN.

The technical components that have been realized by the partners and that are described in further detail below are:

1. The AccessGUIDE application, which was developed by vsonix for PC platforms (see chapter 2.1) and is transferred by PPG and SCREEN to be used on HbbTV 1.5 platforms (see chapter 2.2).
2. The UI adaptation service (see chapter 2.4) including the UI adaptation API (see chapter 2.3) provided by vsonix for PC and HbbTV platforms that can be used by application developers to integrate access service personalisation into their applications.
3. The text to personalized speech rendering service (see chapter 2.5) that constitutes an essential part of the overall service

Those components are the basis for all accessibility feature provided by the MOOC sub-pilot as well as by the HbbTV showcases provide by SCREEN and PPG.

2.1. AccessGUIDE - PC

An essential part of the UI personalisation framework is the user profiling application (AccessGUIDE) that is used to determine the UI customisation parameters for the individual users. In HBB4ALL the UI adaptation framework as well as the AccessGUIDE application already includes customisation capabilities for personalised subtitling, for the user interface itself as well as for the integrated text to speech service (see chapter 2.5). The UI adaptation framework was conceived to be expandable also to other interface modalities as those targeted in Pilot-A and Pilot-C. Therefore the basic design of the AccessGUIDE application is realised in a way that it could be expanded to include also other modalities with personalisation parameters such as the alternative audio targeted in Pilot B as well as sign language from Pilot-D. The application is designed in a “one fits all” manner, with very low accessibility barriers for the whole target group as it will be used as an initial step to determine the individual user needs.

AccessGUIDE serves as the frontend for the UI adaptation service. Its function is to lead the user through a series of quick assessments to establish their preferred UI settings. These user preferences are then passed to the AccessGUIDE API (see chapter 2.3), which allows to stores those parameters on the server. Each instance of AccessGUIDE is tied to a specific application (in our case the MOOC), so that user preferences can only be accessed by the respective application they have been established for (its “host application”). The AccessGUIDE application with its underlying service can be configured by its host application to show only a subset of assessments based on the supported UI requirements. The user can activate AccessGUIDE from a designated button in the host web application. Once AccessGUIDE gets activated, it will show as an overlay on top of the host application (see figure 1).

The user may discard the AccessGUIDE anytime through the assessment process. Of course it is possible to repeat the assessment or redo any assessment at any time in the future.

During the second period of the project the software was going through a major redesign throughout the agile development process. On the one hand this was based on the results of the early user trials (see chapter 5.1.).

On the other hand the redesign was necessary to fulfil the modular and application related nature of the application and its underlying online service.

Another aim of the redesign was to provide a seamless user experience, which does not require the use to exit their current application and refocus on the AccessGUIDE application. Instead the AccessGUIDE is now a context-sensitive application which allows to change adaptation requirements from inside the linked applications themselves. AccessGUIDE provides instant previews of the user interface changes and allows applications to instantly adapt to the new adaptation requirements.

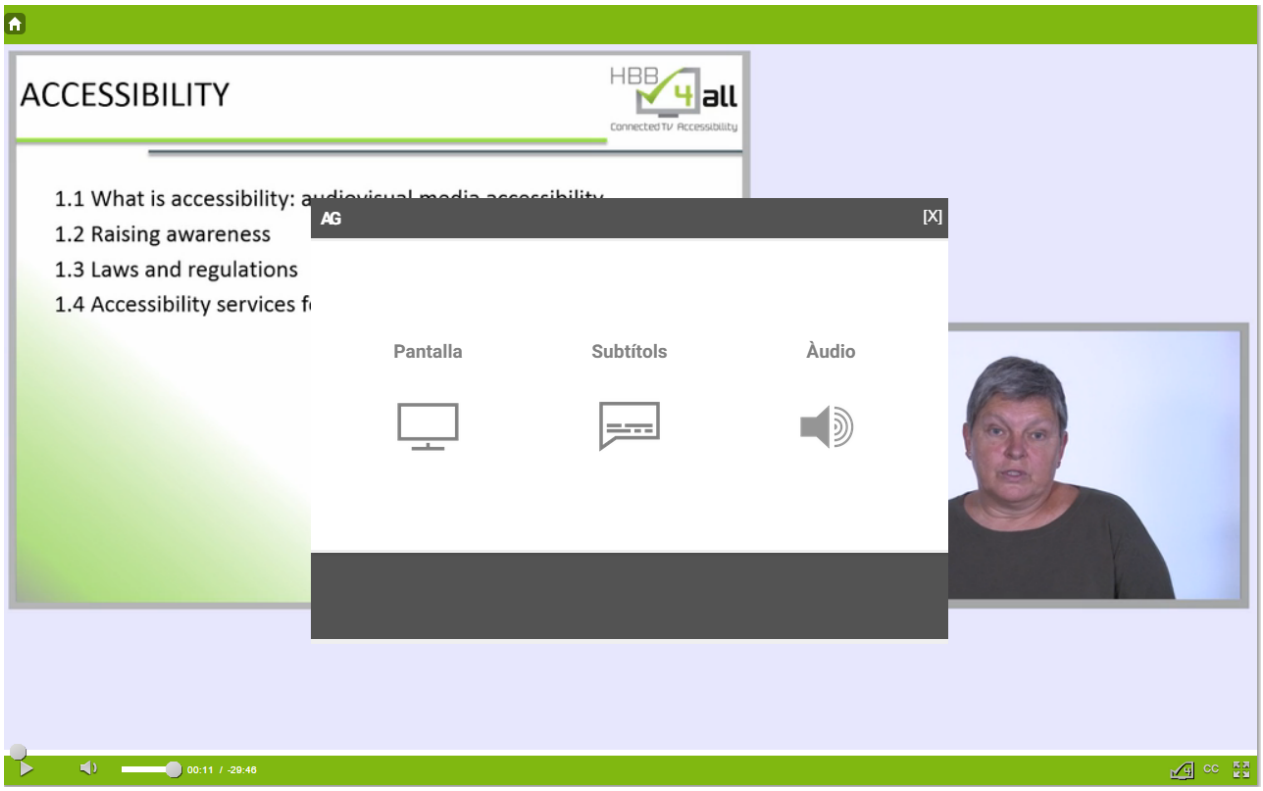


Figure 1: AccessGUIDE application triggered by the host application (in this case the MOOC application)

The different design phases for the application design are depicted in the figures below. The first figure shows a black-and-white design study of the full screen AccessGUIDE settings screen. In this design, we have tried to work with commonly known imagery to convey the majority of information and reduce the amount of textual information (since we try to establish the optimal parameters to display text to the user). The second figure shows how the mock-up has been translated into an application. Notable changes from the first mock-up are the more prominent navigation bar on the left in order to provide the user with orientation inside AccessGUIDE, and the step back from navigation icons to a textual description. After we had decided to transform AccessGUIDE from a full-screen application to a context-sensitive popup we consolidated the user interface in order to make it more efficient. The design of the second iteration can be seen in the figure below. Notably we completely removed the navigation bar and removed the extensive spacing in between each area of the application layout (navigational elements, description, and action).

In the final version of AccessGUIDE we added back informational elements that provide feedback to the user regarding their position in the adaptation process. We did not provide advanced methods for the user to move through the adaptation because the process is simple and quick enough to allow to omit those advanced

methods of navigation. The colour scheme has been adjusted to match the established HBB4ALL design and of course the communication with the AccessGUIDE API has been implemented completely.

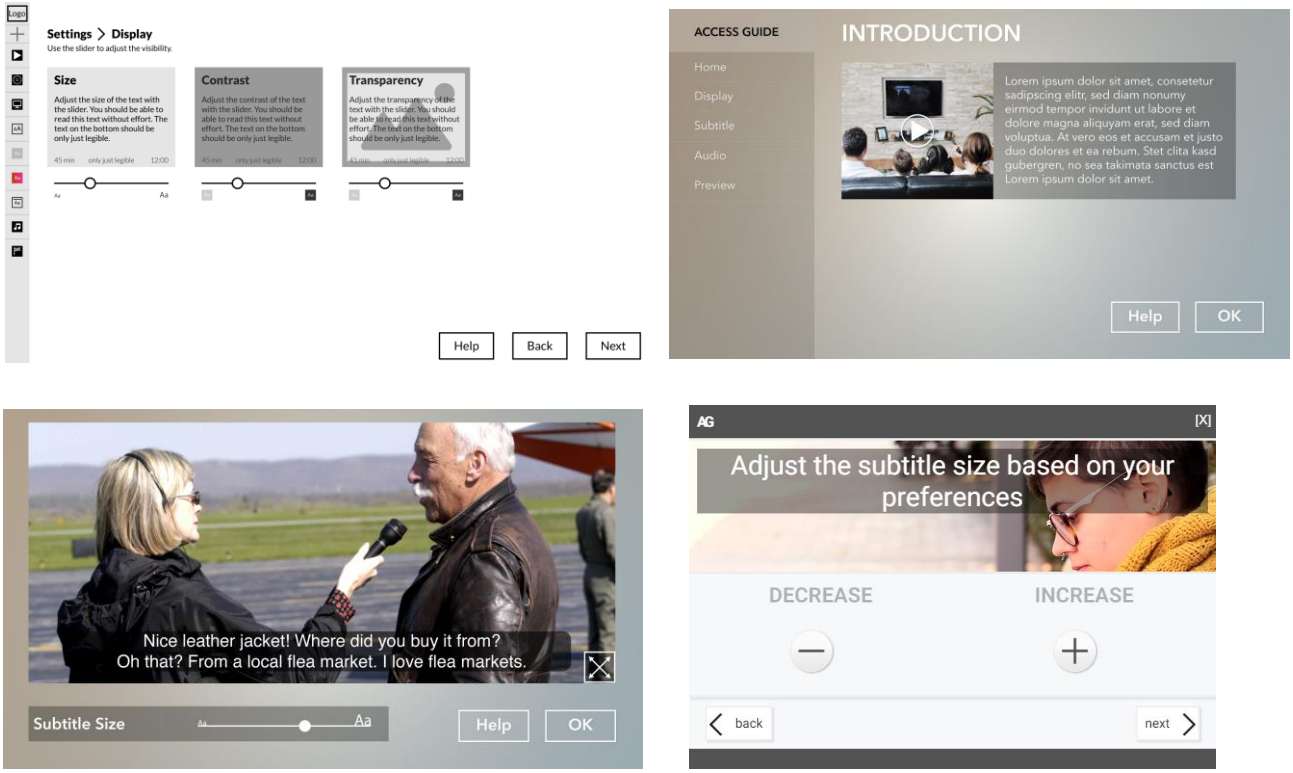


Figure 2: AccessGUIDE UI Design evolution from initial wireframe (upper left) to the final UI design (lower right)

2.1.1. *Overview*

The AccessGUIDE application represents the graphical frontend of the AccessGUIDE API and allows users to modify their adaptation profile through a convenient and simplistic user interface. The user interface went through several transitions, some of which may be seen in figures above. The final version we decided to use features a modular, extensible and simplistic user interface which does not require the user to completely refocus their attention and stays in the current context of the application. The AccessGUIDE application may be triggered from any web application at any time any is displayed as an overlay in top of the current content. The main menu of the AccessGUIDE application presents the three different modalities that could be adapted by the application. Those currently are “Display Settings”, “Subtitle Settings” and “Audio Settings”. Activating one of these categories will guide the user through the respective section, however, only the relevant adaptation settings will be shown to the user. If, for instance, the text-to-speech system is disabled then the system automatically skips all other dialogs for adjusting TTS parameters since they are ignored anyway. The application can be extended with other modalities, whereas their customisation parameters can be attached as an additional dialog chain to the main menu of the application.

Available adaptation settings are for subtitle-related adaptation settings: subtitle size, background transparency and position, for display-related adaptations: minimal font size, support for transparent elements, and colour schemes, and for text-to-speech synthesis: volume, speed, and gender. After a section has been completed the user is brought back to the main menu screen. Figure 3 illustrates the path through the application screens.

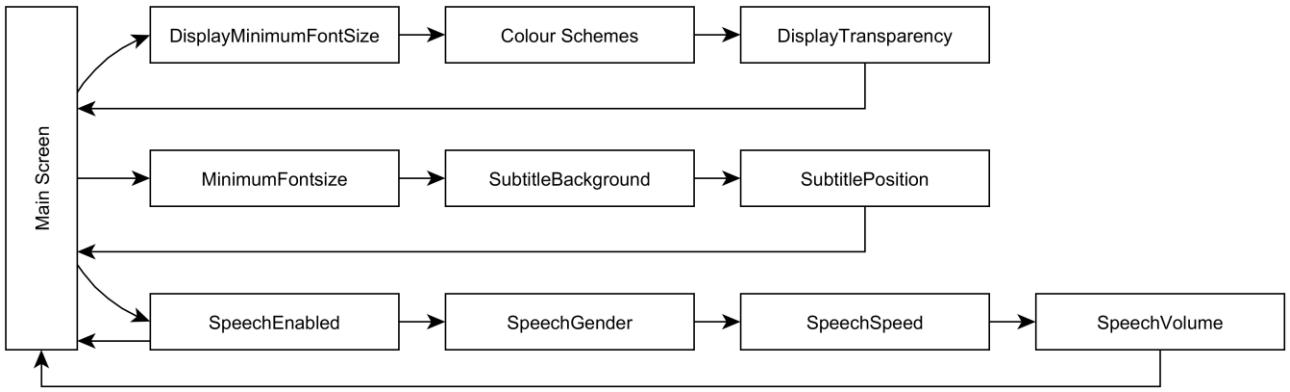


Figure 3: Menu structure of the AccessGUIDE application

Each of the AccessGUIDE screens will honour the already given adaptation criteria of the user and, for instance, change the font size of its screen to the value given by the user (if any). Navigating through the screens, the user may change any adaptation setting and preview the changes in real time: If the user changes the TTS gender, then they will instantly be presented with a preview of what the voice will sound like. The same setting will then be used in the remainder of the audio settings screens (volume, and speed) to give the user a meaningful preview of what the other settings will sound like.

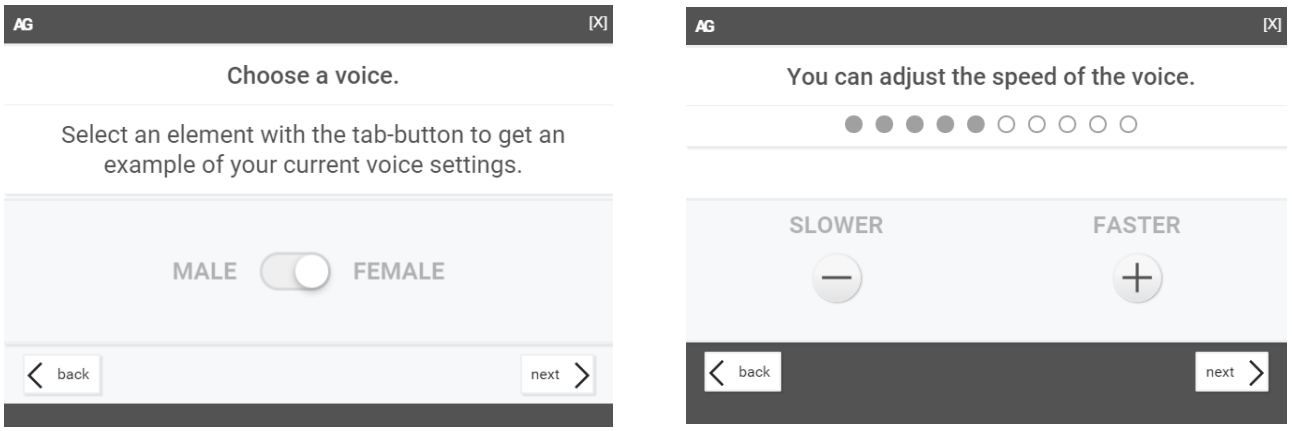


Figure 4: Dialogs for TTS service adjustments

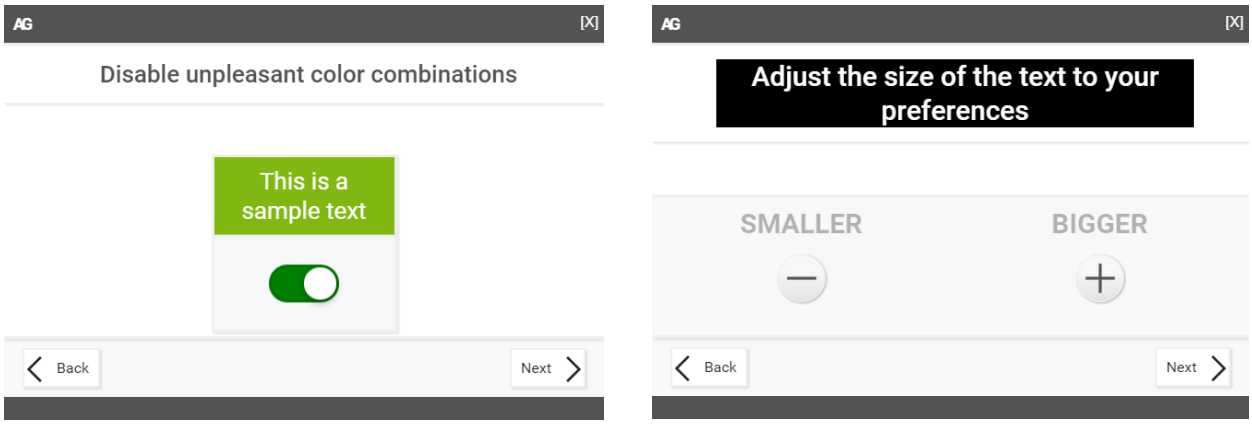


Figure 5: Dialogs for UI adjustments

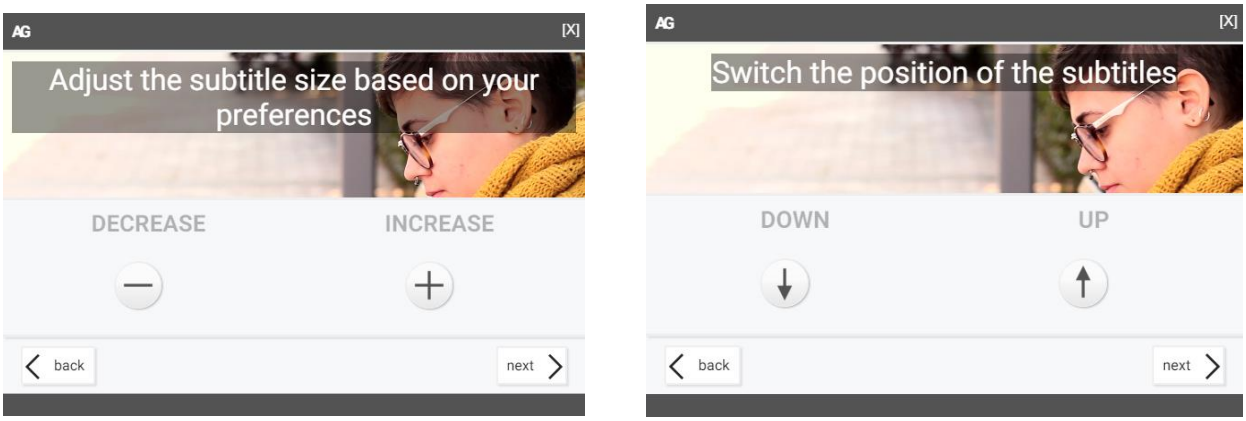


Figure 6: Dialogs for subtitle adjustments

2.1.2. *Status of completion*

AccessGUIDE has been fully conceptualized and re-designed in order to provide an enhanced and less intrusive user experience. It is fully connected to the AccessGUIDE API and communicates all changes and events in real time with the API, which means that user selected values get stored and restored correctly each time the AccessGUIDE application is being used. There are only minor tasks left to do such as reorganizing and restructuring some portions of the source code as well as providing further polishing to the user interface to further reduce its complexity. Our goal is to have an easy-to-use application which does not interfere with the user's wishes, demands, and needs and does not prevent them from applying those to the AccessGUIDE API.

2.1.3. *Relation to the sub-pilots*

The AccessGUIDE is integrated into the MOOC sub-pilot provided by vsonix and was adapted to run as HbbTV application by PPG (see 2.2). In the MOOC sub-pilot the AccessGUIDE is used in order to allow users to adapt the learning experience to their individual needs. Both the playlist view and the player view will be subject to various adaptations, so that a wide array of implemented adaptation requirements will be in use for the MOOC. Specifically, the MOOC will provide support for colour schemes, font size adjustments, all subtitle adaptations, and text-to-speech.

2.2. AccessGUIDE – HbbTV

2.2.1. *Overview*

The HbbTV component of the AccessGUIDE is implemented within the NPO application, which delivers videos on demand. It enables the user to adjust the subtitles of the video content. This improves the accessibility of video content especially for people that are hearing or visually impaired. By pressing the blue button on the remote control or selecting the accessibility button [Accessibilitat] of the bottom navigation bar (see Figure 7).

Figure 7: Start of AccessGUIDE application via Blue Button

The subtitle settings screen includes a looping video in the background (a part of the HBB4ALL presentation video without audio) with example subtitles. The menu offers three different subtitle properties to adjust: The subtitle background transparency [Fons], the font size [Mida del text] and the position [Posició], see Figure 8. The background transparency [Fons] includes six different states. The first one has a transparency of 0 %. That means the white subtitles are shown without a black background but with black text shadow. By using the plus and the minus button, which are positioned in front of the looping video, you switch between the different transparencies in steps. The last one has a transparency of 100 %.

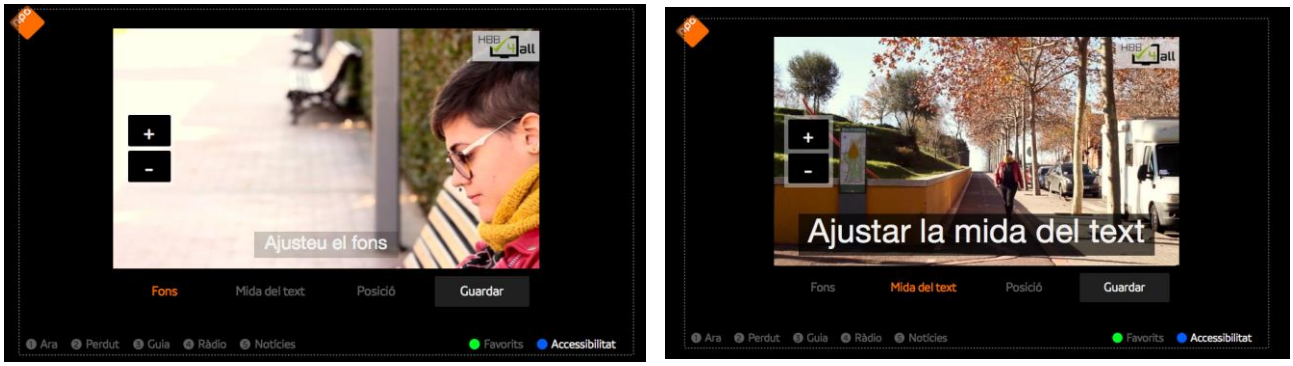


Figure 8: Possible Subtitle Adjustments

The next property, the font size [Mida del text] may be adjusted similarly and includes eleven different states, see Figure 8. Some are bigger than the default size and some are even smaller. The last property, the subtitle position [Posició] offers only two states. The default state is “bottom” and the other one is “top”. The plus/minus buttons are replaced by bottom/top buttons [dalt]/[baix] in this case.

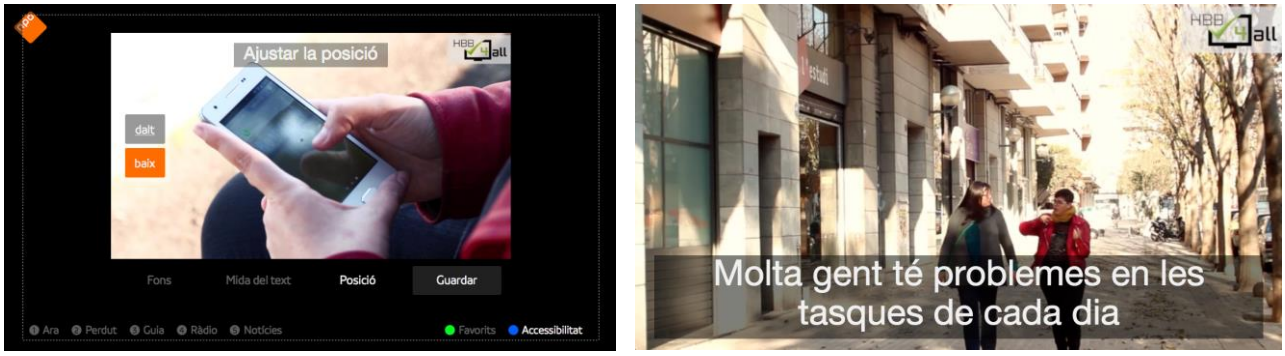


Figure 9: Possible Subtitle Adjustments

If the user is satisfied with their adjustments, they have to select the "save" button [Guardar] in the settings screen menu, see Figure 9. If the user starts a video of the "missed" section [Perdut] and activates the subtitles in the player menu by selecting the subtitle button [T], the subtitles are shown with the chosen properties.

2.2.2. *Status of completion*

Subtitles are adjustable as described in 2.2.1. For the process of the implementation, we used the web app provided by vsonix as an example, which has a similar functionality. Contrary to this example application, we didn't create the settings screen as a pop-up in front of a video, but as an own page within the NPO user interface. For this purpose we had to add a new template to the app, which contains the settings page and a JavaScript controller file that is responsible for the interaction. It is necessary to adjust the subtitles before a video is played since this application is a full screen application instead of an overlay. To assist the users in choosing the right subtitle settings, example subtitles are directly shown in front of a looping video at the settings screen to let them decide if the current settings are adjusting the subtitles in a way that they are easily readable or not. The chosen subtitle settings are stored as cookies on the devices of the users after pressing the "Save" button [Guardar] and still stored when the TV is turned off and on. The text-to-speech function isn't implemented due to limitations in the current HbbTV 1.5 standard. It's not possible to simultaneously play a video and TTS-audio. This could be resolved by allowing this in the standard.

2.2.3. *Relation to the sub-pilots*

AccessGUIDE HbbTV version is used by the NPO Video on Demand application

2.3. AccessGUIDE API

The AccessGUIDE API is the JavaScript based interface to the AccessGUIDE Service. The API is used by the AccessGUIDE and third-party applications as well as other sub-pilots directly in order to access the AccessGUIDE service. The AccessGUIDE API represents the client-side part to the AccessGUIDE Service on the server side.

2.3.1. *Overview*

The API has been developed alongside the AccessGUIDE service in a common project based on the Google Web Toolkit (GWT) framework. The functionality has been grouped into logical packages and divided into server-side functionality (AccessGUIDE service) and client-side functionality (AccessGUIDE API). The AccessGUIDE API abstracts away the complexity of accessing the HTTP-based AccessGUIDE service, such as asynchronous network requests, event handling, and error handling. It wraps the AccessGUIDE service conveniently in easy-to-use JavaScript functions and objects that may be utilized by application developers to incorporate the AccessGUIDE service with very low effort and, most importantly, without having to worry about the various issues that may arise when making heavy use of asynchronous network requests.

Besides handling the communication with the service, the AccessGUIDE API needs to handle all information regarding application state, since the AccessGUIDE Service lifecycle is completely stateless to make the service reusable with different client-side APIs which will be needed for translating the AccessGUIDE API to the HbbTV platform. Application state is stored locally at the browser in regular cookies. We tested storage in HTML5-based storage-entities such as the LocalStorage JavaScript object, but found Cookies to be a more reliable source for information storage and transmission to the server since they are included in HTTP POST requests automatically by the browsers. The API interface for application developers consists of a number of functions. Each function along with a brief description may be found in the following table. More information regarding the usage of any of these functions may be obtained by consulting the documentation file that is part of the source code repository.

initialize	Initialize the AccessGuide API. After this function has been called the API is capable of providing the application developer with adaptation values that are associated with the current user and machine (The identification takes place using a unique token which is read from a cookie).
createProfile	Creates a new, empty user profile for the current application. Afterwards, the profile may be filled with adaptation requirement values and color combination requirement values. After you have called `createProfile`, it is not necessary to call `initialize`, since a newly created user profile will be considered initialized automatically.
logout	Deauthenticate the current user against the AccessGuide API. After this function has been called, `getRequirementValue()` will no longer provide adaptation values and the AccessGuide API is no longer associated to any

	user profile. It is possible to authenticate a user again by calling `initialize()` afterwards.
getRequirementValue	Retrieve adaptation values targeted towards the current user for the given adaptation criteria. This function will return values only when the user successfully authenticated against the AccessGuide API. The available adaptation criteria may be queried by `getAvailableRequirements()` or `isRequirementAvailable()`.
setRequirementValue	Set a specific adaptation requirement to a given value for the current user and the current application. This will only allow to set adaptation requirement values when the user successfully authenticated against the AccessGuide API.
getAvailableRequirements	Retrieve all available adaptation criteria that may be used as arguments in various functions of the AccessGuide API. This function does not rely on any user being authenticated and thus should not be used to predict the availability of adaptation values according to any user profile. In order to verify the presence of an adaptation value for a specific criteria call `getRequirementValue()` instead.
isRequirementAvailable	Check if an adaptation criterion belongs to the set of criteria that may be queried through the AccessGuide API. This function will look up the given criterion in AccessGuide's set of predefined adaptation criteria. This function does not indicate whether a given criterion is set in a user profile, it only checks if that criterion is generally known to AccessGuide. To check if the current user profile holds data for a criterion, call `getRequirementValue()`.
getColorSchemeRequirementValue	Check if a given combination of foreground and background colors can be used in the user interface for the current user. This function will return values only when the user successfully authenticated against the AccessGuide API.
setColorSchemeRequirementValue	Indicate whether a given combination of foreground and background colors can be used in this application for the current user. This function will only allow to set color scheme requirement values when the user successfully authenticated against the AccessGuide API.

addEventListener	Add an event listener to the AccessGuide API. For information about supported events and the signature of their event listeners please consult the respective chapter on "AccessGuide JavaScript Events".
getAppSettings	Retrieve the API configuration as defined in the JSON file that has been passed to the API during `initialize()` or `createProfile()`.
isReady	Checks whether the API is initialized and a user is currently logged in. Use this function to check if other methods may be used. If this function indicates that the API is not ready, then you have to call either `initialize` or `createProfile`, depending on whether a user profile is available on the system.
describeRequirement	Provides meta-information for an adaptation requirement. This function is useful in combination with `getRequirementValue()` because it allows the developer to gain information regarding the expected data type and range of values.
getTTS	Generates a text-to-speech audio object from given text according to the current profile's audio adaptation requirements (`speechSpeed`, `speechGender`, and `speechVolume`). Note that this function will return an audio object even in `speechEnabled` is set to `false`. It is the responsibility of the application developer to only call `getTTS` when the user has enabled TTS.

Table 1: List of API interface functions for application developers

Furthermore the AccessGUIDE API is equipped with an event notification system, which allows application developers to react to changes in the state of the API or the user profile in real time by subscribing to events using the addEventListener function, similar to the event-driven concept known by JavaScript and HTML. A list of supported API events and a short description can be found in the table below.

generateProfile	This event will be thrown whenever a new user profile has been initialized by AccessGuide. This event will be thrown as soon as the profile has been created, which means that it might not yet contain any profile information or adaptation preferences.
changeRequirementValue	This event will be thrown whenever an adaptation requirement value has been changed for or added to the current user profile. After this event has been fired, the application developer will be able to receive the new adaptation requirement value using the `getRequirementValue` API function.
changeColorSchemeRequirementValue	This event will be thrown whenever an adaptation requirement value has been changed for or added to the current user profile. After this event has been fired, the application developer will be able to receive the new adaptation requirement value using the `getRequirementValue` API function.

Table 2: List of API events

The AccessGUIDE TTS system is also exposed conveniently through the getTTS API function. The getTTS function transmits the given text to the AccessGUIDE TTS service and encapsulates the audio URL returned by the TTS service in a native JavaScript object that allows the application developer to take full control over audio playback, without ever having to deal with HTML5 Audio elements or the actual audio stream URL, see Figure 10.

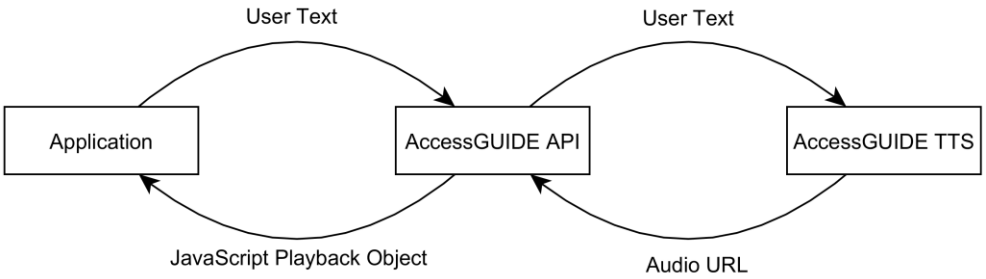


Figure 10: getTTS API function

2.3.2. *Status of completion*

The AccessGUIDE API is feature-complete and is already being used in various applications. There are no major tasks left open for implementation, only bug fixes, optimisations and documentation need to be processed. The integration of the AccessGUIDE service and AccessGUIDE TTS systems are fully operational, and all API functions are implemented.

2.3.3. *Relation to the sub-pilots*

As an essential part of the adaptation functionality it will be used to connect the AccessGUIDE with the AccessGUIDE service and the AccessGUIDE TTS system. The AccessGUIDE API also serves as the basis for a port to the HbbTV platform in order to extend the AccessGUIDE service to the HbbTV ecosystem.

2.4. AccessGUIDE Service

The AccessGUIDE service represents the backend component of the adaptation functionality. It exposes several functions through a publicly available HTTP interface that allow application developers to create, store, and retrieve adaptation profile information, whereas storing adaptation profile information is usually done by the AccessGUIDE.

2.4.1. *Overview*

The AccessGUIDE service will most likely be used indirectly by means of using the AccessGUIDE API, which in turn handles the communication with the AccessGUIDE service. The AccessGUIDE service is powered by a Tomcat Application Server that is connected to a database storage server. The communication takes place using the HTTP/1.1 protocol, while data is exchanged using the JSON data format as HTTP POST queries. The table below lists all available HTTP endpoints alongside a short description of their function. More detailed information regarding the functionality and usage of each function may be found in the documentation that is provided alongside the source code.

CheckProfile	This function verifies that for the combination of provided userId, appId, and appHash a user profile exists in the database. If such a profile exists this indicates that the API has some adaptation requirement value for the user available, which may be queries using getRequirementValue.
http://accessguide.tv/guideapi/vsx.guide.api.GuideAPI/guide/checkprofile	
InitProfile	This function creates a new, empty user profile in the database. It will not erase any existing user profile, but simply generate a new userId. The new profile may be filled by calling SetRequirementValue or SetColorSchemeRequirementValue.
http://accessguide.tv/guideapi/vsx.guide.api.GuideAPI/guide/initprofile	
DescribeRequirement	This function returns various pieces of information regarding a given requirement name. This information may be used to find out about the type of value that will be stored, the allowed data ranges, and others.

http://accessguide.tv/guideapi/vsx.guide.api.GuideAPI/guide/describe	
GetAvailableRequirements	This function returns a list of the names of all defined requirements in the database. Notice, that if this list contains a certain requirement it does not automatically indicate whether that requirement is also set in the profile of a given user.
http://accessguide.tv/guideapi/vsx.guide.api.GuideAPI/guide/getavailablerequirements	
GetColorSchemeRequirementValue	This function is used to retrieve readability information regarding the given combination of foreground and background colors for the current user. The return value of this function indicates whether the given colors should be used in the user interface for this particular user. If this function indicates not to use the color combination, then the app should fall back to a more readable color combination such as black font color and white background color.
http://accessguide.tv/guideapi/vsx.guide.api.GuideAPI/guide/getcolorschemerequirementvalue	
GetRequirementValue	This function allows to retrieve user profile information from the service. Use this function to request adaptation requirement values for given user and application.
http://accessguide.tv/guideapi/vsx.guide.api.GuideAPI/guide/getrequirementvalue	
isRequirementAvailable	This function indicates whether a given requirement is available in the service. Notice that this function does not indicate whether a given requirement is set in a specific user profile, but only checks if the given requirement is defined in the service. This function exists for future extensions of the service, where an arbitrary number of requirements might be defined
http://accessguide.tv/guideapi/vsx.guide.api.GuideAPI/guide/isrequirementavailable	
SetColorSchemeRequirementValue	This function stores readability information regarding a given combination of foreground and background colors for the current user and application. This information may then be queried by GetColorSchemeRequirementValue.

http://accessguide.tv/guideapi/vsx.guide.api.GuideAPI/guide/setcolorschemerequirementvalue	
SetRequirementValue	This function stores adaptation requirement values for a given user and application. This information may then be queried by GetRequirementValue.
http://accessguide.tv/guideapi/vsx.guide.api.GuideAPI/guide/setequirementvalue	
CreateTTSUrl	This function generates a synthesized audio snippet from the text it is given and returns a URL that allows playback of that audio. Audio may be generated for arbitrary text and a variety of supported languages. For the generated audio the user adaptation values such as speechVolume, speechSpeed and speechGender are respected and automatically queried from the backend.
http://accessguide.tv/guideapi/vsx.guide.api.GuideAPI/guide/createttsurl	

Table 3: List of AccessGUIDE Service functions

Internally, the AccessGUIDE service is composed of the core classes that handle database communication. A request from the JavaScript application is marshalled by individual API worker classes that transform the JSON structure into Java-based objects and extracts the necessary information for the core classes. With this information the actual AccessGUIDE service is instructed and returns the information accordingly. The Java-based result objects are then marshalled again into well-defined and well-documented JSON structures by the API worker. Finally these JSON structures are passed back to the AccessGUIDE API which distributes it back to the original browser application. This process is displayed in Figure 11 below.

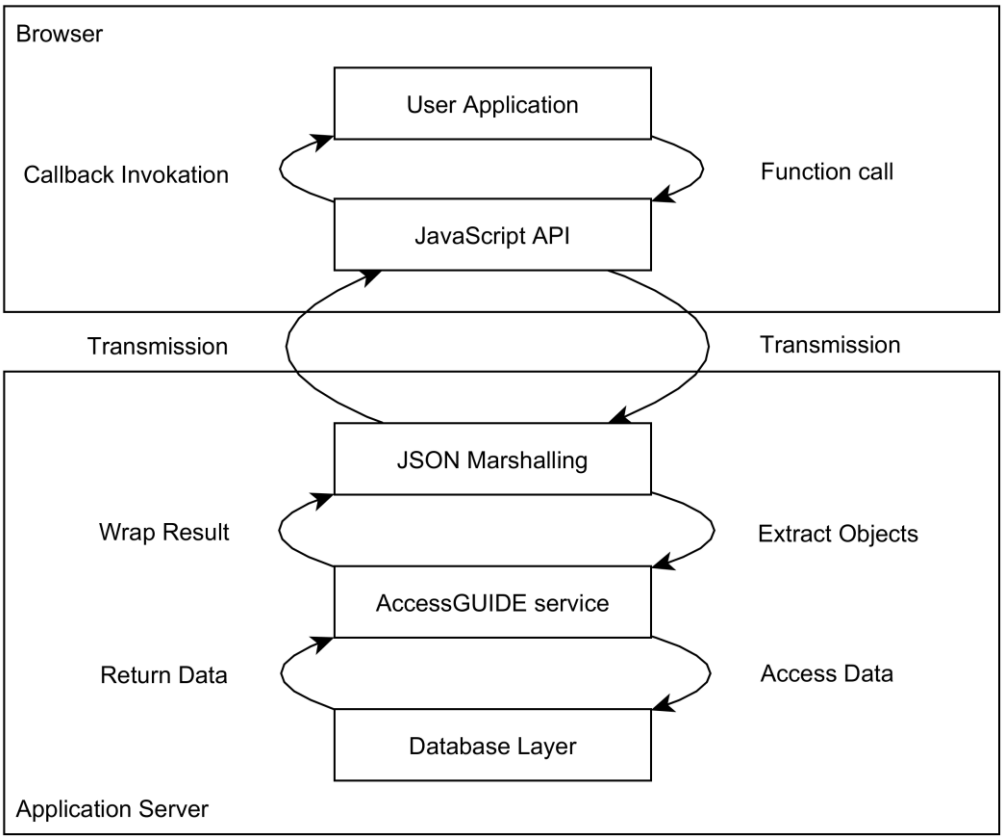


Figure 11: AccessGUIDE service integration principle

The AccessGUIDE service is built in a modular way which allows for easy swapping of individual parts. If the implementation of the JSON marshalling layer needs to be modified, it is fairly easy to swap it with any other implementation as long as the interfaces do not change. The same is true for the database layer or any other layer. We have chosen to make use of this loose coupling technique in order to facilitate porting the AccessGUIDE service to the HbbTV platform.

2.4.2. *Status of completion*

The AccessGUIDE service is feature-complete. All specified functionality has been added and is available through the above documented HTTP. All data is correctly marshalled and passed to the core components which correctly store and retrieve data in the database. We have conducted several long-time tests to ensure system stability and absence of any memory leaks, which completed successfully. We have also tested the interoperability of the AccessGUIDE service with the AccessGUIDE API and the AccessGUIDE TTS system, all of which showed no serious issues that required immediate action. The documentation is complete and reflecting this correctly.

2.4.3. *Relation to the sub-pilots*

AccessGUIDE is integrated directly or indirectly through the AccessGUIDE API into the MOOC sub-pilot provided by vsonix and was adapted into a natively running HbbTV application by PPG.

2.5. AccessGUIDE TTS

The AccessGUIDE TTS component is integrated into the AccessGUIDE TTS service and provides application developers with on-the-fly text-to-speech services in near-real time, with speech parameters adjusted to the adaptation requirements of the current user profile. It returns a URL behind which a MPEG3-stream of the synthesized speech can be streamed using common HTML5-compliant playback techniques.

2.5.1. *Overview*

The AccessGUIDE TTS component provides common text synthesis functionality over a standard HTTP/1.1 web interface. It can be instructed from either a direct HTTP request, or from the getTTS API function, which will do equally that. The AccessGUIDE TTS service will retrieve all applicable user adaptation requirements such as voice volume, voice speed and voice gender from the AccessGUIDE service and use these values for constructing an annotated version of the input text. The annotated input text will then be passed to an external synthesis service which actually produces the audio stream and makes it available through a dedicated URL. This URL is then returned from the AccessGUIDE TTS service. This process is depicted in the sequence diagram in Figure 12.

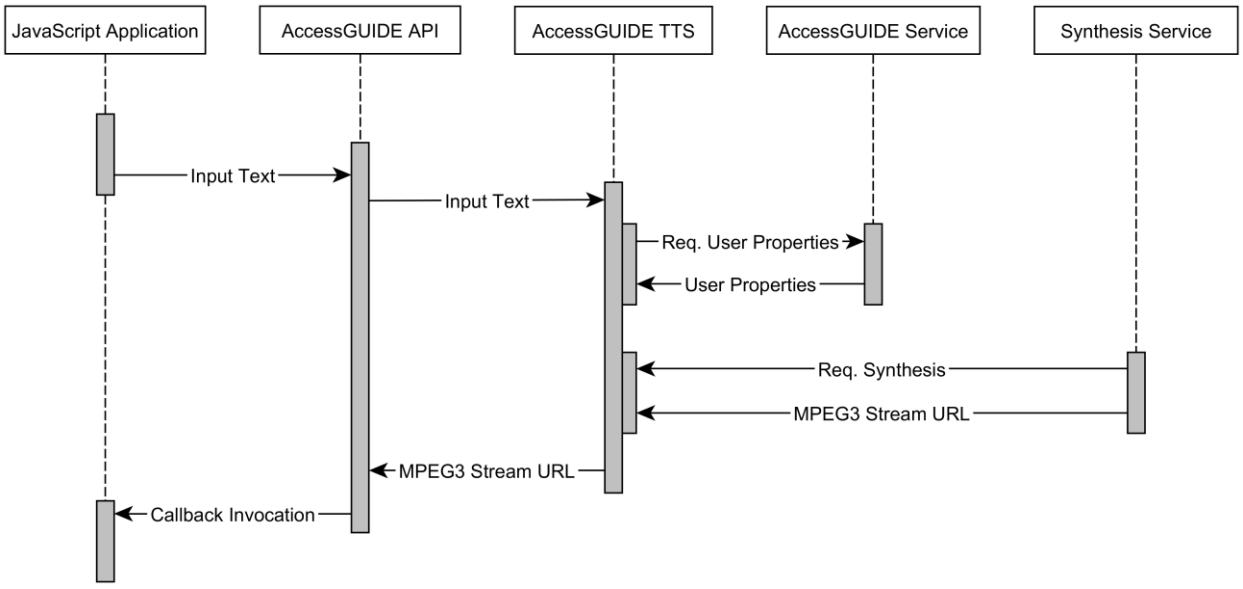


Figure 12: Usage of AccessGUIDE TTS

If the request to the AccessGUIDE TTS has been started from the AccessGUIDE API using the getTTS function, then this function will convert the returned URL into a callable playback object, which allows to play the synthesis very simply by calling the "play" method. If the request has been started using a custom HTTP request to the AccessGUIDE TTS, then a playback mechanism needs to be developed separately based on the URL that is returned.

The URL points to an MP3 audio stream, which means that audio data will instantly available for playback independently of the time needed for processing all of the input text. Audio data may be streamed before processing of all input text is complete, which allows us to reduce the synthesis delay as much as possible and provide the application developer with a close-to-real time experience.

As previously mentioned we make use of an external web based synthesis service provided by Ivona Software. This generic TTS provider allows very flexible audio synthesis because of its built-in support for SSML (Speech Synthesis Markup Language), which we use in order to manipulate the audio according to the user adaptation requirements. SSML is a text markup language similar to HTML, but with a focus on speech, which allows to annotate the input text in ways which alter the synthesis returned by the TTS provider. An example request sent to the TTS provider can be seen below, which requests a speed multiplier of 1.0 and a volume of 100 percent:

```
<prosody rate='1.0' volume='100'>This text will be synthesized.</prosody>
```

Furthermore, Ivona provides an exhaustive list of supported languages and voices in either gender, which is essential for the multi-language user group that HBB4ALL addresses. Finally, the support for HTML5-compliant audio streaming with chunked transfer encoding allows us to reduce delay as much as possible. Network lags and buffering issues are taken care of with the several, worldwide distributed Ivona service clusters, which allow us to pick the one endpoint physically closest to our own server infrastructure.

2.5.2. *Status of completion*

Implementation of the AccessGUIDE TTS service is feature-complete. Currently the component is hardened for stability and always-on operation as a web service, and debugged for the elimination of any unknown usage bugs. We are currently in talks with our external TTS provider Ivona to establish a custom business relationship in order to improve the integration of Ivona services into the AccessGUIDE TTS system.

2.5.3. *Relation to the sub-pilots*

The AccessGUIDE TTS is a standalone web component, but due to its nature of integrating the AccessGUIDE user profile it is mostly used in conjunction with all other components such as the AccessGUIDE service, the AccessGUIDE API and the AccessGUIDE itself. It will be included in the MOOC sub-pilot.

3. Sub-Pilot integration

In the following we will give an overview on how the different service components described in chapter 2 including the AccessGUIDE application and its related API and service functions are used by the MOOC pilot as well as by the showcases provided by PPG and SCREEN.

The architecture diagram in Figure 13 shows the main technical components of the UI adaptation service and how they relate to the MOOC pilot as well as to the HbbTV showcases. Furthermore the diagram shows the different software components provided by vsonix to integrate the online learning course on media accessibility including functions for interactive course playback (vPlayer), a chat function for content related user interaction (vInteract) as well as a web application backend consisting of a component for user management (vUser), a content management system (CMS) and the necessary content delivery network (CDN) for content playout.

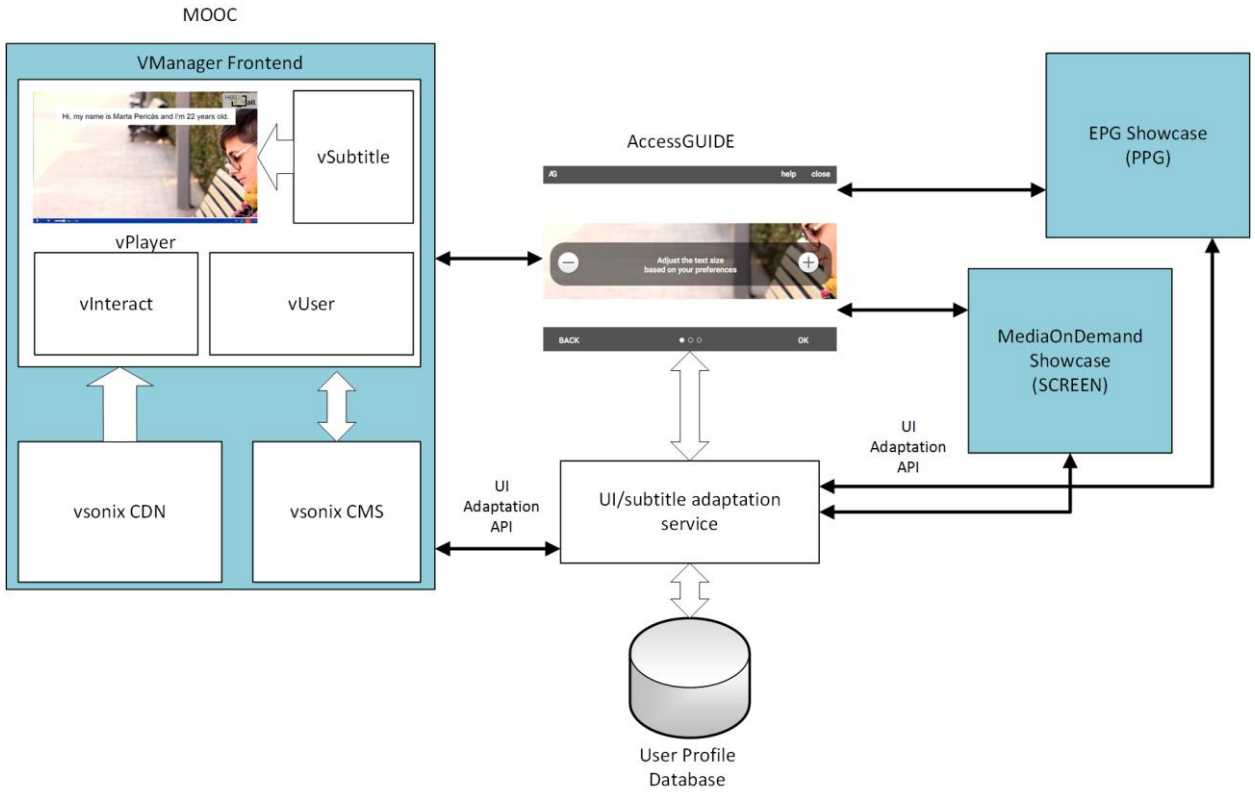


Figure 13: Common system architecture as basis of Pilot C

3.1. MOOC "Massive Online Course on Media Access Services"

3.1.1. *Overview*

The application service for the operational phase of Pilot-C that integrates the different service components is an online course (MOOC) on "Access Services for Media Content" provided by vsonix in collaboration with UAB. The course will be published before March 2016 on the HBB4ALL website and will be freely available to all interested parties that register to the course.

From a technical point of view the online course has already been integrated using the software components and services provided by vsonix. From a content point of view the online course targets a number of topics related to the realisation and integration of advanced Access Services for online and HbbTV media services such as subtitling or sign language (see chapter 3.1.3). In terms of Access Services the online course integrates the UI adaptation and personalisation service (see chapter 2.4) developed by vsonix providing users advanced Access Service personalisation capabilities for the user interface as well as for personalised subtitles. The prototype of the MOOC application integrating the AccessGUIDE service was trialled in September 2015 by vsonix in collaboration with UAB. The prototype already provides the course content by UAB, produced in collaboration with vsonix.

3.1.2. *Additional Service Components*

In the following we will give an overview on the additional software components that were needed for the realisation of the MOOC application, the content of the online course and its production, the backend services needed for the delivery of the service as well as user perception related topics such as the integrated UI and subtitle adaptation/personalisation.

3.1.2.1. vPlayer

The vPlayer component is responsible for delivering the actual video content to the end user. vPlayer is a JavaScript/HTML5-based software, which allows the interactive playback of video content providing a chapter based navigation as well as a full text search functionality. It includes support for multiple subtitle tracks (e.g. for Multilanguage support) as is available for mobile (iOS/Android) as well as common desktop platforms. vPlayer now also features AccessGUIDE integration and adapts according to the user preferences in terms of subtitle display, and application colour scheme.

3.1.2.1. vInteract

vInteract allows users to create comments synchronised with the video lecture content. Specifically, users are able to add their own textual content to the video lecture, including private notes as well as publicly visible comments. Any user added content is related to a specific playback time and can be used for additional advanced video navigation. The notes/comments can be triggered by vInteract to be visualised at its related playback time. At the moment, only textual comments are supported to be added to the video timeline, however vsonix plans to add other types of contents such as links to web sites, images as well as additional video content.

Figure 14 shows the MOOC frontend including vPlayer with its integrated search and chapter navigation functionality as well as vInteract.

Figure 14: MOOC frontend consisting of vPlayer and vInteract

3.1.2.2. vManager

The vManager component is responsible for generating the overall application structure and user interface elements in JavaScript and HTML5. In the context of the MOOC it will be used to display available lectures in a playlist, load the lecture in vPlayer, and orchestrate the communication with the AccessGUIDE service through the AccessGUIDE API. vManager itself also adapts to the user preferences to alter the font types, font sizes and colour schemes. It processes communication with the TTS system and passes lectures titles and presenter information to the AccessGUIDE TTS system, provided this has been enabled by the user.

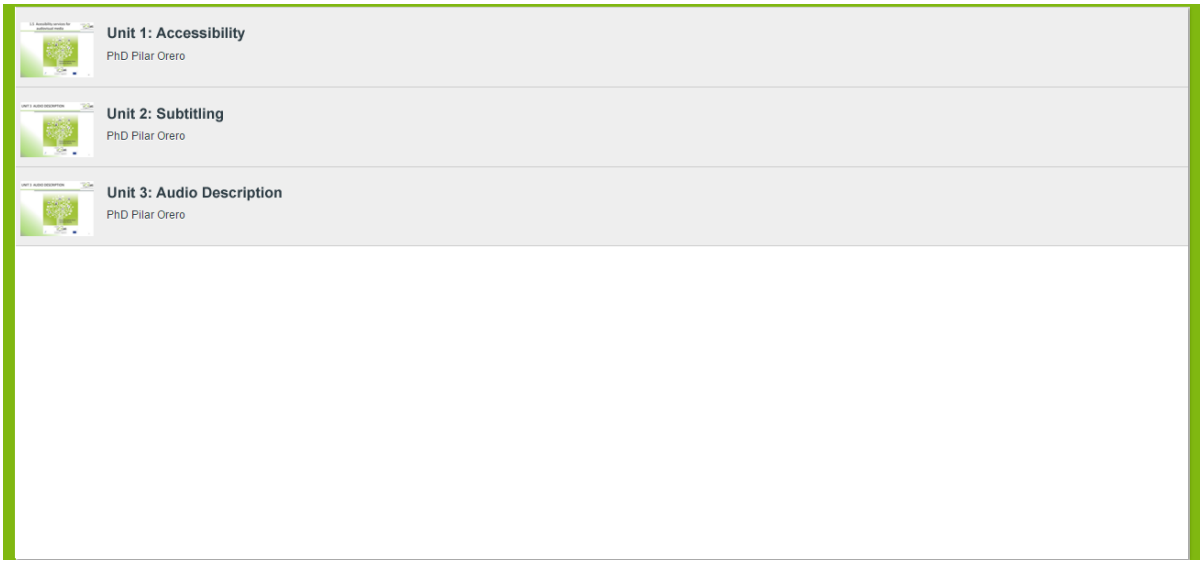


Figure 15: vManager frontend

3.1.2.3. vUser

The MOOC also integrates a service for user registration and access management. This service is based on vsonix vUser component, which provides all the necessary functionality for user access and privacy management as well as the necessary user authentication for the vInteract component.

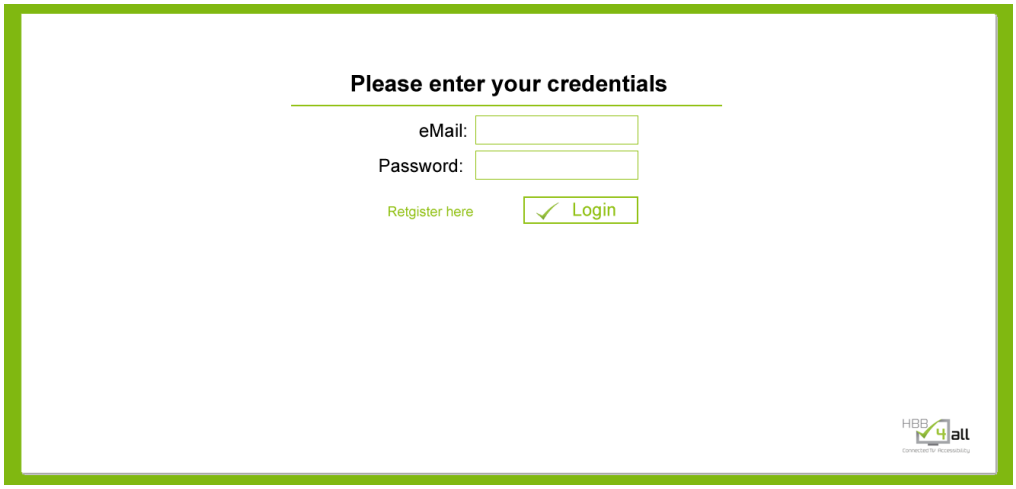


Figure 16: vUser frontend

3.1.3. *Content Production*

In terms of production the content of the MOOC was produced by UAB in collaboration with vsonix, whereas UAB provided the course content and vsonix was responsible for the technical realisation including the recording of the MOOC content in the vsonix studio in Darmstadt as well as the editing of the course content.

Figure 17: Pilar Orero (UAB) during the recording session in Darmstadt

From the content point of view, the HBB4ALL Massive Open Online Course (MOOC) has two objectives. The content of the course will teach the many issues related to accessibility services for media content. In addition to that, the course interaction will be a demo on how to make MOOCs accessible. This is a timely proposal since existing prestigious MOOCs such as those from Harvard University and MIT have been sued for their lack of accessibility (http://www.nytimes.com/2015/02/13/education/harvard-and-mit-sued-over-failing-to-caption-online-courses.html?_r=0). The students will need to complete all the activities at an average of 2-3 hours per week. This MOOC has 4 lessons. Every lesson is divided into units, which have a recommended study time of approximately 30 minutes each. Throughout this MOOC learning will be autonomous, without the need to have peer-support. The content of the MOOC aims at

- Making students familiar with the basic concepts of media access services.
- Exploring fundamental techniques in the process of media access services.
- Introducing the professional process of media access services.
- Teaching the use of media access service technologies
- Realising audio description, subtitling and sign language workflows

All four units will have the same structure and will be organized as:

UNIT 1: Introduction to media access

UNIT 2: Subtitling

UNIT 3: Audio description

UNIT 4: Sign language

3.1.4. *Publishing & Delivery*

As depicted in Figure 12, the MOOC will be published via the vsonix CMS, whereas the video content will be delivered by the vsonix CDN. The content database of the CMS stores all the data and metadata needed for the MOOC as well as the MOOC application itself. The MOOC application is integrated and published using the vManager service component. The vManager has been designed to integrate entire webcast solutions including different functionality for interactive content access, user management, content search and retrieval as well as interactive user communication as a "micro-site". This micro-site can be integrated on a customer's corporate learning platform via an <iframe> or <script> tag while it is hosted and managed by vsonix.

In case of the MOOC, the integrated solution provides a number of functions for video lecture access via playlists, full text search on the lecture content, user access management, content related comments (in sync with video content) as well as a timely synchronized interactive question and answer module, which give learners the possibility to rehearse the content learned while consuming it. The web application (micro-site) for the MOOC hosted by vsonix will be integrated on the HBB4ALL website (www.hbb4all.eu), where it is available from March 2016. It already integrates all the accessibility features provided by the AccessGUIDE service and its user profile generation application.

3.1.5. *Reception & User Application*

The MOOC pilot already integrates a number of accessibility features for UI adaptation including personalizable font types, font size and colour schemes, features for subtitle personalisation including subtitle position, font size, transparency level of the subtitle background and multi-language support. Finally it also includes the personalised text-to-speech features provided by the service including the choice of speech gender and speed. In the following we will highlight some examples for UI and subtitle adaptation in the MOOC application.

Figure 18 illustrates how the MOOC application adapts to the user adaptation preferences. The side-by-side comparison yields how the application is capable of reacting to different font size requests and changes the playlist representation accordingly:

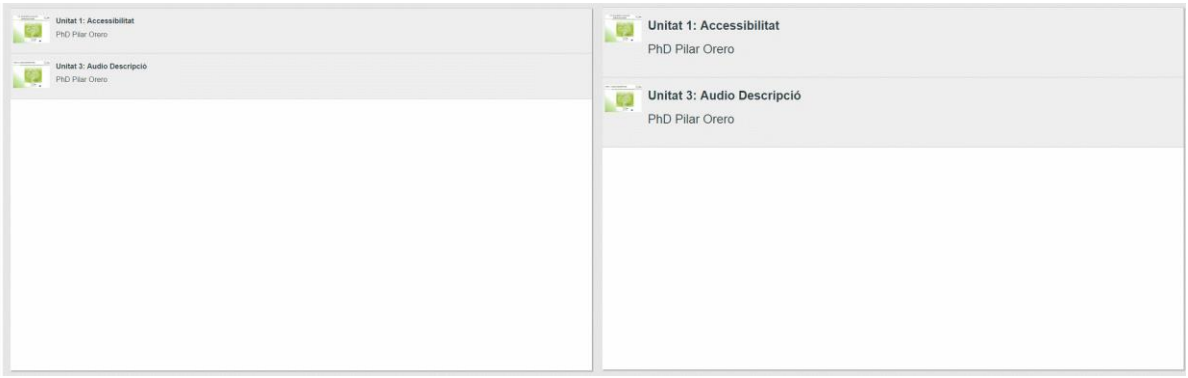


Figure 18: UI Adaptation performed in the MOOC based on the generated user profile

Figure 19 illustrates how vPlayer handles different user adaptation requirements. On the left vPlayer displays its natural colour scheme with standard subtitle font size. Subtitles are displayed in front of a semi-transparent background in order to not obstruct any of the information behind it. The subtitles are positioned at the bottom of the screen. The vPlayer on the right has been adapted by a user to use a high-contrast colour scheme and the subtitle display has been moved to the top of the player. Subtitle background has been changed to fully opaque by the user and the font size has been slightly increased in order to improve subtitle legibility.

Figure 19: Subtitle rendering options available in the MOOC

3.2. PPG NPO Video on Demand Showcase

NPO (Nederlandse Publieke Omroep) is a Dutch public broadcasting system that takes care of public service television and radio broadcasting. The NPO application is a video on demand service, which contents videos that have been broadcasted during the last 7 days on NPO1, NPO2 or NPO3. Besides the video on demand content, the app delivers also live television and radio broadcast. The app already included subtitles for most of the videos, so only the subtitle settings were necessary to improve the accessibility.

3.2.1. *Production*

Due to the fact that the user tests took place in Barcelona, Spain it was necessary to translate the application and merge an external video into the app. The app usually only contains videos with Dutch or English audio and Dutch subtitles. For the user tests we chose the HBB4ALL presentation video with Catalan subtitles, which is also available on http://www.hbb4all.eu. The audio of this video is partly in Catalan and partly in English. For the test purpose, we implemented the video into the NPO app in a way that it will always be played when the video player starts, regardless of which video is chosen in the app.

3.2.2. *Publishing & Delivery*

This application is a catch-up service from the Broadcast Corporation NPO. It gathers the video content including the subtitles from an API of the broadcaster. Most of the video content is geo blocked, which means that it's not possible to receive some data outside of the Netherlands. To avoid that, the appropriate IP-address must be whitelisted on beforehand. A comprehensive description of all functions of the application will follow in chapter 3.2.3.

3.2.3. *Reception & User Application*

The main navigation bar of the NPO application is at the bottom of the screen, see Figure 20. In HbbTV context, the app starts with the "Now" section [Nu] (Dutch), which shows the currently playing programs of the three NPO television channels. This section is not available in a SmartTV context. In a SmartTV context the application starts in the "Missed" section [Gemist], which has a top menu, starting with the "Highlights" section [Uitgelicht]. The "Highlights" section contains a grid with different video item and features has content-bleed to convey to the user that there is more content available than is visible on the current page.

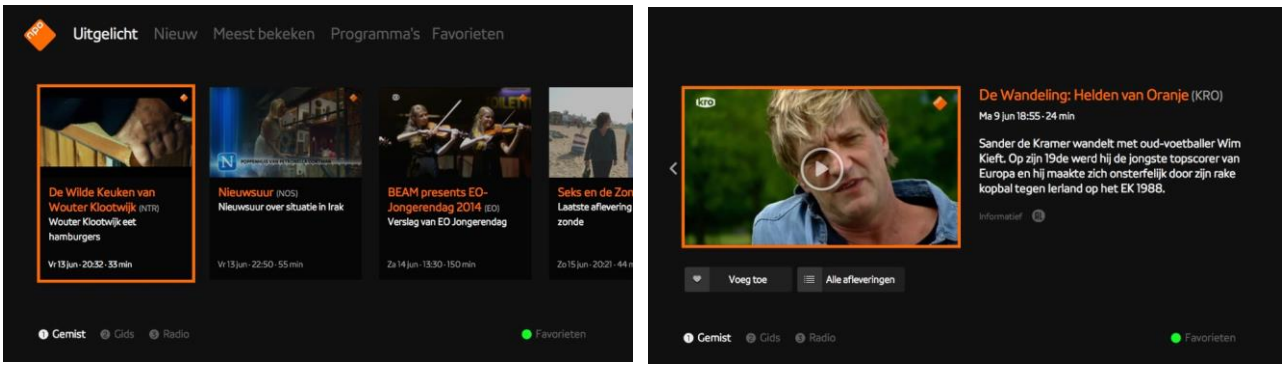


Figure 20: Content selection in NPO application

There are a few different top menu items (some of them include submenus), which offer video content by title, genre, date, popularity, or channel. It is also possible to add shows to the "Favourites" section [Favorieten]. The user is able to do this via the "Detail" page. Every video item has a details page that is shown to you after selecting it, which includes a thumbnail, the title, a short description, and other information about the show.

To start the video, the user needs to press OK when the thumbnail is in focus. The video starts playing in full screen. There will be some information shown at the top of the screen and a control bar at the bottom which features the following controls: stop, rewind, pause, forward, restart, favourite, and in case the video has subtitles available also a button with a capital 'T' to activate them. Below the controls a progress bar is shown, which displays the current position and the total duration of the video. The whole user interface will be hidden after a few seconds without pressing any button of the remote control and redisplayed if a button is pressed later. After a playback finished a few recommended items are shown (see Figure 21, right hand side).

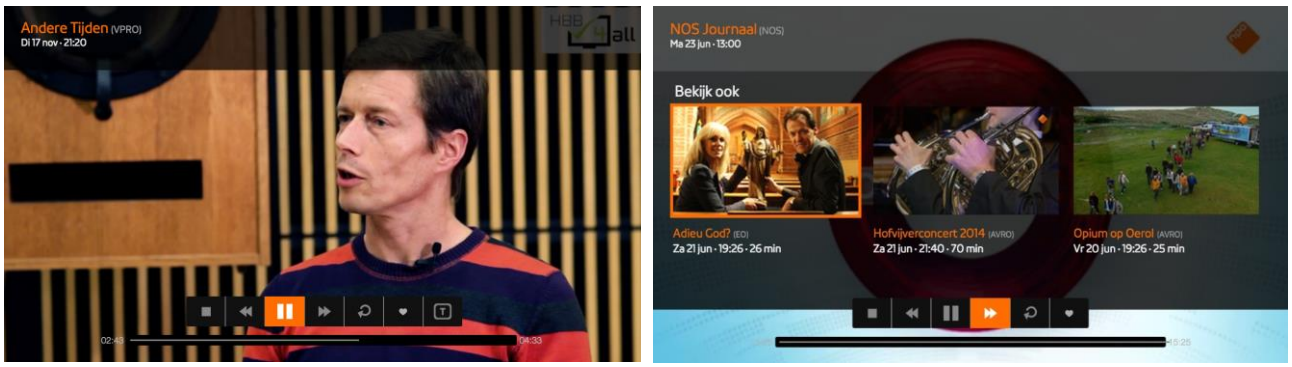


Figure 21: Content playback in NPO application

Another item of the bottom navigation bar is the "Guide" section [Gids], which is the EPG of items from today, see Figure 20. The grid shows the three NPO television channels with the previous, the current and the upcoming shows of the program. It is structured in such a way that items from the other rows (other channels) in the same time range appear next to the selected item. Furthermore, it can have content-bleed on both sides.

The last not already mentioned bottom navigation bar item is "Radio", see Figure 20. The Radio section screen includes all available Radio stations that offer a live audio stream (and optionally a live video stream).

Pressing OK over a selected Radio station will open the Radio station detail screen and play the audio stream.

We've added a subtitle settings screen to the application, which is reachable from the whole app (except of the video player) via the blue button on the remote control or the accessibility button [Accessibilitat] in the bottom navigation bar. The subtitle settings screen is responsible for adjusting the subtitle properties. If you play a video on demand after adjusting the subtitles, the subtitles of the video are customised according to preferences of the user (implied the subtitles are enabled in the video player control and the video has subtitles available).

3.3. SCREEN Teletext Showcase

3.3.1. *Production*

The prototype Teletext Showcase application is an HbbTV application created using Screen's Plasma Gold content publishing system. To more effectively focus on the concept of supporting adaptation of the service for different viewer's needs, the developed application contains predominantly text content. The overall design of the information service used in the initial expert user tests is based on real world applications that have been deployed by Screen's customers using the Screen Plasma Gold product.

A new HbbTV application was created specifically for the HBB4ALL project. To facilitate testing, the size of the application was minimised by having a single index page that allowed access to several stories. In practical deployments the structure of the 'information service' supported by the application would be expected to be significantly more complex, with multiple index pages and sub-indexes.

The application was created by the following steps:

1. Overall content structure design
2. Creation of pages for the news stories
3. Creation of a pages for the index
4. Importing the story text from external systems
5. Linking the stories to the index
6. Creation of the layout templates for the stories and index
7. Creation of 8 alternative layout templates for the stories and index to enable users to choose their colour scheme and text size preferences.
8. Creation of the presentation preference page outside of the Plasma Gold system to integrate with the AccessGUIDE API.
9. Linking all the pages in the application to the presentation preference page.

The first six steps are typical of the methodology used to create similar services within the Plasma Gold product. The additional steps 7 and 9 were necessary to create parallel / alternate versions of the content to support adaptation in accordance with selected user preferences – these were performed within Plasma Gold using its existing capabilities.

Step 8 was added specifically for this stage of the HBB4ALL project. The presentation page effectively directs the viewer into one of 9 parallel sets of content that is automatically generated and maintained by the Plasma Gold system. This is considered an 'interim' mechanism for selecting the required type of adaptation by the viewer, as it is anticipated that the selection of adaptation might be made automatic using 'stored

cookies' on the viewers device that have been created by using the AccessGUIDE framework in future developments of the showcase.

The alternative layout templates consist of the same information presented in a range of different text sizes and colours. There were 3 text sizes chosen, and 3 colour schemes, resulting in a total of 9 sets of templates. For this stage of the project this was considered an acceptable approach, but for a more complicated application it may be better to dynamically change the content using a combination of style sheets and JavaScript running in the browser on the set-top box rather than having content published in 9 parallel forms. However, the approach taken for the initial trials does provide the benefit of allowing a direct preview of the content (as would be seen by the viewer) when authoring, and does not rely upon features that may not be implemented in some viewer's set top boxes.

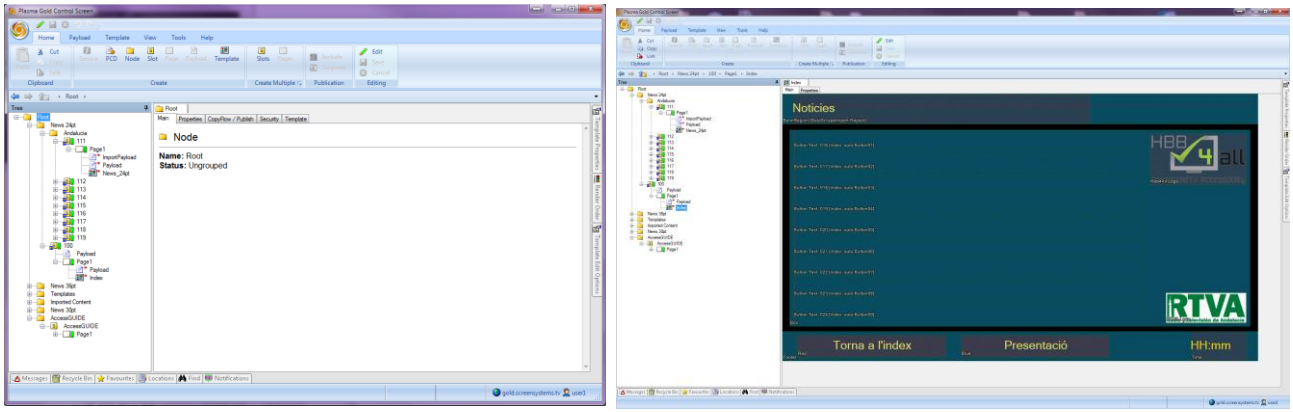


Figure 22: Application creation in Plasma Gold

For the initial trials the integration with the AccessGUIDE API was written such that a new user would initially be presented with the application in the default configuration. A returning user would be presented with the application with their previous preferences already enabled. Only part of the AccessGUIDE API integration was implemented for this application, but the implementation can be easily expanded as the application was written to allow the straightforward addition of other adaptation choices.

The user preference adaptation page was implemented as a grid of visual options to allow the user to choose their adaptation preferences. The grid presentation was chosen as parts of the full AccessGUIDE functionality were not a natural fit with the Plasma Gold system. A simpler integration approach was therefore necessary. If additional adaptation options are added to the showcase application it is likely that a more complex mechanism will be required to allow users to choose their adaptation preferences as the increased number of combinations would preclude the use of a selection based upon a grid presentation.

3.3.2. *Publishing & Delivery*

The Screen Plasma Gold system automatically generates a combined HTML, XML and JavaScript output and publishes the output to a web server. Each application designed within Plasma Gold may be delivered to a separate location, which can be different web servers, or different directories on the same server. For the showcase the output was published to a Microsoft IIS web server hosted in the cloud. This content typically would be continually modified during operation, even whilst the application is being accessed by end-users, but in the showcase the content was static as there were no automated data feeds connected to the Plasma Gold system. In addition to the teletext showcase application, Screen published a copy of a generic 'red button' application on the same web server to allow the end user to launch the application. In a practical

implementation the ‘red button’ application is associated with the broadcast channel, and is used by the viewer to select which application to launch if there is more than one available.

3.3.3. *Reception & User Application*

From an end user point of view the teletext showcase provided by SCREEN contains the UI adaptation mechanism provided by the AccessGUIDE service. This includes features such as font size, font type and colour. The screenshots in Figure 23 show the different variations of the user interface based on the underlying user profiles.

Figure 23: UI adaptation in teletext

4. Service pilots

In the following we will give an overview on the service pilots that are targeted by Pilot-C and on which we have worked within the first two periods of the project. Those pilots include the AccessGUIDE, which usability and accessibility aspects have been examined in focus group discussions and two user tests (see chapter 5). The AccessGUIDE application was developed as a near to production prototype, whereas minor adjustments are planned based on the results of the user tests for the last year of the project.

The online service for UI adapation has been integrated in the MOOC sub-pilot provided by vsonix in collaboration with UAB as well as the two HbbTV showcases by SCREEN and PPG. In the following we will describe the two sub-pilots, AccessGUIDE and MOOC, which together will be published as an online service from the beginning of March 2016. In addition we report about the HbbTV showcases provided by PPG and SCREEN.

4.1. Access GUIDE Evaluation

As described in chapter 2.1., the AccessGUIDE is the frontend of the UI adaptation service that is provided by vsonix based on the GUIDE framework. It was re-designed taking into account the results of the focus group discussions taking place in September 2014 as well as the early user tests taking place in January 2015.

The application provides a number of standard-tests to determine the user's preferences / needs related to UI personalisation including parameters like font size, font type, UI contrast and colour as well as screen reader parameters such as voice gender or speed of speech output. AccessGUIDE was intended to be a standard online application for UI personalisation on PCs, mobile, and HbbTV platforms. It can be used by application developers as part of the UI adaption service to determine the accessibility needs / UI preferences of their users. It already supports UI and subtitle adaptation as well as preferences for a support text-to-speech service. The concept of the AccessGUIDE could be extended to other modalities as those targeted in the project such as personalized audio rendering (Pilot-B) and signing (Pilot-D).The AccessGUIDE was an important component to be tested by users from the target groups in terms of accessibility and usability and as such acts as an integrated pilot to be used in conjunction with the other service pilots.

4.1.1. *Status of work*

The AccessGUIDE application was readily developed as a near to production prototype. It was successfully tested by vsonix in corporation with UAB with the target group including visual and hearing impaired users from all ages. Based on the results of the main user tests that took place in September 2015, the AccessGUIDE application will be refined before it is published in March 2016 as part of the MOOC online learning service. It will be available via the HBB4ALL website.

4.1.2. *Timeframe*

The near to production prototype of the service was realized until August 2015. It was successfully tested in September 2015. At the moment refinements are ongoing before the service will be launched in March 2016.

4.1.3. *Test users and evaluation approach*

The targeted users are mainly mild to moderate visual and hearing impaired users that can use the UI adaptation service for personalised subtitles, improved personalised UI accessibility as well as personalised screen reader functionality e.g. for blind users. The evaluation has been made in a number of user tests conducted by UAB (see chapter 5.1 and 5.2). The final evaluation will be done based on online questionnaires via the HBB4ALL website (www.hbb4all.eu) addressing those users that access the service.

4.2. MOOC Service on Media Accessibility

vsonix has worked on the video based learning application ("MOOC"), which is planned to be provided as webcast service via the HBB4ALL website. The content was produced in English. There will also be German, English and Spanish subtitles available. The MOOC acts as a cross-pilot showcase addressing Pilot-C and Pilot-A. It integrates the AccessGUIDE UI adaptation, personalised subtitling and screen reader capabilities.

From a technical point of view, it integrates a variety of functions including lecture content playback, user access and profiles, functions for social communication as well as functions for content related learning assessment. The content of the MOOC showcase was developed by UAB in corporation with vsonix. The goal was to provide an online course for media accessibility. The course consists of a number of lectures addressing different aspects of media accessibility. The MOOC service was integrated using software components developed by vsonix including vPlayer, a Flash and HTML5-based webcast player that is capable to playback lecture and presentation content as well as vInteract, a software component that provides functions for social interaction including messaging, chat, and voting functions. The MOOC will be hosted via vsonix' content delivery network (CDN).

From a content perspective, UAB has prepared a series of lectures that have been and will be further recorded by UAB and vsonix to be used in the MOOC. The course will introduce students to the principal systems ensuring accessibility to these content and services. On one hand, linguistic accessibility aimed at those who do not understand the original language will be provided through techniques such as dubbing, subtitling and voice-overs, traditionally studied in the context of audiovisual translation. On the other hand accessibility will be explained alongside with how captioning for the deaf, audio description or audio subtitling allows people with hearing or visual disabilities to access audio-visual content and services. Content and media services are becoming increasingly important in our society, whether in traditional settings such as television or film or in environments such as the internet. The MOOC will try to address this importance by proving an overview on the current state of the art in media accessibility for all interested parties including service providers and application developers.

4.2.1. *Status of work*

As described in chapter 3.1 and 3.2, the different components of the Massive Open Online Course (MOOC) service including vPlayer and vManager were implemented and tested within the WP5 user trials (see chapter 5.2). The MOOC sub-pilot already integrates the accessibility features exposed by AccessGUIDE. A significant part of its content was produced by vsonix and UAB. The MOOC pilot is nearly production ready. It will be further refined in the next months based on the feedback we gained from the user trials in September 2015.

4.2.2. *Timeframe*

The MOOC application integrating the AccessGUIDE application for UI and subtitle personalisation has been integrated in a first complete version that was ready at the beginning of July 2015. This version is being tested at the time of writing and refined to be prepared for the final user tests that will take place in September 2015.

Based on the test results, further refinements will be made before the MOOC service is operational, including the video course on media accessibility, which will go online in March 2016. The content of the MOOC has been produced to 50%. The production will be finalised at the beginning of December 2015.

4.2.3. *Test users and evaluation approach*

As for the AccessGUIDE, the target group for the test users were mild to moderate visual and hearing impaired users that can benefit from the UI adaptation service. The evaluation has been made in a number of user tests conducted by UAB (see chapter 5.1 and 5.2). The final evaluation will be done based on online questionnaires addressing those users that access the service via the HBB4ALL website (www.hbb4all.eu)

4.3. Teletext Showcase

Screen intend to support the objectives of WP5 by continuing to develop the concept of user adaptation as supported by the web based UI adaptation and personalisation service to HbbTV related products within the Screen product range. Screen intends to deploy a web based simulation of the adaptive user interface experience (supporting emulation of HbbTV devices by using a compatible browser) and will support any broadcaster participating in the HBB4ALL projects who wish to deploy adaptable services within their HbbTV demonstration channels. Screen also offer to support standalone small scale HbbTV demonstration systems for focus group testing by the non-broadcast partners in the HBB4ALL project.

Screen anticipate supporting further authentic user trials that incorporate ‘real data’, including information services, news and weather, but the availability of this data is subject to the agreement of non-project partner organisations to supply the necessary information services. It is hoped that other interested organisations with a specific accessibility orientation (e.g. RNIB, RNID) will make material available to supplement the information service aspects.

4.3.1. *Status of work*

Screen have successfully developed, deployed and tested an initial HbbTV application that integrates with the AccessGuide framework and that provides adaptation of presented content in two axis of adaptation: font size and font colour (contrast). This application has been deployed for limited user acceptance trials.

4.3.2. *Timeframe*

Screen plan to develop the current HbbTV application as follows by M30:

- Add support for additional types of adaptation (font face, transparency/background, language, layout etc.). As previously identified, the current implementation creates duplicate sets of content for each adaptation combination… additional adaptation types would require a different approach to supporting the adaptation by using styling features in the browser software of the viewers device.

- Improve support for the AccessGUIDE user profile mechanism. The current implementation uses just the AccessGUIDE server to store the viewer's preferences. The current AccessGUIDE profiling application cannot run on an HbbTV device. PPG has already produced a version of the profiling application that will operate in an HbbTV environment. Screen proposes to link to this implementation from our Teletext Showcase application.

- Extend the content available within the application to provide additional content, including 'real live data'. The current implementation of the Teletext Showcase does not include live data or any media content (pictures or video). It is proposed to add media content and (dependent upon availability) live data to the showcase and to consider appropriate adaptation concepts for this media.

- Investigate adding speech-to-text functionality to support 'speaking' of the highlighted item within the Teletext Showcase. This would involve the pre-generation of speech fragments in the Plasma Gold system that would be played out at the HbbTV device when selected by the viewer.

- Deploy the developed HbbTV application on a website, allowing experimentation and tests of the application without requiring a full broadcast chain.

4.3.3. *Test users and evaluation approach*

Screen proposes to functionally test these improvements to the Teletext Showcase using the application deployed on a website as an 'emulation' of an HbbTV viewing experience. It is anticipated that other partners in the project will use this website to test the reception of the additional adaptation types within HBB4ALL.

4.4. NPO Video on Demand Showcase

4.4.1. *Status of work*

The NPO application pilot was selected as the NPO is an EBU member and the NPO app has a big market share for HbbTV in the Netherlands. There are opportunities to re-use learnings from this project to improve accessibility of VoD content for the production version of the application.

After integration of the AccessGUIDE into the app, usability tests were executed, the results of which are reported in section 5.2 of this report. The findings of will be used to prepare a proposal for the NPO for actual integration of improved subtitle accessibility to the NPO production environment.

4.4.2. *Timeframe*

Q2 2015: Assessment of AccessGUIDE framework with vsonix

Q3 2015: Integrating the AccessGUIDE framework into the NPO App

Q4 2015: Usability tests using the NPO Showcase App

5. Complementary User Tests

In the following we will describe the results of the user tests that were organized for WP5 in the second year of the project. We will also describe some early user trials (chapter 5.1) as well as the main trials (chapter 5.2) that were organized to test the AcccessGUIDE application, the integrated MOOC pilot by vsonix as well as the two HbbTV showcases provided by PPG and SCREEN.

5.1. Early User Tests (January 2015)

5.1.1. *Objectives*

After completing the re-design based on the expert group discussion performed in the first year of the project, we performed a user test for the AccessGUIDE application prototype (see chapter 2.1). In this test our aim was to identify all serious usability issues in the concept to prevent making unreasonable steps in developing the project.

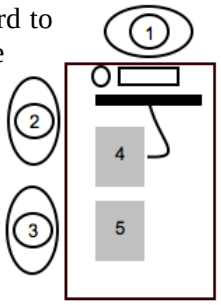
5.1.2. *Methodology*

After having collected information in the first test carried out with the experts, the end user tests were performed for the AccessGUIDE application. With the feedback obtained from the experts, vsonix' designer developed a clickable prototype for testing. The aim of the test was to improve aspects related to organisation, inclusion and exclusion of selected steps (discussed in the expert focus group) and to test the first implementation built by vsonix.

The tests were conducted at UAB facilities in Barcelona on January 23th and 30th 2015. The participants arrived at a previously agreed time in 30-minute intervals.

Individual interviews were carried out and after some general and demographic questions, the users were able to use the clickable prototype of the application. Once they finished exploring its different options, participants answered the System Usability Scale (Brooke 1986) questionnaire. Finally, an open interview took place concerning the organisation of the steps in the application configuration process and inclusion or exclusion of certain app features. Aim of that interview was to collect general opinions about the app design as well.

The application was displayed using the Chrome browser running in a 24 inches external screen on MAC OSX Yosemite 10.10.1. The participants used a standard PC mouse and keyboard to avoid any differences in answers if they were used to using a PC. The layout during the interview is shown in Image 1.



Layout. 1: user. 2: interpreter. 3: researcher. 4: display laptop. 5: recording laptop.

To obtain more information on the visually impaired participants, the last set of questions was asked in a group. Thanks to that, we were able to gather more data from the discussion regarding different aspects of the application.

Participants were 6 men and 9 women, aged 24 – 69, with 11 of them hearing impaired and 4 visually impaired. All the participants use the internet at least 2h a day, most of them use it half of the time at their workplace and the other half for leisure. The majority of participants stated that they use Video on Demand (VoD) services occasionally, but at the same time complained that many web pages do not offer appropriate accessibility services that would enable them to consume the content. When asked about the expectations they have towards the application in

general, they said to hope that this application grants them access to the content. Blind people experience trouble with the web interfaces and for them it is complicated to locate the content in the web environments. Specifically, some of them answered that they expect the application to help them personalise specific parameters of the subtitling.

5.1.3. *Results*

The results of the tests are presented in the next table. The answers are coded on a scale ranging from 1 to 5, where 1 stands for "strongly disagree" and 5 for "strongly agree". The mean of all the answers for each question is shown.

	System Usability Scale	M	SD
1	I think that I would like to use this system frequently	4.53	.74
2	I found the system unnecessarily complex	2	1.41
3	I thought the system was easy to use	4.75	.46
4	I think that I would need the support of a technical person to be able to use this system	2.07	1.44
5	I found the various functions in this system were well integrated	4.53	.92
6	I thought there was too much inconsistency in this system	1.47	.64
7	I would imagine that most people would learn to use this system very quickly	3.53	1.25
8	I found the system very cumbersome to use	2.07	1.53
9	I felt very confident using the system	4.73	.59
10	I needed to learn a lot of things before I could get going with this system	1.87	1.51

Table 4: Test results of early user tests

General considerations

From the discussion some general considerations regarding the design and the content of the application were pointed out.

1. **Sidebar menu improvements:** The current sidebar menu is not displaying the current step the users are in. Moreover, there are some sub-options missing. When the users are in a specific step, the menu should open and display the sub-options and the current position of the user in the configuration steps.
2. **Font weight:** Some of the participants (mainly those with hearing problems, but some with visual impairments as well) asked for the option of having the subtitles in bold.

3. **Default settings options**: Some of the participants asked for a button to return to default options in case they want to revert the changes.
4. **Making the interaction points more visible:** It is necessary to make different sliders more visible and to make the buttons of these sliders bigger. Many participants had problems with understanding that they could change the options by dragging the sliders. Also, many had problems with clicking on the sliders to move them.
5. **Adding indicators on the sliders:** The icons indicating the side to which the slider has to be moved in order to make the text larger or smaller should be placed on the extremes of the sliders.
6. **Confusion with display visualisation options:** Many participants did not understand that the first steps in the configuration process were meant to change the visualisation of the application and web interface. This was partially solved in the next iteration tested on the second day by making the changes affect the application display right away. This quick fix was applied only to font size, but it needs to be applied to transparency and contrast settings as well.
7. **Reorganising the profile creation:** Some participants complained that the profile creation step was placed in the middle of the process. They suggested moving it to the final step when all the options are set and the only thing left is to save the configuration.
8. **Tutorial and support:** In general, the users think the application is easy to use, but many of the elderly participants asked for a tutorial or a "How-To Guide".
9. **Feedback options:** The participants suggested that once the app is implemented, a general feedback forum or questionnaire would help them acknowledge the site developers if any problem arises or if there is anything to improve in the app.
10. **Explanation of the display adjustments:** To avoid unnecessary changes made due to the lack of knowledge of the users, some additional instructions seem to be needed, e.g. *"These changes will affect the web interface. Change them with caution as they will modify the layout of the web page you are on"*. This may be fixed when the changes the users make in the display visualisation options take place live on the display of the application itself (as defined in Issue 6).
11. **Explanation of the colour selection step:** Many participants misunderstood the colour modification step. They thought that this step was an option to change the contrast when the combinations of colours were presented. Many of them, even if they saw the colours perfectly, changed the configuration. Some of them even eliminated the colours. This may also be fixed when the changes the users make in the display visualisation options take place live on the display of the application itself (as defined in Issue 6).

Hearing impaired users

12. **Menu with sign language:** There are many differences among the hearing impaired population regarding their reading and writing skills. Many of them may have problems following and understanding long texts or explanations. The participants think it is necessary to add a sign language interpreter for the introduction and possible tutorials or help material that are to be developed for the application.
13. **Personalisation of the sign language display:** Many participants with hearing problems asked for the possibility of personalising the display of the interpreter. Although this is technically impossible, it has to be noted that almost all users asked for it.

Visually impaired users

14. **Contrast in the left menu:** The contrast on the interactions areas was fixed between the first day and the second day of testing. The "next" and the "help" buttons were modified in order to display more contrast between the letters and the background. The same change must be introduced in the sidebar menu so that the visually impaired users could see different options not only when modifying the contrast and transparency options, but from the beginning.
15. **Subtitle reading engine:** During a focus group discussion, visually impaired users suggested using a text to speech engine to offer spoken subtitles. This option could be implemented in the audio section.
16. **Clear separation between audio description and text to speech options:** Now audio description can be activated under the audio options. This *per se* is not a problem, but it needs to be clarified that the first two options (voice choice and voice speed) are for the text to speech engine and not for the audio description.

5.1.4. *Final Considerations*

In general, the users expressed positive opinions about the application. It managed to fulfil the participants' expectations and, in some cases, it even exceeded them. Among the people with hearing impairments the problem was that some of them do not have good reading skills so they prefer to have long texts and explanations translated into sign language. Kids and the elderly, for example, are the most likely to have trouble comprehending content if it is not displayed in such a way.
Visually impaired users declared that the idea of having the audio on/off option at the beginning of the configuration process could be quite useful. That is because some of them use screen readers or screen zooms. Apart from that, the users were really excited about the subtitle size option. They consume foreign language materials and with this function they think they would be able to access this content more easily.

5.2. Main user trials (September 2015)

5.2.1. *Objectives*

The aim of the trials was to test the integrated prototype of the AccessGUIDE application in three different application environments, including the MOOC application running on a desktop computer as well as two HbbTV based TVs, one running the NPO VoD service and the other running the teletext application provided by SCREEN. The results are going to reveal the problems users may encounter as well as the overall utility and efficiency of the application.

5.2.2. *Methodology*

The tests were conducted at UAB facilities in Barcelona on September 13th - 16th. The participants each arrived at a previously agreed specific time. The test consisted of the think aloud method with some variations due to the impairments that participants have. Ecological testing setups are going to be placed in a controlled environment.

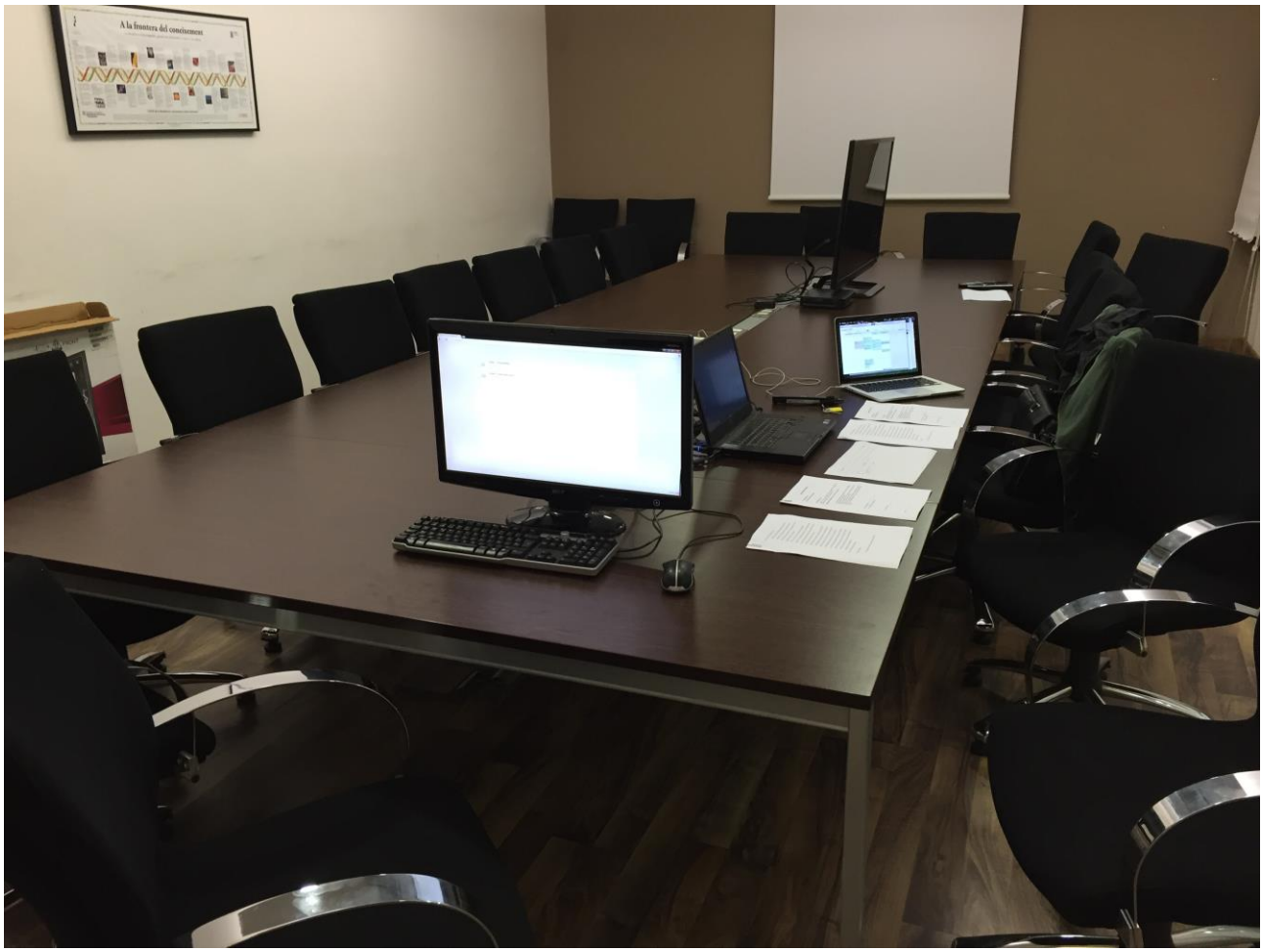


Figure 24: Test setup for MOOC test

For the desktop version of the MOOC, the application was displayed using a Chrome browser on Windows 7 running in an external 24 inch wide screen. The participants used a standard PC mouse and keyboard. The layout during the interview is shown in the image above. The HbbTV applications were presented in a 47 inch wide TV connected to a set-top-box with a redirection to both apps.

Finally, the System Usability Scale was administrated so we could compare the results with those of the first test and assess the changes in the application. This scale constitutes 10 statements which the participant has to rate on a scale from 1 to 10. The administration of this scale was done orally or with signed language to avoid comprehension problems. The participants had a piece of paper placed in front of them with the numbers to help them visualise the scale and respond accordingly. The participants were 4 men and 6 women, aged 25 – 65, with 8 of them hearing impaired and 2 visually impaired. All the participants use the internet at least two hours a day,most of them use Video on Demand (VoD) services in the PC and half of them use VoD via TV as well.

5.2.3. *Results*

5.2.3.1. MOOC (Desktop Application)

The MOOC application started in a course selection page. For the blind people the fact that in the index page there is no way of accessing the application was a problem. In order to be able to navigate they need to configure the display options from the very beginning. Once they are able to configure the display options they valuated them very positively. The group of participants with visual impairments was able to navigate correctly and faster with the personalised interface.

Once they entered the videos the main problem was to find the AccessGUIDE application. Only a couple of the participants intuitively went to the bottom corner and found the app, but most of them needed help to recognise where it was. Once inside the app, some of them had problems realising that the app was displayed. The complexity of the display with the app and the MOOC running in the background distracted them. A separation between the accessibility app and the background needs to be implemented to avoid this confusion in the future.

Display Options

All the different display options were understood correctly and clearly by the users. They valuated them positively and did not consider any option that was not in the app. The only problem all of them mentioned was that the text size modifier should affect also the icons on the video control screen. The play, volume, and accessibility app button should change size when the user asks to enlarge the font size. Ultimately, a reference to what is the standard font size should be clear in case the changes need to be reverted.

Subtitle Options

The group of deaf users appreciated the implementation and improvements done in the app. Some of the users did see the previous iteration and congratulated the changes. All the participants found all the steps correctly and did not advise adding or deleting any of them. The problems detected in this section were involving the example display and the instructions. First of all, the example display was cut instead of being displayed completely. That generated confusion regarding the relative size of the subtitles on the screen. Finally, the fact that the instructions were embedded in the example subtitle generated confusion. It took a while to some of them to realise that the instructions of what they were supposed to do were written in the example subtitle.

Speech Options

As we mentioned in the beginning, the main problem of AccessGUIDE application was that it should be available already from the index page. Apart from that, the participants did not consider necessary the expansion or reduction of possibilities offered by the app. The only less important option reported was the gender of the TTS system, which some of the participants reported could be omitted. Another observation made concerned audio speed, where the extreme of the lower speed can be cut tree points while the faster speed can remain as it is. The current configuration outputs an unnecessary slow audio.

Overall results

	System Usability Scale	M	SD
1	I think that I would like to use this system frequently	4,86	0,38
2	I found the system unnecessarily complex	2,14	1,07
3	I thought the system was easy to use	3,71	1,38
4	I think that I would need the support of a technical person to be able to use this system	1,57	1,13
5	I found the various functions in this system were well integrated	4,57	0,79
6	I thought there was too much inconsistency in this system	2	1,29
7	I would imagine that most people would learn to use this system very quickly	3,29	1,50
8	I found the system very cumbersome to use	1,86	0,90
9	I felt very confident using the system	4	1,41
10	I needed to learn a lot of things before I could get going with this system	2	1,41

Table 5: Test results of the MOOC trials

5.2.3.2. NPO VoD Showcase by PPG

The implementation on the HbbTV application addressed the subtitle personalisation aspects of the app. To access the application, the participant had to navigate to the "Accessibilitat" button or press the blue button. The participants used to the TV intuitively managed to access the personalisation app, but the ones that were not that used to the TV took a while. Nevertheless they rated it as easy to access and attributed their own performance to the lack of use.

Once in the application some navigation problems were detected. The participants had problems determining their position in the application between the tree levels of menus, so a more salient way of highlighting the current position of the user needs to be implemented most importantly for the app menu. Moreover, a problem with the adjust buttons was detected: When you reach the maximum value in the enabled scale, the cursor goes down or up to the contrary button. That provokes a problem because if you don't realise, you keep pressing and the app is doing the opposite of what you desire.

Contrary of what they reported in the desktop app, in this version of it no one complained about having the instructions embedded as a subtitle. Everyone realised what it was expected for them to do. They also acknowledged the bigger preview window, where all the video was displayed. That minimised problems between what they saw in the personalisation app and the final result of the personalisation visualised in the video itself. Finally, some of them did not agree on the "T" option in the menu displayed above to be the button to turn on and off the subtitles. Some were expecting the button to redirect to the app, their argument being that to turn on and off the subtitles you should have the subtitle button on the remote control.

Overall results

	System Usability Scale	M	SD
1	I think that I would like to use this system frequently	5	0
2	I found the system unnecessarily complex	2,33	1,21
3	I thought the system was easy to use	3,83	0,98
4	I think that I would need the support of a technical person to be able to use this system	1,50	0,84
5	I found the various functions in this system were well integrated	4,50	0,55
6	I thought there was too much inconsistency in this system	2,33	1,21
7	I would imagine that most people would learn to use this system very quickly	3,50	1,05
8	I found the system very cumbersome to use	1,67	0,82
9	I felt very confident using the system	4,33	1,21
10	I needed to learn a lot of things before I could get going with this system	1,33	0,52

Table 6: Test results of the NPO VoD trials

5.2.3.1. Teletext Showcase by SCREEN

The application consisted of a news reading service with a screen personalisation option. The access to the personalisation options was simple and all the participants were able to access it without help. In a first impression none of the participants realised that apart from the colour scheme of the app, the font size was changing as well from option to option. Most of them argued that a dial option like the one in the desktop or the VoD app version would have been better. Moreover, a rethinking of the available colour combination needs to be done. The users liked having tree options to choose from but the colour combinations of those options need to be more standardised.

5.2.4. *Overall Remarks to User Trials*

Overall we can say that the users find the application really useful and like the implementations. The general mood of the participants once they had some hands-on experience was positive. We had people with different levels of experience in the use of computers or SmartTVs and they all had a positive experience. That said, participants reported all the details that need to be improved. There still is work to do regarding the implementation of technologies for blind people even though users report that the application itself is easy to use and helpful. In the MOOC application there are some serious improvements required in order to make it completely usable for them.

In conclusion, we could say that the application with some minor improvements is ready for the deaf and hard of hearing user group as well as for people with a mild vision problem. For the blind and for people that require the assistance of a screen reader to navigate, there is yet some modifications to be done.

5.3. Online Questionnaires (February 2016)

Before the MOOC will be available online, vsonix and UAB prepare the final user evaluation of the MOOC and the AccessGUIDE service based on online questionnaires. Those will be available for all registered MOOC users from the moment the course is available online until the end of the project.

5.3.1. *Objectives*

After the release of the application in the intended platform, a recollection of user feedback will be implemented. The objective of this last part of the user tests is to ensure that the corrections and implementations made in the application are indeed correct and suitable for all the users.

5.3.2. *Methodology*

To assess the objective of the last user tests we are planning to use a quick feedback questionnaire. To gather information of as many users as possible we need to make the data recollection as easy and smooth as we can, so the users agree to let us know their opinion. In order to do so we are going to introduce a question that will appear at the end of the user interaction with the application. A Likert scale with 4 points will be displayed, and 4 icons and supporting text will represent 4 different levels of usability. If the participant clicks on any the two icons representing poor usability a text box will appear where the participant can enter feedback regarding which problems they found while using the application.

6. Conclusions

Concluding it can be said that Pilot-C is well advanced, whereas all objectives defined in the DoW have been met for the first two periods of the project. This also includes the technical goals such as the provision of the online UI adaptation service based on the GUIDE framework and its AccessGUIDE user profile generation application. In addition vsonix, PPG, and SCREEN have collaborated together on the realisation of the HbbTV version of the UI adaptation service that was integrated by PPG and SCREEN in their respected showcases. For the NPO showcase the findings of the project will be feed back to NPO for the integration of improved subtitle accessibility to the NPO production environment.

Within the final period of the project vsonix will refine the AccessGUIDE service as well as the MOOC application based on the results of the main user trials. This will be done before the online course on media accessibility is published via the HBB4ALL website. The envisaged date for the publication is March 2016.

Regarding the course content, 50% percent have been produced so far, whereas the rest of the course content will be produced within the first weeks and months of the final project period by UAB in collaboration with vsonix.

Before the MOOC is made available online, vsonix and UAB will prepare the final user evaluation of the MOOC and the AccessGUIDE service based on online questionnaires. Those will be available for all registered MOOC users from the moment the course is available online until the end of the project.

7. References

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