D2.1 – Report on the specifications of an alphanumerical and symbol-based keyboard front

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1. Executive Summary

This deliverable is the first deliverable of the WP2: Human-Machine Interface. It gives an overview of the Graphical Interface for ALIAS platform specifications.

In this deliverable, all recommendations for designing the symbolic keyboard have been firstly reviewed, and then the results of work package 1 have been analyzed to find the main requirement of the Graphical User Interface.

The main requirements of the user interface have been defined:

- Several applications are handled by ALIAS. The main screen of ALIAS manages all applications. A search function in this screen should be developed.
- The graphical user interface should handle external events in close collaboration with the dialog manager (WP3).
- The graphical user interface should be able to modify its appearance according to user profile.
- All application interfaces should be integrated in a single framework.
- The ALIAS project will not develop its own virtual alphanumerical keyboard with text prediction but reuse an existing one.
- No complex menu structure should be used, giving preference to the symbolic keyboard.
- The different components implicated in the user interface should be strongly coupled to provide a good user experience of the ALIAS platform.

Some recommendations have been also issued related to the easy usage by older persons and in relation with other components of the ALIAS platform.

2. Introduction

2.1. Scope of This Deliverable

This deliverable is the first deliverable of the WP2: Human-Machine Interface. The objective of this WP is to develop all components related to the user interface: speech interface, keyboards and graphical user interface.

More specifically, the aim of this deliverable is to give overall specifications of the symbolic and alphanumerical keyboard. In these specifications, the kind of interfaces that have to be developed for ALIAS will be reviewed. We issue also several recommendations for developing the user interface.

The first results of Work Package 1 – User Inclusion have been included into a review of the different use case proposed in the WP1.

The design of specific interfaces to be developed in ALIAS demonstrator is out of the scope of this deliverable; this design will be developed later in the project.

2.2. Structure of This Deliverable

This deliverable covers the following topics:

- Chapter 3 describes the context of the development of the User Interface as foreseen in the ALIAS project.
- Chapter 4 summarises an extensive watch on the state of the art in terms of intuitive keyboard to easily access data. It shows a review of in existing virtual alphanumerical keyboard.
- Chapter 5 issues recommendations for developing the symbolic keyboard.
- Chapter 6 reviews the use case in terms of user interface requirements.
- Chapter 7 presents the current state of the graphical user interface.
- Chapters 8 and 9 conclude this deliverable and give the further steps to be done in WP2.

3. Context Overview

The impact of accessibility of digital information on older persons is one of the issues of AAL Joint-Program. This is mostly due to two major causes: on one hand, age involves failing sight, loss of hearing, limited dexterity, even reduced mental acuity, and on the other, senior generations are not familiar with touch-sensitive input control tools (keyboard and mouse usage, windows management, device management).

To compensate for these deficiencies, ALIAS has to find simple and implicit tools, requiring no or little training.

Old people may be living alone, or with their family or in a retirement home, but wherever they live they will have limited access to personalized one-on-one help to get started. Therefore handling of the Robot must be intuitive and should require as little training as possible. The question is what should the human computer interface (HCI) for an older person look like? (Or in other words, what is wrong with the typical HCI?) How might older persons want to interact with a computer?

3.1. The Issues

In our experience discussing a topic like “computers” with older persons (and novices) who are not familiar with desktop environment, the following thoughts are typically bound to be addressed:

- The standard keyboard has too many keys and that is confusing. The layout and size of keys could also be improved.
- A standard mouse is difficult to use and the relationship between its movement and what happens on the screen is not self-evident.
- The biggest problem is with the layout of the screen. The desktop contains a series of tools for the user to pick and choose from. Too many of them are unnecessary or inadequate.
- What a novice needs is a menu of tasks they can perform and then detailed instructions on how to perform the task (a directing approach). For example (on the main screen):
    - You have some mail …would you like to open it?
    - Would you like to send a friend a message?
    - Would you like to see your photos?
    - It is Monday do you want to order some food at XYZ?

  Thinking in terms of tasks is more intuitive than in terms of available functions and how they need to be applied to achieve the desired goal. For example if the user

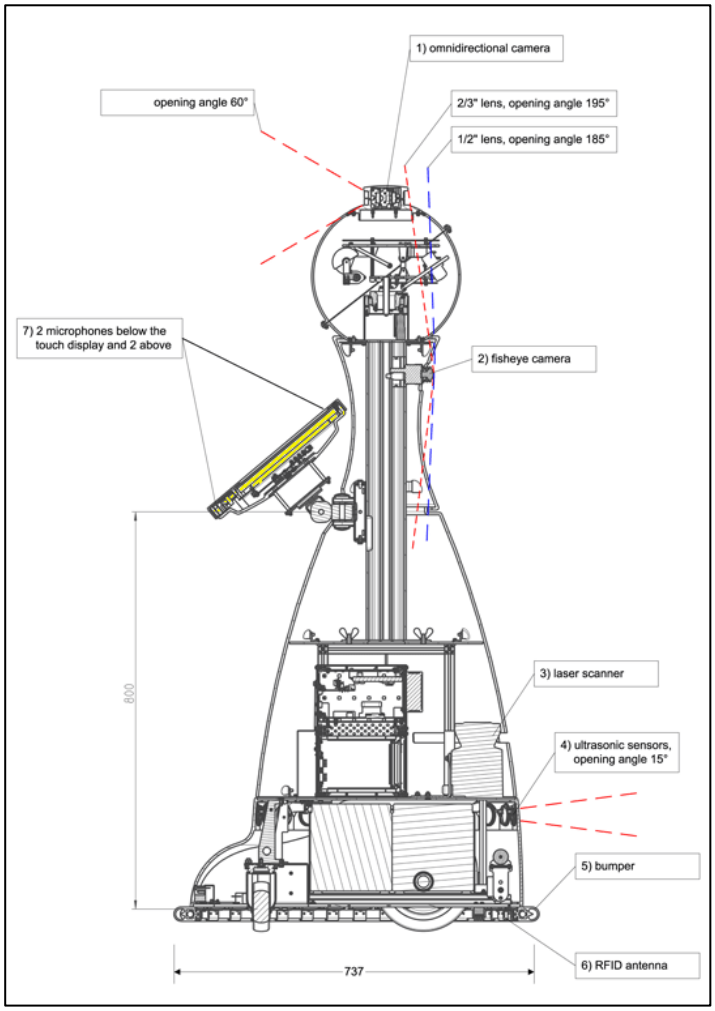
wants to read an email, switching to the address book, selecting a contact and than displaying the related email is hardly the obvious way for reading mails.

- Multiple windows and things disappearing behind other windows can be confusing and potentially worrying for the novice. So, in the directive mode, only one window should be displayed at a time and one set of task options displayed.

Most previous attempts to introduce aided services in the community of older persons have failed since by involving some sort of computer-like interface, they did not observe the above requirements. A computer (in its traditional fashion) is an element foreign to most users' environment that requires skill, modifies their way of living and has been systematically refused by the users.

3.2. ALIAS Configuration

ALIAS proposes to use a tablet PC integrated to the robot platform. This Tablet PC includes touch-sensitive screen display in order to avoid keyboard and mouse that are not suitable for a large part of older persons.



To optimize the command activation through the touch screen of the tablet PC, it recommended using well-sized icons managed in an “intuitive” way, according to the availability of services. Practical use cases have to be designed and approved firstly in order to organize the commands and to design relevant dedicated icons.

4. Existing Systems

The following chapter describes the different software modules, which were integrated in the 1st ALIAS prototype by the different work packages.

4.1. Overview

4.1.1. Keyboard

Option 1: Usual keyboard with larger alphanumerical buttons

Some Mobile phone manufacturers haves easily found a way to support older customers. The way to use such a device is simple: to type the phone number of the correspondent and to wait for an answer. For this special kind of customers, they propose big large keys on their "customised" devices.

For a smart phone or a computer, the way to solve the problem is not so easy: the usages of such devices are multiple and one needs a solution for each of them.

Another topic is the actual layout in which the individual keys are arranged. In modern days most "computer aware" people are used to a so-called "QWERTY" keyboard layout or a derivative in their native language, respectively. These keyboards are optimized for a certain language, placing the most frequently used keys in positions that provide fast access, to persons using all their fingers for typing. For novices or people who type using a single finger only, an alphabetically layout might be a better choice, since the keys use a more intuitive ordering. However such keyboards are rarely used.

Option 2: Keyboard with a few icon buttons instead of a typical keyboard

4.1.2. Touch Screen

A touch screen is a computer display screen that is sensitive to human touch, allowing a user to interact with the computer by touching an active area, target or control such as pictures or words on the screen. As touchscreens become more common it is essential that they are designed for ease of use by everyone, including disabled and older persons. Touch screens are key features for seniors who have trouble operating small buttons with even smaller text. They can be managed with fingers, pens or highlighters.

A prototype robot dubbed Kompott[1] and developed by Zurich University of the Arts' Interaction Design laboratory, gathers virtual content varying from emails to video, which can be accessed using

[1] http://iad.projects.zhdk.ch/kompott/

the robot's touchscreen head, **Figure 1**. The head displays intuitive icons which can be browsed through by tapping on the left and the right side of the robots head, while tapping on the icon to open it. There is a large button on Kompott's chest that gives access to all the contacts of the user. For the ones who have difficulty in reading or writing replies, the robot uses a speech synthesis technique to read out the message, and speech-to-text technique to take voice commands to type out email and other types of messages.

Figure 1: The Kompott prototype, its whole face is prepresented by a touchscreen. Touching the head itself accounts as user input, also.

French service robotics company has introduced a robot prototype called Kompaï designed to assist older persons, disabled people and others who need special care[2]. Its primary means of communication with people is speech, with an additional touch screen (tablet PC) that features simple icons. See **Figure 2**.

Figure 2: The French service robot Kompaï.

[2] http://spectrum.ieee.org/automaton/robotics/medical-robots/robosoft-kompai-robot-assist-elderly-disabled

Some commercial software already available such as PointerWare Software[3] who proposes a panel of utility software dedicated to older users with an elegantly simple interface, designed with first-time computer users in mind. It customizes the email utility, voice and video calling based on popular Skype™ technology, games, photo viewing interface and easy web browser. See **Figure 3**.

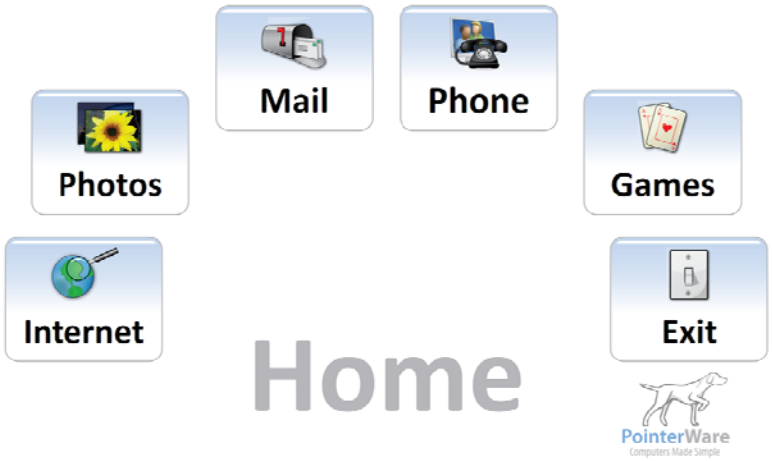


Figure 3: The PointWare main menu.

Another Software project, aimed at elderly computer users is called Eldy. It's Italian closed-source freeware software that turns any standard PC into an easy-to-use computer for people that have never used a computer before, as stated on http://www.eldy.eu. It implements more regular menu layouts than the PointerWare software and will be presented in closer detail in section 7.1 An Existing Software as a "Template".

4.1.3. Virtual Alphanumerical Keyboards with Word Completion

Word prediction is the provision of words that are frequently used in response to a user's keystrokes. This technique is well known now and used even for people with no disabilities.

Word prediction is based on different Natural Language Processing techniques but that are all specific to languages.

The methods for word prediction can be classified as statistical methods based on statistical and probabilistic language models and syntactic methods in which syntactic information is extracted and exploited. Most of the existing methods prefer the statistical language models using word n-grams and Part-Of-Speech (POS) tags. Generally, syntactic and lexical based language models have not been as beneficial for language prediction or disambiguation tasks as statistical language models.

The following table reviews some alphanumerical keyboards that can be used for ALIAS project. All of those tools are provided with text prediction or at least word completion functionalities.

[3] http://www.pointerware.com/

Product Name	Links	Size of keys	Operating System	Language	Cost
AAC Keys	http://www.aacinstitute.org/Resources/ProductsandServices/AACKeys/AACKeys.html	Small	Microsoft Windows-based and Macintosh (only in English) computers	German English	Free
Click-N-Type	http://cnt.lakefolks.com/	Small	Windows based.	English German French Italian Spanish	Free
VirtualKeyboard	http://www.indra-tecnologiasaccesibles.com/	Small	Windows based.	English Spanish Catalan French	Free
SofType	http://www.orin.com/access/softype/	Small	Windows based.	English	Com
Touch-It	http://www.chessware.ch/virtual-keyboard/index.php	Small	Windows (TabletPC)		Com
WiViKM	http://www.wivik.com/	Small	Windows based.	English French German Norsk	Com
beKey	http://www.be-enabled.de/en	Small	Windows	English German	Com

	/products.php				
Hot Virtual Keyboard	http://hot-virtual-keyboard.com/tabletpc/	Each key is customizable (size and form) and therefore can be adapted to the specificity of the older users.	Windows	German Spanish Italian French Dutch Portuguese Brazilian Greek Russian Turkish	Lic.
Windows 7 keyboard	http://windows.microsoft.com/en-US/windows7/Type-without-using-the-keyboard-On-Screen-Keyboard	Keyboard can be resized but not customizable	Windows	English French Italian German Spanish	Delivered on Windows 7 platforms
Gingerbread Keyboard	http://droidfreeapps.com/2010/12/gingerbread-keyboard-with-text-prediction-now-available-for-all-rooted-android-2-2-devices/		Android	Italian Swedish Spanish French German	Delivered on Android platforms

The 'Hot virtual keyboard' from the list above was chosen to be used for the ALIAS project (cf. also Section **Fehler! Verweisquelle konnte nicht gefunden werden.**) since it showed the highest degree of flexibility and can easily be configured in various languages such as English, French and German, the languages envisaged for ALIAS.

5. Recommendations for Symbolic and Alphanumeric Keyboard

The goal is to introduce intelligence into the system; trying to move, as much as possible, the initiative and decision-making from the user to the system so that interfacing requirements are reduced to a minimum. However, as the system offers more intelligent capabilities, it becomes increasingly more difficult to maintain a reasonable dialogue with the system with such simple devices as a remote control or a keyboard.

5.1. Relevant Standards

ISO/IEC 19765 (2007) Information technology - Survey of icons and symbols that provide access to functions and facilities to improve the use of information technology products by older persons and persons with disabilities

ISO 3461 General principles for the creation of graphical symbols.

Tango Icon Library – As a part of the Tango Desktop Project[4] these free icons represent a quasi standard for many open source projects. The Project homepage also provides a set of rules and suggestions for creating additional icons. Figure **4** shows some icons of the Tango Library.

Figure 4: The Tango Icon Library, picture taken from http://tango.freedesktop.org/images/2/20/Tango-feet.png.

5.2. To a Solution

To attract older (and disabled) persons, computer systems should include some very special and important features [P.Makris[5]], depending on specific disabilities, such as:

[4] http://www.freedesktop.org

Voice Input

Very helpful for people who can not (or do not want) control computer systems with their hands.

A Magnifier

Software which will enlarge (zoom) the text and icons of the desktop. Magnifying might be needed of the whole screen or only of the working area or will only happen when the mouse pointer is over a certain area. This tool is needed to most older persons and people with low or narrow vision.

A Scanning Program

Scanning is the method of access and selection which is used mostly for people with motor control problems and communication disorders. Instead of having the user selecting the button to be pressed a program is doing this for him. In practice the controls (i.e. buttons, labels, lists, menus, windows, selection keys) are selected the one after the other. This happens by highlighting them. When the control is sent to a button that the user would like to click on instead of using the mouse (this is difficult with people with motor control problems) the user simply tabs on a big switch. For the switch to work a special switch adapter is connected on one of the ports of the system. A program driver is needed for the communication of the adapter with the computer.

Big Discrete Mouse Pointers

Needed to help users locate the mouse. Most older persons will need this as well as people with vision problems.

Variation of Keyboard Layouts

Size of letters would be bigger and more easily read, side of keys as well as location of keys might need to change. There are already available special keyboards to serve different disabilities. For the designers it will be a good suggestion use bigger characters on keyboards.

Keyboard Keyguards

This is a special plastic or metal surface which is placed over a keyboard. The keyguard has holes one for each key of the keyboard. In this way the user can only press one key each time. This device is helpful for people with minor motor control problems. These people can with minor changes use the normal keyboard. One of the minor changes is the use of a keyguard.

[5] P. Makris Accessibility of Ubiquitous Computing: Providing for the Elderly, Workshop on Universal Accessibility of Ubiquitous Computing: Providing for the Elderly

Possibility of Adjustment of the Speed of the Mouse Clicks

The existing Accessibility Options which come with the new Operating Environments like Windows9X and Windows2000 provide some tools like, mouse setup control to control mouse buttons and the speed of clicks (single or double click) of the mouse, to increase or decrease repeat delay and to use sticky keys which enable a user to use shortcuts. All these facilities do not provide of help to older and disabled persons.

Possibility of Adjustment of the Repeat Delay of the Keyboard

This already exists within Windows9X and newer versions. When the user keeps pressing down a key the corresponding character will be typed only once even if the user keeps pressing for a long time. The above tools could be easily used and the existing software and hardware are at affordable prices and for this reason there are lots of disabled aged people who use them extensively.

On the other hand, some research projects have designed their robot prototype without any "manual" interaction. For example, Flo (NurseBot project[6]) communicates only vocally. At the moment, Flo's vocabulary consists of approximately one hundred words, enabling it to understand a variety of questions relating daily living activities such as inquiries for the television program and the weather forecast.

An interesting AAL workshop[7] has been held in 2009 dealing with those issues. "Designing ambient interactions for older people" focuses on the various interaction methods, technologies and paradigms that are useful to support the interaction of older people with ambient technology. It aimed to address the question which interface paradigms are best mapped to the cognitive and motor skills of older people, taken into account that this is a group that is in itself more heterogeneous than the group of -all- other people. The workshop conclusions focused on "natural interaction styles" for older people:

- TV can display graphical user interface, use multimodal elements (audio and video) and requires low degree of expertise;
- remote control is familiar to the user;
- In the forthcoming development, available devices should be used to present adaptive interfaces in the right context;
- (Multi)-Touch interface is a way to provide intuitive input mechanisms;

Speech for activities of daily living has to be emphasised.

[6] Towards Personal Service Robots for the Elderly; G. Baltus et Al. (2000); Computer Science & Robotics, Carnegie Mellon Univ. http://www.cs.cmu.edu/nursebot

[7] http://dai09.cure.at/

5.3. Icons and Symbols

5.3.1. Design

Well-designed icons and symbols can have the following advantages over written commands and labels[8]. They can be:

- more distinctive;
- more efficient for denoting spatial attributes;
- easier to recognise and remember over long periods of time;
- easier and faster to learn when the size of the symbol set is small; and
- language independent

Figure **5** shows a selection of properly designed icons, as specified by the "ISO 7001: Public Information Symbols."

Figure 5: A selection of properly designed Icons, taken from the "ISO 7001: Public Information Symbols". Image downloaded from http://www.tiresias.org/research/guidelines/pictograms.htm.

Simplicity

Icons used for ICT interfaces must be easy to understand. Currently the 'enter' button on most keypads uses a 'return' arrow which is a left-over from the old style typewriters where this icon indicated a 'carriage return'. The meaning is not obvious unless you are old enough to remember moving carriage typewriters.

However, the use of a simple icon, such as the 'return' arrow, is approved of by the Apple Human Interface Guidelines (2008) as they recommend using one easily recognisable object, because the basic shape or silhouette of an icon can help users to quickly identify it. Ziegler and Fähnrich (1988)

[8] http://www.tiresias.org/research/guidelines/pictograms.htm

also state that graphical symbols should be constructed with as few graphical components as possible - usually not more than 2 or 3 components.

Icons such as the icon for on/off seem to evolve with little thought to the difficulties users might have in understanding them. In many cases it would be better to use the appropriate words rather than leave the users to guess the meaning of the icons. This latter suggestion has been confirmed by an investigation carried out by Fennell (2007) into icons and labels for buttons on audio devices, which revealed that partially sighted people show a significant preference for the button to be labelled with a word, rather than an icon, when possible.

Size

According to the ETSI standard 201 379 (1998), no general recommendation can be given on the minimum acceptable size of an icon, this is because what is acceptable depends on a number of parameters:

- The user
- Viewing distance between the user and the interface
- The complexity of the symbol: a simple symbol with one or two elements (e.g. the ISO/IEC symbol for on/off) can be reduced to a very small size and still recognized by most people while a complex one may not
- The display qualities of the medium including: the resolution, the contrast, the focus and glare
- The viewing conditions including environmental factors such as poor illumination, and physiological and psychological factors such as fatigue and workload.

For this reason, the best way to assess the minimum acceptable symbol size is to design the symbol and test it with test subjects from the relevant user target population.

Shape

According to the ETSI standard 201 379 (1998), on some equipment, particularly small machines, special manufacturing considerations or lack of space preclude the use of graphical symbols of the exact recommended shape. In such cases, the design of the graphical symbols used may be modified provided that their pattern differs as little as practicable and still conveys clearly the intended meaning.

Colour

Colour can be informative when used to link information as long as it is used in moderation. It does this by linking elements together, to indicate organisation and relationships. Colour helps in searching tasks by drawing attention.

Colour should not be added just to make the icon more colourful and smooth gradients typically work better than sharp delineations of colour. In addition about 10% of the population are affected

by various types and degrees of colour blindness. Most dominant among these vision deficiencies is the red-green partial colour blindness. Colour vision defects are sex-linked, affecting predominantly males. Icons have to take colour blindness into account. So the distinctions of icons must not solely be based on colours, but has to comprise shapes, saturation and shadings as well.

Adequate contrast between symbol and background is essential. This is especially true for older persons, e.g. suffering from visual impairments. It is recommended that some type of border should always be used around a symbol to prevent it from blending with background images.

5.3.2. Positioning on Devices

The position of labels with text or icons is crucial for an unfamiliar user. All too often labels are positioned in a way that they are obscured from the user's view when the controls are being operated. The problem is particularly common when the control panel is at an acute angle to the user's line of sight or at an inappropriate distance. When deciding on the positioning of graphics or labels, the way people who are left handed use the controls should also be considered. Also, many people with low vision like to get their face close to the control panel to read the labels, or use face-mounted or hand-held magnifiers.

Recommendations

- Symbols should match the medium
- Symbols should create the illusion of manipulatable objects, e.g., it should be clear that they can be selected, how to select them and be obvious when they are selected
- Graphical symbols should be constructed with as few graphical components as possible (usually not more than 2 or 3 components)
- Symbols should always be presented upright
- Smooth gradients of colour typically work better than sharp delineations
- The symbol stands out from the background
- Ensure that each icon is distinct from, and clearly visible within, a surrounding group of symbols
- Symbols should be designed according to a grid, or a basic pattern as human perception is sensitive to optical weight. Thus symbols sharing the same pattern are more easily recognized, and provide a feeling of unity and of consistency
- Angles smaller than 30° as well as filled areas are avoided
- Visual graphics:

- Make icons highly discriminable
- An icon should remain comprehensible and discriminable through any changes in appearance due to changes in its state or mode
- Do not overlap icons
- Do not differentiate by colour alone
- The visual appearance of icons should be consistent within the set of icons
- Label icons consistently

5.4. Use Case Example: To Send an E-Mail to a Relative

As example of ALIAS functionality, email is put forward. Activating the “email application” icon in the main menu, the user accesses visually several functionalities as:

- To check received mails
- To compose new mail
- To choose a familiar contact
- To quit the email application

Figure 6: Example of email menu (from Pawpawmail.com)

To check and read email can be processed fully visually, activating the tasks manually by touching icons.

5.5. Graphical User Interface vs. Vocal User Interface

Graphical user interface: symbolic keyboard and alphanumerical keyboard must work together to achieve an ergonomic and user friendly interface, especially for older users. Several recommendation related to the complementary of both interface can be already issued before the user testing.

1. The user must be able to use simultaneously the graphical user interface and the vocal one. It means for instance that any functionality must be accessible by voice or by graphical interface (menu or text based search). In addition any recognized input requires a visual feedback in order to confirm that a command has been recognized and is being processed.

2. The user must be able to choose if he wants a voice output or not. For any voice output, a textual input should be shown on screen at the same time the system speaks.

3. Icons should be always accompanied by text that can be pronounced as command by the user.

4. The number of options in a dialogue must be limited to a maximum of 5; 3 is best. More options would increase the cognitive load of user and decrease the user satisfaction.

5. For complex task such as form filing tasks, a step by step approach should be preferred.

6. Finally, no complex menu structure should be used, giving preference to the symbolic keyboard with immediate access to preferred application.

6. Description of the integrated software module

6.1. User Interface Requirements

Thanks to WP1, several use case have been defined. Let us review the typical use case in order to study what kinds of components should be integrated.

Use cases can be classified in several groups of functions shown on this table.

- Reminders: alarm clock for drugs and drinking,
- Reading function.
- Writing text: messaging, mailing, managing calendar.
- Simple tasks: device controls, Domotics (Heating system control, Light control, security system control), Robot control.
- Searching function: information about cultural and leisure events, shopping (finding a product), TV On Demand, Video On Demand, searching receipts, search address of people, searching application.
- Complex tasks: Tax calculation, Form filling, Interactive cooking, Learning/teaching function, shopping (buying a product).

In the ALIAS project, several User Interface components can be integrated:

- The symbolic keyboard.
- The virtual alphanumerical symbol.
- The TTS - Text-to-speech component: transforms a text message into an audio stream.
- The speech recognition engine.

These components must strongly cooperate in order to increase the user satisfaction and not decrease it by multiple and not understandable choices. For instance, we should not bore the user with question such as “Do you want to use a Vocal Interface or a Graphical Interface?”. Such question will certainly not be understood by the user.

As several components can be used simultaneously for creating the User Interface, let’s now review which different component should be implemented for each group of function:

- Reminder and reading function requires the implementation of the text-to-speech component. From the graphical user interface perspective, it requires that the graphical user interface must be able to receive external events and show messages on screen.

- To write a text such as an email can be designed to be vocally assisted. The options are:

    - To activate a virtual keyboard to fulfil the tasks (to write the mail content and the mail recipient)

    - To dictate vocally (Speech-to-text) the message content and recipient(s)

These two capabilities may be coupled to allow an alternative in case of a difficulty of usage from one or other techniques.

- Simple tasks will be implemented with a symbolic keyboard and corresponding simple vocal commands.

- Searching function will be implemented with vocal natural commands, the search should be also accessible through the alphanumerical keyboard as keyword based search. Searching function should allow the user expressing naturally.

Complex tasks must be implemented with a step by step approach (question/answer approach).

6.2. First Screen

The first screen should dispatch the user to specific applications: email/chat with relatives, leisure/entertainment, connexion on social network(s), TV/video activation, e-shopping, etc. Though it should be possible to customize the menu system, i.e. change the applications that are accessible to the user.

For each application, people should satisfy their request in a fast, easy-to use and confident way.

- FAST: the process should be reduced at minimum combining “push icon” and vocal activation to fulfil the request.

- EASY-to-USE: the process must be as intuitive as possible for the envisaged older users. The icons should be representative; the use of text to read must be minimized as the training.

- CONFIDENT: the result of the process must be guaranteed in a high level of occurrence. Any failure would imply risks of disinterest of the user.

A searching process should be implemented based not only on the name of application but also based on the need the application should solve. For instance,

- Search by name: I want to open Wii Resort.

- Search by need: I want to play golf.

6.3. User Adaptation of Interface

The last but not least requirement of the ALIAS project is to construct an adaptive and proactive behavior on the robot platform. This adaptive and proactive behavior is developed in work package 3. But for the graphical user interface, this implies strong requirements:

- The graphical user interface should be able to respond to external events: (Send message). An event listener should be then developed to handle such requirement.
- The graphical user interface should be able to modify its appearance according to external data model. This model should change with the user but also over the time (each action of user and/or the hour in the day may change the content of the user interface).

For instance, typical interactions between the graphical user interface and the user profiling module can be:

- The user starts ALIAS main application,
- The user interface asks for the list of functionality that should be shown to the user and show it.
- If the user cannot find on screen the application corresponding to what he wants to do, the user searches the application thanks to the application search engine. Hopefully he succeeds and finds it.
- The user chooses the application
- The user profile is modified by storing the application profile and user related data (time, date of the week, localization, …).
- The application is started.

When the application stops, the list of shown menu options may have changed to include the recently executed application.

7. Current State of GUI and Symbolic Keyboard

Research on the internet revealed that the need for a special user interface for old people was tackled in different projects. Though, so far this need hasn't been met. Interestingly the proposed requirements and demands on such a “user interface for older users” are pretty much alike: A plain screen, containing three to six large buttons, either leading to another sub-menu or launching an application. The most demanded applications being “Internet” (i.e. a web-browser,) “Mail” (i.e. an e-Mail-Client,) and “Skype” (i.e. a video chat or chat application.)

7.1. An Existing Software as a “Template”

The most fitting already existing software package the ALIAS consortium is aware of is called “Eldy”. Eldy is Italian closed-source freeware software that turns any standard PC into an easy-to-use computer for people that have never used a computer before, as stated on http://www.eldy.eu. Besides multi-language support (22 languages) it incorporates usability studies, conducted at University of Padua, Center for Cognitive Science (cf. http://www.eldy.eu/software/usability/). Because of this and the fact that Eldy follows a similar design paradigm as planed for the ALIAS user interface, it has been decided to use some parts of this software as raw model for the ALIAS interface.

Figure **7** shows the Eldy main menu, the so-called “Square.” The Square is a plain screen which contains six easy recognizable “user friendly” buttons at its center. Each button represents a different feature, leading to another sub-menu or an integrated application. In Eldy all buttons and captions are a certain degree larger than on common PC software, furthermore each button features an easily recognizable icon. Also the mouse cursor is nicely enlarged and way more visible that with common PC software.)

Figure 7: The so-called Square represents the Eldy main menu. It features six easyly recognizable large buttons at its center. On the top is the typical Eldy title bar showing the current location (i.e. the menu name) and the generic help and exit buttons.

Eldy is not a launcher for external programs, like Firefox or Thunderbird. Instead all its features are integrated components. For example if one performs a click on the "Surf the Web"-button, the Square menu will be replaced by an integrated web-browser, see Figure **8**. While the browser is not a stand-alone application, it becomes part of the Eldy interface following the same design paradigm, having the same "elderly-friendly" look and feel as the surrounding system. Meaning the web-browser uses large fonts only the most basic controls (address input, back, forward, home, and print.) This is the similar feature as it is desired for the ALIAS system.

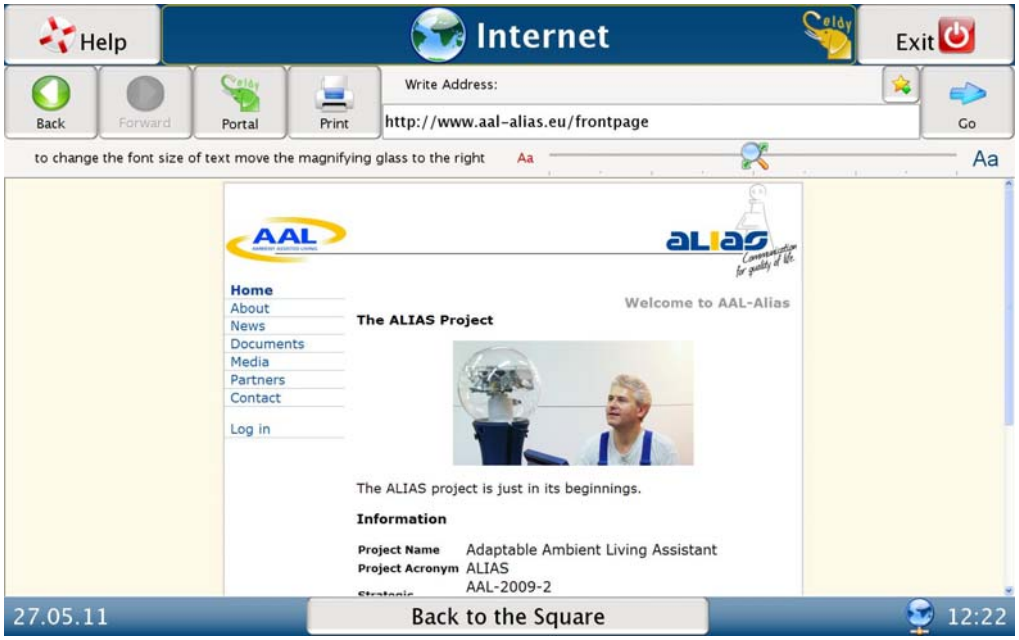


Figure 8: The Eldy web-browser is an application, completely integrated in the Eldy menu system. It's a plain browser stripped off all commonly used gadgets and needless features. Again, fonts are a certain amount larger than usually and at the bottom is a „back" button, leading back to the Square or to the previous menu, respectively.

On the downside, however, Eldy is not customizable. Menu structures and layout stay the same at all time. This is pretty fine because it enables the user to grow accustomed to the system – assuming the user has the ability to do this. Here, ALIAS chooses the opposite direction, i.e. the ALIAS interface should adapt to its user, not the other way around. If a person, for reasons whatsoever, is unable to press any buttons on the left side of the screen, the ALIAS interface will move the button to the right side, only.

Another thing that can be learned from examining Eldy is that menus require animations, layout alterations or some kind of additional feedback when changed. For example Eldy's "Mail" sub-menu contains three large buttons (Read, Write, and Address book). In case the "Read" button is pushed, it leads the user to another sub-menu, again containing three buttons. Since these buttons are of the same size and in the exact same locations as the button of the previous menu, the change in menus easily goes unnoticed. This might confuse the user, lead him/her to mistake the system for broken or

make him/her push the button again; not realizing that by now this is a different button which has a whole other meaning.

7.2. The ALIAS Main Menu

This section presents the current (preliminary) version of the ALIAS graphical user interface. The main menu of the ALIAS graphical user interface, as depicted in Figure **9**, consists of six large buttons similar to the Eldy Square. Please note that this is still a work in progress, thus neither layout nor design can be considered as final and are likely to change in the future.

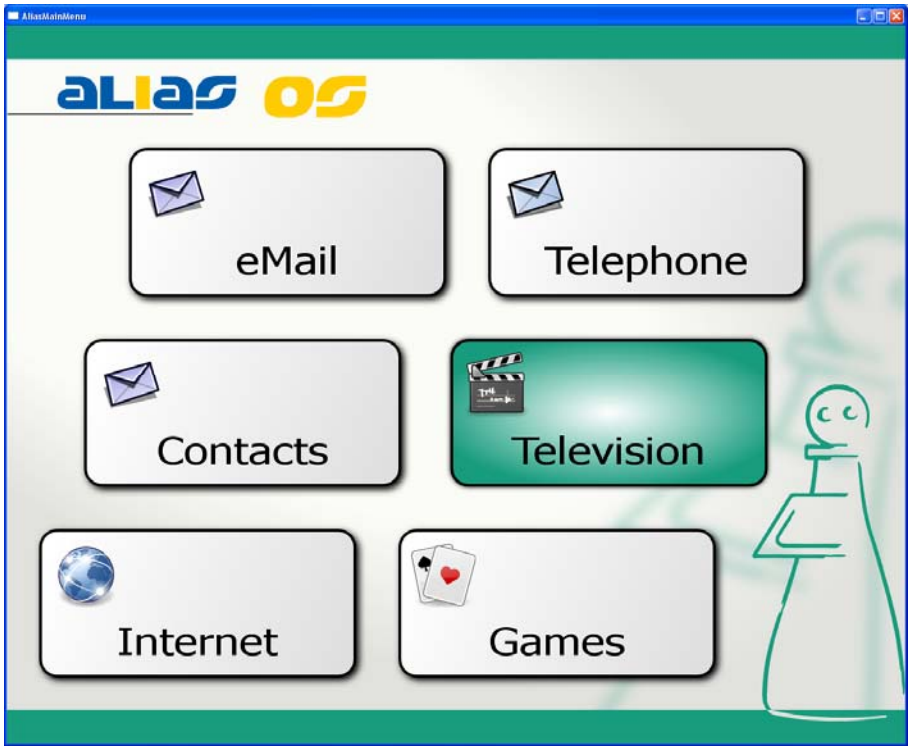


Figure 9: The current version of the ALIAS main menu. It contains six large buttons, similar to the Eldy Square. However, button style, position and function are defined by means of editing external XML configuration files. The same holds for background image and menu layout.

Initially this menu was intended to be a launcher for external applications. But after careful consideration this seemed no longer appropriate. Since every external program comes with its very own graphical user interface, doing so would lead to a mix of various different interfaces. Whereas some programs allow total or at least limited reconfiguration of their appearances others don't. So a consistent adaption to the users needs would not be possible.

It was decided to integrate components / programs into a unified user interface as far as possible. Unfortunately this results in a higher workload than originally planed but is absolutely necessary in order to provide a high quality user experience. Another great advantage of doing so is that the system attains full control over the available functions and features, offered to the user. So the system will be able to provide the user with simplified interfaces, containing the most basic functionality, only. This should result in cleaner and less intimidating interfaces that are way easier to

handle and comprehend – even for persons with limited PC experience. In addition the application interfaces can be adapted use with the ALIAS robot's touch screen and speech input.

The entire menu structure is intended to be adaptable. This is realized by means of a set of XML formatted configuration files. One XML file defines the general style by including several classes of menu and button designs. Each menu class describes the menu's appearance; its layout, background, and visual effects. For example there may be a "Square" menu class as depicted in **Figure 9** while another XML file might define an iPod-like Cover-Flow menu class, where the user could (by means of the touch screen) flip thru applications like he would with a box of LPs. (Validation of modified XML files is done by means of document type "Document Type Definition" files, as described by the XML standard.)

Another configuration file does the same for the buttons. Each button must belong to a predefined button class. There will be classes for large main menu buttons, smaller toolbar buttons, text-only buttons, or clickable icons. Each button may have several states like "normal", or "pressed." **Figure 10** shows a diagram of the fictive "default" style.

- Style: Default
  - Menu Classes
    - Menu Class: Square Layout
    - Menu Class: Vertical Layout
  - Button Classes
    - Button Class: Menu
      - State Normal
      - State Pressed
    - Button Class: Menu Icon Only
      - State Normal
      - State Pressed
    - Button Class: Toolbar
      - State Normal
      - State Pressed
    - Button Class: Toolbar Icon Only
      - State Normal
      - State Pressed

Figure 10: Overview of the ALIAS GUI style description structure.

These menu and button classes define the appearance (and handling) of the entire user interface. By providing special classes optimized for certain special needs (e.g. high contrast or extra large text-only), the interface can be adapted to account for several disabilities and/or the user's personal preferences.

Finally another category of XML formatted configuration files defines the actual menu contents, meaning the function, caption and pictogram of each button. Such a menu content file may in some cases even be able to control the menu layout. The menu content also defines interconnections between multiple sub-menus. The menu content may be fixed or it could also depend on the time of the day or the day of the week.

At this point there is only one a single "debug"-class and a single default menu layout available, since the configuration file structure is still being redefined and updated during development. The plan is

to provide a wide variety of style classed and menu layout, ranging from eye-candy to black-&-white high contrast.

In general each button requires specification of a text, an icon and a button class. Buttons are composed of a set of pre-rendered background graphics, a caption, font and an icon in scalable vector format. The button class defines in what manner these components are composed for each button state, pressed or un-pressed.

7.3. Interaction with Menus

Interaction with the menu system requires feedback. In the event the user provides the system with an input, he should receive some kind of notification ensuring that his command is being processed, executed, or even rejected. Otherwise the user might suspect his input has been missed by the system, in consequence he would push the button again, ending up sending the same command over and over. Hence the graphical user interface is supposed to implement some kind color or changes for pressed buttons or animations for menu transitions. The user doesn't need to follow these animations, they are meant to provide feedback to the user to signalize that a command has been recognized and will be processed.

7.4. Virtual Keyboard

The virtual keyboard, used for text and numeric inputs is most likely to become a licensed third party product. The Hot Virtual Keyboard (http://hot-virtual-keyboard.com) offers great freedom for customization. At this point it seems most effective licensing this software instead of developing an own version. It is possible to implement matching keyboard skins for every supported button style, as well as optimized keyboard configurations for different types of inputs (text or numbers.) The Hot Virtual Keyboard integrates into the Windows operation system, so it can be used with external or embedded programs also. This allows us to concentrate on integration of external software like Skype, Firefox, and the Hot Virtual Keyboard itself.

Figure **11** shows the Hot Virtual Keyboard layout editor, which can be used to configure every single key individually. These keys are configured using a similar approach as the menu's button class definitions.

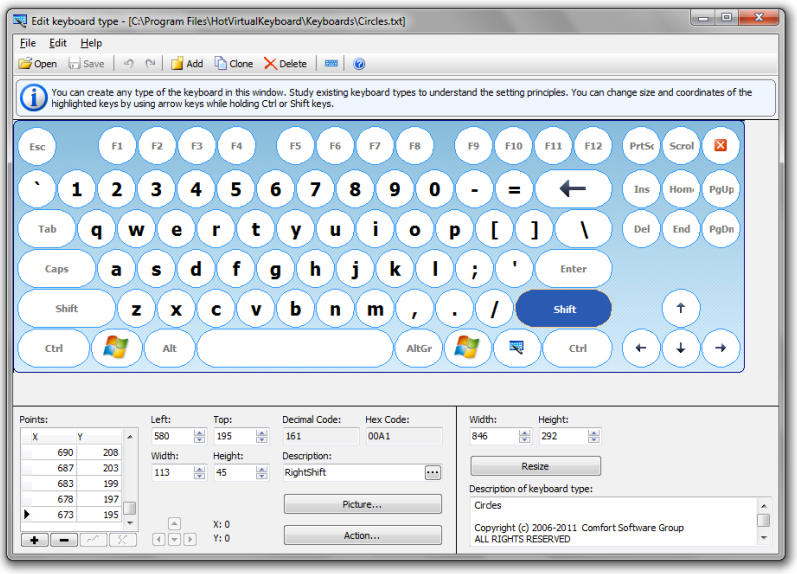
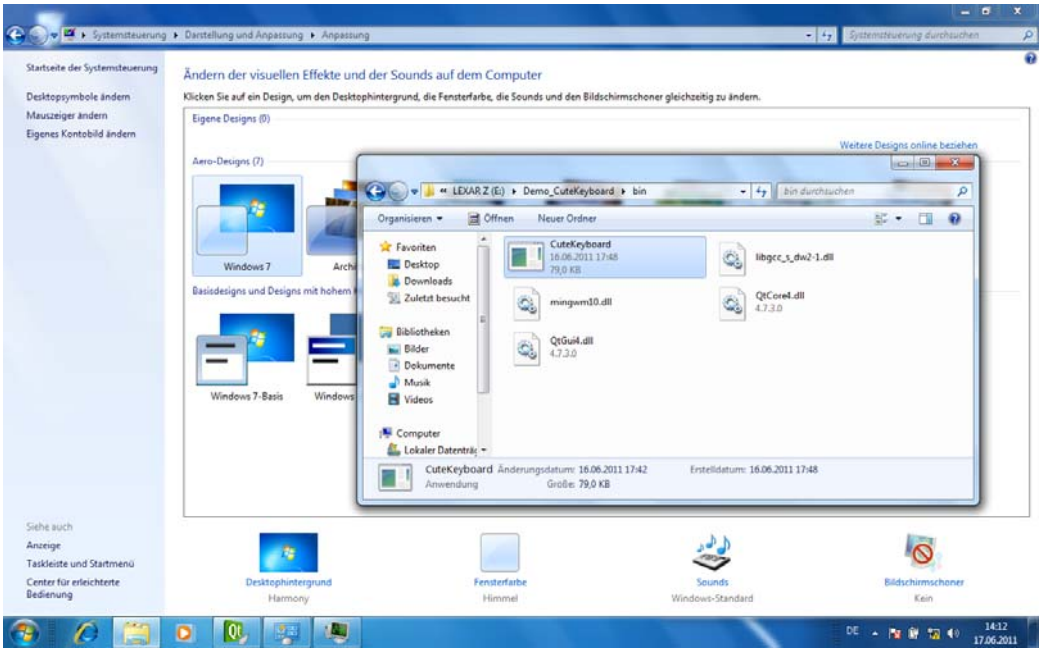


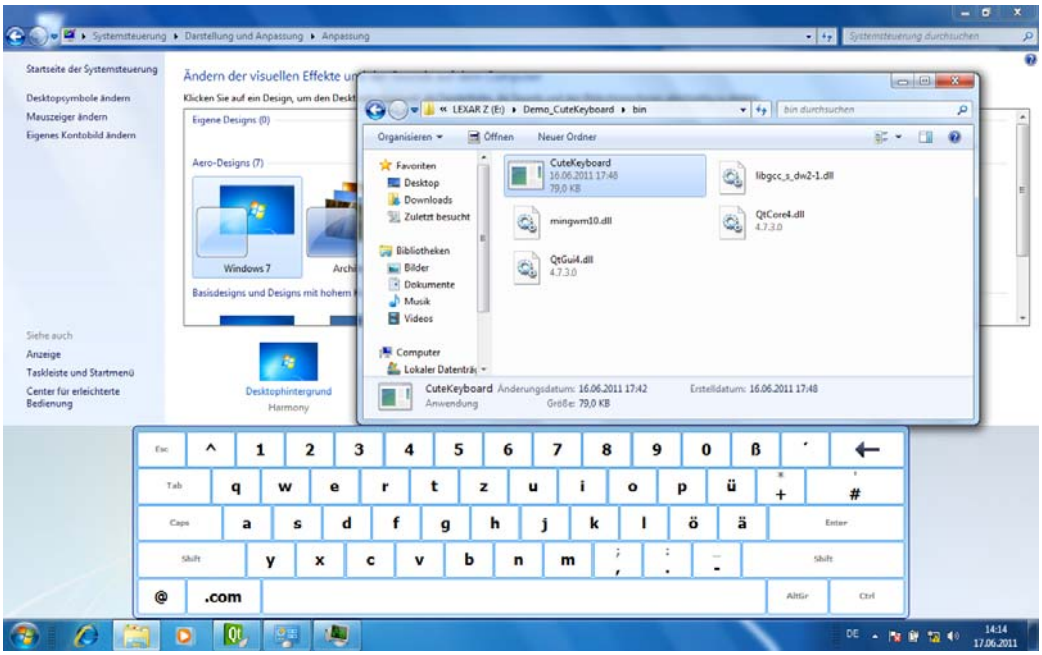
Figure 11: The Hot Virtual Keyboard layout editor offers a great deal of freedom for designing custom keyboard layouts. Buttons may either use a fixed predefined design or can be represented by a series of graphic files.

Normally the Hot Virtual Keyboard shows up as a floating window atop other programs. In most cases this behavior seems to be just fine, but not for ALIAS. The ALIAS interface accounts for users with limited computer experience or disabilities. So a floating keyboard, which has to be moved when blocking access to buttons or displays would be a great annoyance. Thus the ALIAS virtual keyboard will be integrated at a fixed position.

Figure 12 illustrates the behavior of common Windows applications, in case the virtual keyboard is activated. Existing screen contents are pushed aside to make room for the keyboard. Thus the keyboard won't cover any screen contents; neither will the keyboard be blocked by other applications. In consequence the ALIAS menu and the provided functionality / integrated software must be able to operate at a reduced screen size, due to the virtual keyboard.



Screen before activating the virtual keyboard.



Screen with the virtual keyboard activated.

Figure 12: Integration of the Hot Virtual Keyboard. The upper picture shows a common computer screen, containing maximized and floating windows. In case the virtual keyboard is activated, initial screen contents are "pushed aside" in order to provide space for the keyboard. So no actual content is blocked or hidden by the virtual keyboard. In case the keyboard is deactivated, maximized windows will be restored, while floating windows remain at their current position. (The ALIAS interface is likely not to contain any floating windows.)

8. Next Steps

The ALIAS graphical user interface is a work in progress and still subject to further development. None of the presented functionality is final and likely to be adapted to design changes and external interface updates.

In addition it has been decided to avoid the use of external “stand-alone” applications as far as possible. Meaning external programs should be seamlessly integrated to the ALIAS GUI, if possible, or replaced by self-developed components. Doing so will allow more control over provided functionality, GUI layouts, and program configurations. This results in an increase in workload, but is absolutely necessary in order to provide an optimal user experience.

The next steps will include:

- Further development of the GUI structure and functionality. This includes
    - Interfaces to the dialog manager
    - Interfaces to external applications
    - Integration of external applications, if possible
    - Implementation of the actual menu functionality, i.e. rewriting applications that cannot be integrated with the ALIAS menu system, properly
- Design and implementation of additional menu layouts.
- Design and implementation of required virtual keyboard layouts and configurations, matching the menu system styles and application requirements
- Refinement of the XML configuration structure, in accordance to evolving menu structure.

9. Conclusion

Older users require specially designed interfaces that are: simple, affordable, always ready, integrate easily in their living environment and offer a single access point for all services.

Computer technologies are a promising method of increasing the quality of life of older persons providing that the designed systems accommodate to specific needs of these users. In general, the user interface is unnecessarily complex and far from easy to use.

Many improvements have been done on virtual keyboards. Virtual keyboards with text prediction are more and more implemented on Tablet PC and Smart-Phone. With its last version, just recently released, Google pushes new perspective on this technology, and it challenges other providers. Because the virtual keyboard is a component that cannot be put aside from the roadmap of Tablet PC and Smart phone development, the evolution in this matter should be very rapid in the coming years. Reuse and test the existing system is therefore a valuable option for the ALIAS project.