Project no.: INFSO-IST-045515

Project acronym: EASY LINE+

Project title: LOW COST ADVANCED WHITE GOODS FOR A LONGER INDEPENDENT LIFE OF ELDERLY PEOPLE

Instrument: Specific Targeted Research Project

Thematic Priority: Information Society Technologies (2002-2006)

D5.3 Report with a description of the support performed in WP4 and the description of the tests carried out and their results obtained v2.0

Due date of deliverable: 03/01/2009 Actual submission date: 03/31/2009

Start date of project: 01/01/2007 Duration: 30 months

Project co-funded by the European Commission within the Sixth Framework Programme (2002-2006)		
Dissemination Level		
PU	Public	X
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	

Document History

Version	Status	Date
Version 1.0	M. Lindemann circulated draft for comment	06/11/2008
Version 2.0	M. Lindemann circulated document • Modification of Chapter 1 “Introduction” • New Chapter 3 “Accessibility workshops” • The procedure for assessing applicability (originally included in Annex I) is now modified and presented as Chapter 2.5 "Procedure for assessing applicability". • Revision of Chapter 4 “Conclusion”	03/31/2009
Version		
Version		

Author/s: Matthias Lindemann

Keywords: Accessibility Guideline, requirement specification, checklist, support, applicable, full compliant, accessibility workshop, user interface

Abstract: This document contains a practice-oriented Accessibility Guideline for the user interface development. The report also includes a developer checklist for the measurement of the implemented accessibility features. Furthermore the report describes the specific support for WP4 that was performed during the accessibility workshops in October 2008 in Paderborn.

TABLE OF CONTENTS

1. INTRODUCTION

The number of people using information and communication technologies (ICT) equipment and services, which combine hardware, software, and network technologies, is increasing, as is the variety of ICT equipment and services. The everyday lifes are filled with these equipment and services.

This guideline can help developers to enable ICT equipment and services to be used by the widest range of people regardless of their abilities and disabilities, limitations and culture. It can help to ensure access to ICT equipment and services by persons with temporary disabilities, as well as those with permanent disabilities.

Because aging can cause increased disabilities that may create a barrier to access to ICT equipment and services by older persons, access to such equipment and services by older persons is important.

With regard to this challenge C-LAB provides work package 4 with an Accessibility Guideline to further the development of the user interface. This guideline is based on the practical knowledge of the accessibility experts of C-LAB, on the user requirement specifications and on international accessibility standards.

C-LAB also supports work package 4 with a specific developer checklist that acts as a measuring instrument for the verification of the implemented accessibility features of the user interface.

The guideline and the corresponding checklist ensure the consideration of accessibility requirements during the whole cycle of the user interface development.

Moreover, C-LAB performed two all-day accessibility workshops to gather important information for the coming accessibility tests of the user interface. The practical workshops took place in October 2008 in Paderborn and 42 elderly people (personal carers included) took part in the workshops.

The important results of the workshops will significantly influence the next stage of the user interface development in terms of accessibility design factors that fit the specific needs of blind and visually impaired users.

2. PRACTICE-ORIENTED ACCESSIBILITY GUIDELINE FOR ICT DEVELOPERS

2.1 Scope

This guideline is intended for use by those responsible to plan, design, develop and evaluate information and communication technology (ICT) equipment and services. It provides recommendations to improve the accessibility of ICT equipment and services. Equipment and services following this guideline will have wider accessibility for use in home environments. This guideline covers issues associated with designing equipment and services for people with a wide range of sensory, physical and mild-cognitive abilities, including the elderly people.

2.2 Recommendations related to user characteristics

ICT equipment and services are generally designed for a limited range of contexts of use. Accessibility is only achieved when the ICT equipment or service is designed to take sufficient account of the goals, abilities and limitations of users and supports successful interaction. Factors that may limit accessibility arise from one or more components of the context of use (i.e. the user, task, equipment and environment) and interactions between them. ICT equipment and services developed for a limited range of contexts of use risk having more accessibility problems than systems developed for a wider range of context of use.

ICT equipment and services shall be operable by people with widest range of capabilities.

2.2.1 Vision

2.2.1.1 Users with no vision

ICT equipment and services shall support intended users who do not have vision. Some people may not be able to utilize vision due to environmental conditions.

Information shall be provided by sound whether or not connected by a visual presentation.

Individuals who have learned Braille can take advantage of software and hardware that will provide “screen readers” which will produce Braille output. Those who become blind later in life are less likely to learn such specialised skills however they might learn some new auditory skills and thus might rely on additional, simple or more special auditory methods to obtain information.

Since many users with no vision read screens by means of synthesized speech output, they might find it difficult or impossible to attend to auditory outputs that occur while they are reading.

The capability to navigate in an audible environment among controls and display objects shall be provided.

Navigation which is based on understanding a spatial metaphor or seeing graphically represented objects disadvantages users with no vision.

Location and function information about controls and display objects shall be provided by auditory and/or tactile means.

Users shall be allowed to control focus, navigation and other functions by keyboard, voice or other non-visual mechanisms.

Interface mechanisms shall be provided to support assistive technology devices.

Many users with no vision interact with systems through “screen readers”, i.e. assistive software that can provide spoken or Braille information for windows, controls, menus, images, text and other information typically displayed visually on a screen.

2.2.1.2 Users with limited vision

ICT equipment and services shall support intended users with limited vision.

The capability to adjust the size of displayed text, task related character fonts, icons, and other user interface objects shall be provided.

The capability to adjust the contrast of displayed user interface objects shall be provided.

The capability to magnify (or enlarge) portions of the screen or display shall be provided.

Standard interface mechanisms shall be provided to support assistive technology devices.

Common assistive technologies include the use of oversized monitors, large fonts, high contrast, and hardware or software magnification to enlarge portions of the display.

An option that provides for light user interface objects on a dark background (i.e., a negative polarity colour scheme) shall be provided.

Some users with limited vision find white backgrounds to have an extreme amount of glare and prefer the negative polarity presentation.

2.2.1.3 Users with limited colour vision

If the colour is used for coding, additional coding such as shape, position, or text labels shall be provided (so that colour is not the sole method of coding), e.g. an emergency stop knob, which is coloured red, shall also be labelled “emergency”.

2.2.2 Hearing

All verbal information also shall be provided in visual form.

2.2.2.1 Users who cannot hear

ICT equipment and services shall support intended users who cannot hear. Verbal information can be provided by icons and common symbols, text format or “Show Sounds/Captions” features that notify software to present audio information in visual form.

Alarms and critical event notification (that are normally presented in auditory form) shall be presented visually using appropriate highlighting techniques.

Where voice input is used to activate a process, alternatives such as keypads or the use of video monitoring shall be considered.

Standard interface mechanisms to support assistive technology devices shall be provided.

2.2.2.2 Users with limited hearing

ICT equipment and services shall support intended users with limited hearing.

The capability to increase and decrease the volume of any information presented in auditory format shall be provided. This is particularly important in noisy environments.

The capability to adjust the frequency of non-speech sounds shall be provided where appropriate to the task. Where this is not possible, consider using frequencies that are not in the higher ranges.

The capability to obtain verbal information in a visual form shall be provided.

Interface mechanisms to support assistive technology devices shall be provided, e.g. the receiver on a telephone is compatible with hearing aids.

Where speech and non-speech channels are presented, the capability to adjust the volume of any non-speech channels shall be provided.

Alarms and critical event notification (that are normally presented in auditory form) shall be presented visually using appropriate highlighting techniques.

Where voice input is used to activate a process, alternatives such as keypads or the use of video monitoring shall be considered.

Some individuals with limited hearing cannot produce speech that is recognizable by voice-input systems.

2.2.3 Users with limited speech capabilities

ICT equipment and services shall support intended users with limited speech capabilities.

Alternative input methods shall be provided for voice inputs, e.g. the keyboard is used to provide text equivalent input in an application using voice to control an operation.

Speed of voice input shall be controllable by the user. People with speech problems often need much more time to pronounce words and sentences.

The capability to enhance speech input shall be provided where possible. The use of a speech enhancer enables many persons to use speech recognition software who could otherwise not do so because of their soft, inaudible voice or unclear speech.

Interface mechanisms to support assistive technology devices shall be provided, e.g. the equipment shall provide a plug-in connection for an external speech enhancement device.

2.2.4 Physical capabilities

2.2.4.1 Limited physical force and movement

ICT equipment and services shall support intended users who have limited physical movement (e.g., users of wheel chairs).

The placement of controls and displays shall be adjustable to heights and locations that the intended users can reach.

Controls shall be movable with the minimum force required (within the constraints of the operation being performed).

Controls shall be operable using either hand.

Interface mechanisms shall be provided to support assistive technology devices. Such devices include eye movement trackers, headsticks, mouthsticks, and remote controllers.

2.2.4.2 Limited motor control

ICT equipment and services shall support intended users with limited motor control, e.g. for users with limited motor control, voice control can be used, according with the user's disabilities.

If a task requires users to make responses (e.g. press a button or type information) within a limited time in order for that response to be valid, the time range shall be adjustable by the user, including the option to turn off all timing requirements. It is important to design ICT equipment and services so that time-outs are not an essential part of interaction, or that at least one of the following is true:

- The user is allowed to deactivate the time-out.
- The user is allowed to adjust the time-out over a wide range.
- The user is warned before time expires, allowed to extend the time-out with a simple action (e.g. "hit any key") and given time to respond.

If the ICT equipment or service will be operated or used by individuals with limited fine motor control the controls shall be designed to compensate for the limitations.

2.2.4.3 User comfort and fatigue

ICT equipment and services shall avoid causing user fatigue and ensure user comfort over extended periods of time by avoiding requiring precise joint movements and avoiding requiring static positions near the extreme range of movement.

2.2.5 Cognitive capabilities

2.2.5.1 Avoidance of unnecessary high cognitive demands

ICT equipment and services shall avoid unnecessary high cognitive demands on users by ensuring that the basic activities required to operate the equipment or to use the service are as straight forward and simple as possible. The use of consistency can help to decrease the cognitive demands on users. The ability to review information can help to decrease cognitive demands.

2.2.5.2 Understandability

Information shall be presented in a manner that will aid understanding. The layout of information and controls will determine how easy they are to be read by someone with a visual or cognitive impairment. Factors to consider include logical grouping of information and controls, line length of text, relevance of information and relationship of controls to actions to be undertaken.

2.2.5.3 Vocabulary

The vocabulary used to describe and operate ICT equipment and services shall use expressions and terminology that are as easy as possible to understand irrespective of the level of expertise and cognitive capabilities of users. An explanation or glossary can be offered to help users understand expressions and vocabulary that they might not know.

2.2.5.4 Appropriate hints

ICT equipment shall provide appropriate hints to assist users in paying attention to important information, e.g. the user interface provides a highlighted message for the fridge: Please take your expired food out of the fridge.

2.2.5.5 Speed of interaction

Where possible, the speed of interaction shall be adjustable by the user. Users with cognitive difficulties may need additional time to perform certain activities.

Whenever moving, blinking, scrolling, or auto-updating information is presented, the user shall be enabled to pause or stop the presentation.

2.3 Recommendations related to task characteristics

2.3.1 Flexibility of tasks

ICT equipment shall allow users to easily perform tasks in the manner most suited to their contexts of use.

ICT equipment shall allow users to easily combine existing functionalities in manners suited to performing new tasks. A task is specified to use a certain system and to be performed in a certain environment. These systems and environments can impose their own limitations.

For example, a wizard is used to perform a complicated task, whereby the user is given a choice to do a standard (i.e. default), full, or customized set of steps to complete the task.

2.3.2 Maintenance and other non-task related operations

ICT equipment shall minimize the need for maintenance, set-up, and other operations that are not directly part of performing the users' tasks.

2.4 Recommendations related to environmental characteristics

2.4.1 Range of intended environments

ICT equipment and services shall be able to be operated in a range of intended environments. ICT is used in multiple environments, like e.g. office and home environments. Many ICT services are used on a variety of hardware platforms, including personal computers, notebook computers and others. The following aspects shall be considered:

- Glare from bright lights negatively affects visual conditions.
- Background noise affects auditory conditions.
- Constrained workspaces affect physical movement conditions.
- Distractions and other tasks needing attention affect cognitive conditions.
- Distractions decrease the amount of time available to satisfy temporal conditions.

2.4.2 Impact on environment

The operation of ICT equipment and services shall not negatively influence its environment.

2.5 Recommendations related to outputs

2.5.1 Enable user control of time-sensitive presentation of information

Whenever moving, blinking, scrolling, or auto-updating information is presented, software shall enable the user to pause or stop the presentation. Individuals with low vision or reading problems need time to study information in order to comprehend it.

Varying speed of presentation is also useful. Users can control the tactile output by pausing its presentation to be allowed to read and to continue again or users press mouse down on animated text, which pauses it as long as they hold the mouse down to read it.

2.5.2 Provide accessible alternatives to task relevant audio and video

When task relevant information is presented by audio or video, software shall provide equivalent content in accessible alternative formats. E.g., a video

includes captions for the auditory track or the system provides an auditory description of the important information of the visual track of a multimedia presentation (Audio Description).

2.5.3 Visual output

2.5.3.1 Enable users to adjust graphic attributes

To increase legibility of graphics, software shall enable users to change attributes used to present the content without changing its meaning.

There are numerous cases where changing the view will necessarily change the meaning. The intent is that users are enabled with the capability to change views as much as possible without changing the meaning. Some examples:

- The user can change attributes, such as line, border, bullet size and shadow thickness, for improved viewing of charts, graphs and diagrams, but such changes would not affect the meaning.
- The length of a temperature gauge does not change unless the scale was lengthened proportionally.
- A user changes the size of icons making it easier for him to tell them apart.

2.5.3.2 Provide a visual information mode usable by users with low visual acuity

Software shall provide at least one mode for visual information usable for users with corrected low visual acuity, without relying on audio. One possibility is that the software magnifies what is shown in the screen. Another one is to enable the user to change the size of fonts and icons.

2.5.3.3 Use text characters as text, not as drawing elements

In graphical interfaces, text characters shall be used as text only, not to draw lines, boxes or other graphical symbols.

Characters used in this way can confuse users of screen readers, e.g., a box drawn with the letter “X” around an area of text is read by screen-reader software as “X X X X X X” on the first line, followed by “X” and the content and “X”. Text used for graphics in this way is usually confusing or uninterpretable when read sequentially by users with assistive software.

2.5.3.4 Provide keyboard access to information displayed outside the physical screen

If the virtual screen (e.g. desktop) is made larger than the visible screen, so that some information is off screen, the platform software shall provide a mechanism for accessing that information from the keyboard. A viewing area extending the physical boundaries of the computer is usually called a virtual screen. A moving view-port allows the users to pan to see the virtual screen area not displayed on the physical screen.

2.5.4 Text/Fonts

2.5.4.1 Enable users to set minimum font size

Software shall enable users to set a minimum font size with which information would be presented on the display (despite its font size in the document).

If the platform software already provides this facility, the application may utilize it. Some examples:

- A word processor contains a “draft mode” which shows all document text in a single, user-selectable font, colour, and font-size, overriding any formatting information specified in the document itself. When users encounter small text that they have difficulty reading, they can switch into this mode and will still be viewing the same section of the document, but at a size they have already selected as meeting their needs.
- A user has difficulty reading small text on the screen, so he sets a “minimum font size” preference value in the operating system’s control panel. The Web browser respects this setting and automatically enlarges any text that would otherwise be smaller than this size.

2.5.4.2 Adjust the scale and layout of user interface elements as font-size changes

User-interface elements shall be scaled or have their layout adjusted by software as needed to account for changes in embedded or associated text size.

This also applies to text associated with icons. In many cases these features are supported automatically when software incorporates standard user interface elements provided by the platform software. For example:

- As fonts grow, button and menu sizes adjust to accommodate them. If they become large enough, the window increases in size to prevent buttons from clipping (overwriting) each other. If the window would otherwise become too large to fit on the visible portion of the display, scroll bars are added.

2.5.5 Colour

2.5.5.1 Do not convey information by colour output alone

Software shall not use colour alone as the only way to convey information or indicate an action. Some examples:

- Red is used to alert an operator that the system is inoperative or to indicate an emergency situation. In these cases, the use of colour is supplemented by text indicating “warning” or “emergency”.
- If an indicator changes colour to show an error condition, then the user can also get text or audio information that indicates the error condition.
- Negative numbers are coded in red and also have parentheses.

2.5.5.2 Provide colour schemes designed for people who have visual impairments

Software that includes colour schemes shall provide colour schemes designed for use by people who have visual impairments.

For example, high-contrast monochrome schemes are provided, including one using light foreground on dark background and another using dark foreground on light background. The software system also includes schemes that avoid the use of colours that may confuse users who have common forms of colour blindness, macular degeneration and other visual impairments.

2.5.5.3 Provide individualisation of colour schemes

Software that uses colour schemes shall allow users to create, save and individualise colour schemes, including background and foreground colour combinations. The ability to share schemes is also useful. Some examples:

- A user adjusts the colour scheme provided for those with red-green colour blindness to optimise perceptibility for their particular requirements.
- A person with low visual acuity uses the operating system’s control panel to request that window captions and menus be drawn in yellow text on a black background.

2.5.5.4 Provide contrast between foreground and background

Default combinations of foreground and background colours (hue and luminance) of the software shall be chosen to provide contrast regardless of colour perception abilities.

For example, colours are selected for contrast differences so that they are distinguishable, on the basis of light/dark differences, by users who cannot discriminate between different hues.

2.5.6 Window appearance and behaviour

2.5.6.1 Enable non-pointer navigation to windows

Software shall enable users to use the keyboard or other non-pointer input mechanisms to move focus to any window currently running that is allowed to accept focus.

The intent here is to allow users who cannot use a pointing device to navigate among windows with a keyboard in a manner that is as efficient as possible compared to what other users might do with a pointing device. For example, by browsing a continuously displayed list of currently running windows, the user uses a keyboard to select a window that receives focus.

2.5.6.2 Enable “always-on-top” windows

Platform software shall enable windows to be set to always remain on top of other windows. If a function or a window is required continuously for users to perform a task, it is important for the window to be able to be set to always remain visible regardless of its position relative to other windows. Some examples:

- The user has a movable on-screen keyboard that is on top of all other windows so that it is visible at all times, but when the user clicks his mouse on the on-screen keyboard another window keeps the input focus and the keyboard input goes to that window.
- A user selects a screen-magnification window that is the top-level window through which all other windows are viewed and which remains always on top.

2.5.6.3 Enable window positioning

Platform software shall give the user the option to adjust the position of all windows, including dialog boxes and software on such systems shall support this option. This helps the users to better use several applications and/or windows at the same time.

For example, a user with an on-screen keyboard changes the position of a pop-up dialog so that it fits alongside of his keyboard.

2.5.6.4 Enable window sizing

Platform software shall give the user the option to size all windows, including dialog boxes, and software on such systems shall support this option.

For example, a user with low vision uses larger font size that causes text to run off the bottom of the default window size. The user enlarges the window to see all text.

2.5.7 Audio output

2.5.7.1 Use tone pattern rather than tone value to convey information

When conveying information audibly, software shall use temporal or frequency-based tone patterns rather than using a single absolute pitch or volume.

For example, in a teleconference service, a high to low tone pair (rather than just a low tone) indicates a person signing off.

2.5.7.2 Enable control of audio volume

Software shall enable users to control the volume of audio output.

2.5.7.3 Use an appropriate frequency range for non-speech audio

The fundamental frequency of task-relevant non-speech audio used by software shall occur in a range between 500 Hz and 3 000 Hz or be easily adjustable by the user into that range.

The sounds in this range are most likely to be detectable by people who are hard of hearing.

2.5.7.4 Enable adjustment of audio output

Software shall enable users to adjust the attributes of task-relevant audio output such as frequency, volume and speed. The range of adjustment will be constrained by the sounds that a system can produce. For example, a user may alter the speed of speech from a synthesizer to enhance understanding.

2.5.7.5 Allow users to choose visual alternative for audio output

Platform software shall enable users to choose to have task relevant audio output (including alerts) presented in visual form, auditory form or both together.

For example, an explanatory text is provided in a dialog box when a distinctive audio (alert) is played.

2.5.7.6 Synchronise audio equivalents of visual events

Software shall synchronise audible equivalents with the visual events they are associated with. This allows a user who cannot see the screen to follow the event sequences.

2.5.7.7 Provide speech output services

If the hardware has the ability to support speech synthesis, platform software shall provide programming services for speech output. This is relevant for blind users that depend on speech-based assistive technologies.

2.6 Recommendations related to inputs

2.6.1 General

The term “pointing device” refers to any physical or logical pointing device. Such devices include mice, trackballs, touchscreens, and touchpads, as well as specialized input devices such as head trackers and many other hardware/software combinations that systems treat as pointing devices. Some devices, such as touchscreens and touchpads, may use a finger tap or gesture in place of physical buttons and these shall be interpreted as equivalent to pointer-button events and covered by provisions addressing such types of input.

2.6.2 Provide keyboard input from all standard input mechanisms

Platform software shall provide a method for generating keyboard input from each standard input mechanism provided by the platform.

For example, a platform that supports mouse input and includes a mouse-operated on-screen keyboard utility that can be used to control any application that is designed to take keyboard input.

2.6.3 Provide parallel keyboard control of pointer functions

Platform software shall provide a keyboard alternative to standard pointing devices that enables keyboard (or keyboard equivalent) control of pointer movement and pointer button functions in parallel with the standard pointing device.

This allows users who have restricted limb/hand movement or coordination to more easily control pointing functions. It is important that the keyboard alternative works in parallel with the regular pointing device (mouse, trackball, touchscreen, etc.). A user with low motor function might move the mouse pointer to the general vicinity of a target, and then fine-tune the position using the keyboard control.

2.6.4 Provide pointer control of keyboard functions

Platform software shall provide a pointing device-based alternative to the keyboard that enables pointing device control of key presses.

This allows users who cannot use the keyboard and can only use a pointing device to type.

For example, an operating system includes an on-screen keyboard emulator that allows the user to perform the equivalent of pressing all keyboard keys using only a pointing device.

2.6.5 Provide speech recognition services

If the hardware has the capability to support speech recognition, platform software shall provide or enable the use of programming services for speech recognition.

This is relevant for users with visual, physical and cognitive disabilities.

2.6.6 Facilitate long list and menu navigation

Software shall provide keyboard mechanisms to facilitate navigation within long menus and lists. The usage of HOME and END keys is one strategy. Some examples:

- The user presses “Home” to move to the first item in a list, “End” to move to the last item in the list and “PgUp” and “PgDn” to move forward and backward the number of items currently visible.

- The user types one or more characters to move to the next item that starts with those characters.

2.6.7 Provide easily-selectable pointing device targets

Target size shall be optimized by the software system to maintain adequate target selectability, grouping and separation from adjacent user interface elements. This makes usage easier for all pointing device users, but it is especially important for enabling users with disabilities to select user interface elements effectively with a mouse.

2.6.8 Provide adjustment of pointer speed

Software that handles low-level pointing device input shall enable users to adjust the speed or ratio at which the pointer moves in response to a movement of the pointing device.

2.6.9 Provide adjustment of pointer acceleration

If software provides pointer device acceleration it shall provide adjustment of the pointer movement acceleration.

2.6.10 Provide a means of finding the pointer

Platform software shall provide a mechanism to enable users to locate the mouse pointer, unless it is always in high contrast with background, always visible, and always solid and larger than text.

For example, a user with low vision looses track of the mouse pointer. When the Control key is pressed animated concentric circles are presented around the location of the mouse pointer.

2.7 Procedure for assessing applicability

Annex I provides a developer checklist that can be used to determine whether the applicable requirements and recommendations in the guideline have been met.

The checklist can be used either during the user interface development or for evaluation of the completed equipment including the applying devices like e.g. televisions or mobile phones.

The checklist contains all requirements and recommendations from the guideline. It shall be noted that the procedure described is provided as guidance and is not an exhaustive process to be used as a substitute for the guideline itself.

The use of the checklist provides a basis for determining which of the requirements and recommendations are applicable.

Note: For this reason C-LAB recommends to complete the checklist after each development stage to ensure the consideration of accessibility aspects during the entire cycle of the user interface development.

2.8 Summary

The observance of the practice-oriented guideline ensures that developers consider the wide range of required accessibility aspects during the entire development cycle.

The achieved level of accessibility for the related type of impairment depends on whether the specific requirements of the concerned users will be applicable or not.

In this way the usage of the developer checklist presents a suitable manner to verify the achieved level of accessibility in each development stage.

By following the steps mentioned above, this procedure will lead to an accessible user interface that complies with the needs of the elderly people with physical, sensory and mild-cognitive impairments. Moreover, applying devices like e.g. televisions or mobile phones that satisfy the specific requirements of the different users are taken into account.

3. ACCESSIBILITY WORKSHOPS

3.1 User recruitment

C-LAB performed two workshops to gather specific information for the accessibility tests of the prototypes. The workshops took place on the 15th and 24th of October in 2008 in Paderborn. 42 elderly persons (personal carers included) took part in these workshops. The user selection procedure is detailed described in D5.2 in Chapter 3.1 “User recruitment”.

3.2 Set up of an accessible demonstration environment

The team of experts configured an accessible laboratory environment for the concerned users in advance to assure an unproblematic course of the practical tests. Most of the participants suffer from visual and physical impairments. A detailed description of the set up is presented in D5.2 in Chapter 3.2 “Set up of an accessible demonstration environment”.

3.3 The workshops in detail

Several test scenarios were presented during the workshops and the participants were able to interactively experience the different technologies in terms of accessible design. The complete course of the accomplished accessibility workshops can be found in D5.2 in Chapter 3.3 “The workshops in detail”.

3.4 Specific work package support

The experts from C-LAB intended to perform a practice-oriented demonstration of the user interface during the workshops. With this background, the course of the demonstration included the following test scenarios:

- A practice-oriented demonstration of the “talking appliances” of the Series Logica. The installed appliances were used to exemplify the potential acoustic information of the user interface. All of the demonstrated appliances support the volume control of the voice output.

- A practical demonstration of the serve@home technology that was originally manufactured by BSH. The demonstrated appliances were connected to the local network via Power Line Communication (PLC) and provided the control of appliance functionalities via an accessible web interface. The appliances were used to demonstrate the remote control of household appliances.
- A demonstration of the user interface in an audiovisual manner by using several videos that illustrated different prototype functionalities. The videos were translated into German language and extended with an audio track so that visual information was also available via the acoustic channel. The accessibility experts took care that acoustic and visual information was presented in an easy to understand language.

The accessibility experts explained the design strategy of the user interface in detail in advance to outline the potential benefit of the four-colour principle that is based on the four coloured buttons of the remote control. This strategy allows in particular the blind users to operate the user interface by using a television with a remote control keeping the colour position of the buttons in mind.

Figure 1. The “talking appliances” of Series Logica

Most of the participants were blind or visually impaired and need therefore frequently assistance of relatives or carers to carry out their daily tasks. Many problematic situations occur when blind or visually impaired persons are not aware of the actual states of their household appliances like e.g. if the hotplate is left on or not. Regarding these problems the “talking appliances” of Series Logica support the voice output as an accessible way to retrieve status information.

The participants were able to experience the features of the appliances shown in figure 1. To outline the applicability for the target group, a blind colleague from C-LAB demonstrated the appliance-depended functionalities and explained in detail the different features of the voice output like e.g. the volume control that was used to exemplify the acoustic information of the user interface.

Figure 2. The “talking appliance in “virtual” connection with the user interface

Furthermore, the user interface was demonstrated in “virtual” connection with the “talking appliances” by using a laptop and a mobile phone as applying devices. The following scenarios are shown in Figure 2:

- Refrigerator — Acoustic and visual notification of door left open via mobile phone and laptop

- Washing machine — Acoustic and visual notification of door left open via laptop.

The acoustic as well as the visual information of both applying devices was perceivable via the user interface. In particular the blind people derived benefit from the volume control of the applying devices. Similar to the blind users the visual impaired participants benefit from the magnification function of the configured screen reader that ran on the laptop.

During the practice-oriented test of the serve@home appliances the users were assisted by two accessibility experts who demonstrated the practicability of the supported remote control functions of the appliances. They explained in detail the usage of the accessible web interfaces and the users were able to interactively experience the controllable functions of the following appliances:

- An air-conditioner
- An oven
- A cooker hob

A desktop computer with an installed screen reader and a connected Braille display established an accessible work environment for the affected users. Moreover, a tablet pc with configured zoom support facilitated the usage of the web interface for persons with a limited vision.

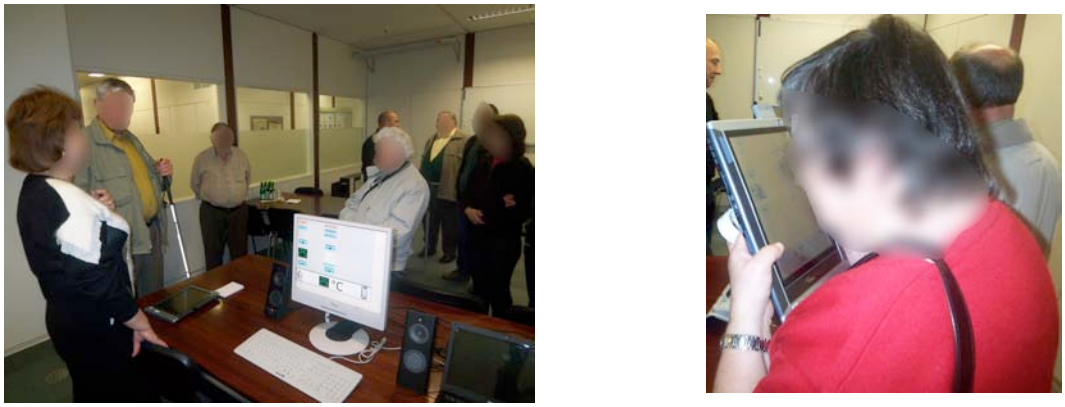

Figure 3. Practice-oriented test of serve@home appliances

Most of the impaired users as well as the carers had their first experience with a tablet pc.

As a result of the tests all participants agreed on the fact that remote control of household appliances would help them to cope with their daily tasks. Many of the all-day tasks that cannot be performed up to now would be facilitated by the use

of the remote control functionality. In particular the carers were very interested in this technology in terms of safety related aspects.

With regard to the audiovisual demonstration of the user interface the following adapted videos were presented during the workshops to serve as example for the corresponding household scenarios:

- Warning on detected water damage
- Notification in case of left open fridge door
- Reminder in case of left open fridge door
- Remote configuration of the fridge
- Notification in case of left open washing machine
- Notification in case of expired food
- Notification in case of oven breakdown
- Notification in case of ready to eat food prepared in the oven
- Remote configuration of the oven
- Warning on detected smoke
- Notification in case of finished washing cycle
- Notification in case of mismatched colour of garments

Some of the above mentioned videos were demonstrated by the means of a "virtual" connection between the user interface and the corresponding appliance to simulate a situation close to reality.

Table 1 lists the applying devices that were used for the audiovisual demonstration of the user interface.

	Supported assistive technology					
Device	**Screen reader**		**Braille display**		**Zoom function**	
Television with remote control	Yes ☐	No ☒	Yes ☐	No ☒	Yes ☐	No ☒
Tablet PC	Yes ☒	No ☐	Yes ☐	No ☒	Yes ☒	No ☐
Desktop PC	Yes ☒	No ☐	Yes ☒	No ☐	Yes ☒	No ☐
Laptop	Yes ☒	No ☐	Yes ☒	No ☐	Yes ☒	No ☐
Mobile phone	Yes ☐	No ☒	Yes ☐	No ☒	Yes ☐	No ☒

Table 1. List of devices that were used for the user interface demonstration

All devices were equipped with audio support. As shown in Table 1 some of the devices were furthermore equipped with assistive technology to ensure an

appropriate set of applying devices that comply with the needs of the affected users.

All participants were well experienced in the use of the television. Most of them own desktop or mobile computers that are equipped with screen readers or magnification software. Only some of them were able to work with a Braille display. Nevertheless Braille support has to be considered because it is very important for congenital blind users who learned Braille in their youth.

Figure 4 shows examples of the presented videos.

Figure 4. Example videos in German language

Radios and vacuum cleaners were used during the user interface demos to simulate different loudness levels. By using their preferred devices all of the participants were able to perceive the audio information via user interface.

Some of the participants encountered difficulties when they tried to perceive the visual information without an additional audio channel. In spite of the fact that they were able to identify changes in the screen content they were unable to read the information without an appropriate magnification. The blind users were unable to perceive any visual information and had to rely on the presented audio channel. Furthermore, many of the visually impaired users asked for appropriate colour schemes that fit their specific needs.

The user interface and the applying devices were intensively discussed in individual and round-table discussions. The potential benefit as well as the expected difficulties in the use of the user interface are presented in detail in Deliverable D5.4 in Chapter 2.2.3.

Furthermore, the results of the practice-oriented demonstration significantly influenced the definition of appropriate test procedures for the accessibility tests of the user interface.

3.5 General results

Besides the project related results the workshops exposed general important information regarding the accessible design of household appliances. The results are presented in D5.2 in Chapter 3.5 “General results”.

3.6 Summary

The results of the workshops point out that the user interface is able to present the available information of corresponding appliances in a perceivable manner that complies with the needs of the participants.
Warnings, notifications as well as reminders are shown in a clear and comprehensible way.

The expected problems (see D5.4 in Chapter 2.2.3) of the user interface for blind and visually impaired users will be considered in the next development stage. The aim of this stage will be to ease the handling of the user interface for this particular user group with regard to the applying devices.

The results of the workshops can be found in D5.4 in Chapter 2.2.3 “User interface design — Potential benefit and expected problems”.

4. CONCLUSION

The requirements and recommendations provided in this practice-oriented guideline provide support for the development of solutions that will lead to increases in accessibility, taking account of the context of use.

The achieved level of accessibility of the user interface is measurable by using the corresponding developer checklist that can be found in Annex I.

The checklist outlines all implemented accessibility features of the user interface that meet the needs of the target group considering their sensory, physical and mild-cognitive limited abilities.

Moreover, the results of the accessibility workshops contain significant information that will be considered during the next development stage to satisfy the specific needs of the target group.

The visually impaired and blind users had a critical look at the user interface and applying devices. Indeed, the interface will present an accessible solution to operate appliance functionalities that they were not able to use up to now.

The results of the accessibility workshops that support the user interface development can be found in Deliverable D5.4 in Chapter 2.2 "Results of the Accessibility Workshops".

WP5 ensures that the different user characteristics as well as their different knowledge levels were taken into account during the entire user interface development.

Several meetings and workshops with affected users established a vital communication between the concerned parties and led to important results that

were considered during the development to satisfy the wide range of specific needs in the handling of the user interface.

User recommendations highly influenced the specific design of the user interface and the selection of applying devices. Furthermore, the gathered information about specific characteristics of affected users was basis for the different user models of the Persona Concept. The defined user models were required for the use case development.

The practice-oriented Accessibility Guideline for the user interface development as well as the developer checklist will lead to an accessible user interface that is applicable for the widest range of elderly people with different impairments.

ANNEX I: DEVELOPER CHECKLIST

Results of development stage: User interface and applying device

No	Summary checklist: User interface and applying device Used device: tablet pc Checklist item	Not applicable	Relevant	Fully compliant	Not compliant	Comments
1	Is user control of time-sensitive presentation of information supported?	X				Time-sensitive presentation of information is designed out of the interface
2	Are accessible alternatives to task relevant audio and video provided?			X		Is provided as an alternative to audio. There is no video in the interface
3	Are users able to adjust graphic attributes?				X	Few graphic attributes are used i.e. only in the tabs symbols to indicate the appliances. They are supported by text representations when the user steps through each

						appliance.
4	Is a visual information mode usable by users with low visual acuity provided?			X		Font sizes are adjustable, and the interface display scales to the size of the physical device.
5	Are text characters always used as text and not as drawing elements?			X		
6	Is keyboard access to information displayed outside the physical screen supported?	X				The physical screen contains 100% of information.
7	Are users able to set a minimum font size?			X		
8	Are the scale and layout of user interface elements adjustable as font-size changes?			X	X	No, in that the font size can be different with the same display, but: Yes, in that the interface scales to the size of a larger device.
9	Do not convey information by colour output alone!			X		
10	Are colour schemes designed for people who have visual impairments?				X	The colour scheme is chosen for its high contrast, and uses colours that make text easily legible (black on

						white). However, individualisation of colours is not currently supported.
11	Is individualisation of colour schemes provided?				X	Not in prototype.
12	Is contrast between foreground and background provided?			X		
13	Is non-pointer navigation to windows possible?			X		
14	Are “always-on-top” windows supported?	X				
15	Is window positioning possible?	X				
16	Is window sizing supported?	X				
17	Are tone pattern rather than tone value used to convey information?	X				
18	Is control of audio volume supported?			X		
19	Is an appropriate frequency range for non-speech audio used?			X		
20	Is adjustment of audio output provided?			X		
21	Are users allowed to choose visual alternative for audio output?			X		
22	Synchronize audio equivalents of visual events!			X		
23	Are speech output services provided?			X		
24	Is keyboard input from all standard input mechanisms provided?			X		

25	Is parallel keyboard control of pointer functions supported?	X				
26	Is pointer control of keyboard functions supported?			X		
27	Are speech recognition services provided?				X	Speech recognition not in prototype.
28	Is long list and menu navigation facilitated?			X		
29	Are pointing device targets easy selectable?			X		
30	Is adjustment of pointer speed supported?			X		In operating systems settings.
31	Is adjustment of pointer acceleration supported?			X		In operating systems settings.
32	Is a means of finding the pointer provided?				X	Would need extra software
33	Is easy individualisation of user preference settings possible?			X		
34	Is individualisation of cursor and pointer appearance possible?				X	Would need extra software.
35	Is the text label display option for icons provided?	X				
36	Are user-preference profiles provided?			X		
37	Is user control of timed responses possible?	X				
38	Is the number of steps required for any task optimized?			X		

39	Is warning or error information allowed to persist?			X		
40	Are user notifications presented in a consistent technique?			X		
41	Are understandable user notifications used?			X		
42	Are standard accessibility services like e.g. screen readers supported?			X		

REFERENCES

[1] International Organization for Standardization. 2006. ISO/DIS 9241-171: 2006. *Ergonomics of human system interaction – Part 171: Guidance on software accessibility*. ISO copyright office: BSI.

[2] International Organization for Standardization. 2008. ISO/TR 22411: 2008. *Ergonomics data and guidelines for the application of ISO/IEC Guide 71 to products and services to address the needs of older persons and persons with disabilities.* ISO copyright office: DIN.

[3] International Organization for Standardization. 2001. ISO/IEC Guide 71: 2001. *Guidelines for standards developers to address the needs of older persons and persons with disabilities*. ISO copyright office: ISO.

[4] State University of North Carolina, Trace Center. 1997. *"The Principles of Universal Design".* [online]. [Accessed on 20 March 2008]. Available from WWW*:* http://www.design.ncsu.edu/cud/about_ud/udprinciplestext.htm*.*

[5] Project Deliverable D5.2. 2009. *D5.2 Report with a description of the support performed in WP3 and the description of the tests carried out and their results obtained v2.0.*

[6] Project Deliverable D5.4. 2009. *D5.4 Report with a description of the tasks carried out and their results obtained in WP6 v1.0.*