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MOVEMENT

Modular Versatile Mobility Enhancement Technology

Specific Targeted Research or Innovation Project
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D5.3 – Prototype Implementation of selected Communication Services

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Content

1	Introduction	5
2	Selection of communication services	5
2.1	Voice over IP telephony.....	5
2.2	Web-Browsing	6
2.3	Text-to-speech communication	7
3	The SW Structure for Communication.....	8
3.1	General	8
3.2	UI Structure.....	8
3.3	Configuration	9
3.4	Drivers	10
3.4.1	Input.....	10
3.4.2	Output	11
3.4.3	SOAP	12
3.4.4	Launch external programs.....	13
4	Communication prototype design	14
4.1	Telephone communication	15
4.2	Internet browsing	16
4.3	Text-to-speech communication	17
4.4	Alerts from Environmental Monitoring	18
4.5	Communication functionality checklist.....	19
4.6	Conclusions	19

Fig. 1: The prototypes as planned in the MOVEMENT project 5

Fig. 2: Screenshot of Skype (left) and a SIPPS client (right)..... 6

Fig. 3: General structure of the MOVEMENT UI 9

Fig. 4: General structure of the MOVEMENT UI configuration 10

Fig. 5: MOVEMENT ICT and UI modules..... 14

Fig. 6: Telephone menu within the UI..... 15

Fig. 7: Menu for incoming phone call..... 16

Fig. 8: Internet browser within the UI..... 17

Fig. 9: Speech communication within the UI 17

Fig. 10: List of alerts within the UI 18

Glossary of terms and acronyms

- SS** System Scout (Base Station) module
- UI** User Interface module
- ICT** Information and Communication module
- EC** Environment Control module
- PA** Personal Alarm module
- TEU** Task Execution module
- MFC** Multifunctional Chair module
- PT/1/2/3** Prototype 1/2/3 of MOVEMENT system

Mobile Base or Platform, MP

Core part of the MOVEMENT system. Can dock application modules and move them around

Application Modules

Functional units to be used in combination with mobile base

- UMPC** Ultra Mobile PC
- OS** Operating System
- SOAP** XML and HTTP based communication protocol
- PSTN** Public switched telephone network

1 Introduction

This document describes the communication services implemented in the application modules built for the third prototype of the MOVEMENT system (PT3). As depicted in the table below, MOVEMENT is based on a set of prototype modules where the ICT-Terminal (ICT) is the module foreseen to offer communication functionalities.

	Application or function concerning the movement of ...		
	People	Objects	Information
Prototype 1 Functional Prototype	Standard Chair		ICT-Terminal with environmental control
Prototype 2 Verification Prototype	Standard Chair MF-Chair Lifter-Walker		ICT-Terminal with environmental control and user communication
Prototype 3 Demonstration Prototype	Standard Chair MF-Chair Lifter-Walker/	Table / Container module and preparation for manipulator	ICT-Terminal with environmental control, user communication and monitoring / alarm system

Fig. 1: The prototypes as planned in the MOVEMENT project

The MOVEMENT system also contains a User Interface (UI) module that typically is mounted on the application modules used for transport of people (see above table). During the development phase the UI was designed to be HW and SW compatible to the ICT, therefore UI and ICT can be considered the same regarding communication functions (despite the apparent difference in size).

The development of the UI and ICT as a prototype was already described in detail in several deliverables dedicated to the 3 prototype stages (D7.x - prototypes, D5.x - communication, D3.x - UI), therefore only a condensed summary of the communication service implementation will be given in this document.

2 Selection of communication services

Communication features can be found in many of today's computer applications, but currently no assimilable all-in-one solution could be found on the market. Therefore, a couple of current state of the art applications were tested, that make some of the required features available to users.

The first decision that was to be made was about the operating system. It was decided to go for the Microsoft Windows family of OS, for which the majority of AT solutions (HW and SW) exists. With this selection there is a wide range of commercial devices and software that could be adopted for MOVEMENT.

With the flexibility built into the MOVEMENT UI and ICT SW it is possible to integrate virtually any SW or HW communication by means of the driver layer. A selection had to be made where distance and local communication both could be demonstrated in an exemplary way.

The MOVEMENT UI supports the user communication through the open driver system. To show the benefits for the users, finally three services were implemented:

- Voice calls (active and passive) via Skype
- Internet browsing via Microsoft Internet Explorer (this service also supports email via web clients)
- Local speech output for selected phrases.

2.1 Voice over IP telephony

Telephony still is a very important communication feature. It would have been a very simple approach to integrate the remote control of a hands-free telephone into the UI (as already possible with the EC functions of the prototypes). Nowadays classic PSTN telephony is replaced by IP based solutions.

Currently many providers offer Voice over IP solutions. Some of them are mentioned here to give an overview:

- SIPPS (<http://www.sippstar.com>) by Nero
- PC2Phone (<http://web.net2phone.com>) by net2phone
- Pc to Phone (http://www.icconnecthere.com/nonmembers/eng/pc_to_phone/index.htm) by icconnecthere
- Skype (<http://www.skype.com>) by Skype (proprietary protocol)

Most of these solutions are PC to PSTN solutions and most of them have no accessible user interface or available programming interface.

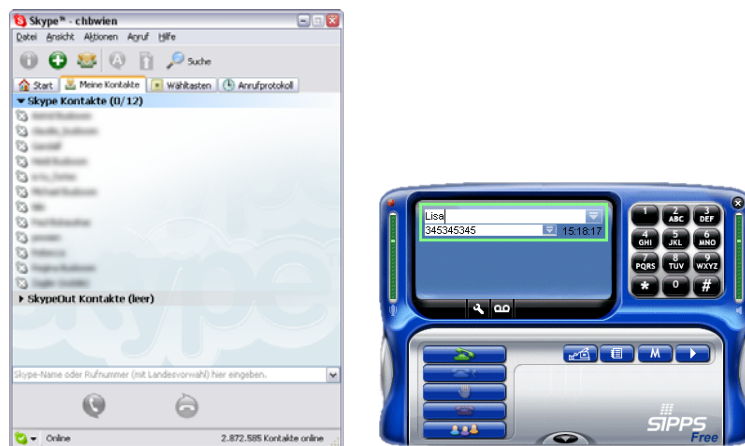


Fig. 2: Screenshot of Skype (left) and a SIPPS client (right)

The decision to use Skype is based on the following facts:

- Skype offers a free programming API, the client is free for private and commercial use (as of 07/2006).
- Skype offers PC to PSTN voice calls and PC to PC voice and video calls
- Skype offers Instant messaging from PC to PC and Short Message Service (SMS) from PC to PSTN
- Skype offers incoming calls from PC and PSTN
- Skype works with different network solutions

Skype offers all needed functionality with a free API. No further licence costs are to be paid. Therefore Skype technology will be used for the exemplary integration of communication.

Of course with more and more VOIP applications using SIP it seems obvious that SIP compatible communication will become interesting in the near future, this will depend on the call pricing and development of user numbers.

The voice communication supports active calls to/from other PCs (free) and to/from standard telephones (landline and mobile – paid service) from an address book or by typing in the name (PC) or number (telephone). The voice communication can be supported by the text-to-speech system for non-speaking persons. With this feature set, a normal telephone can be fully replaced with this accessible communication.

2.2 Web-Browsing

A variety of internet browsers are available for the Windows platform. The UI will be operable with many different input devices. The standard browsers are operable with mouse like devices and more or less with keyboard only, but none of the common browsers are operable with special input devices alone.

The UI should be able to use the special input devices to control a standard browser. The decision was taken to use the Microsoft Internet Explorer that is available per default on every Windows system and embed it transparently into the UI. The Internet Explorer offers a very easy to control programming interface (ActiveX) and is therefore the best solution for this special case (this does not in any way lessen the value of other browsers like Firefox).

Gathering information from the internet is a common demand. This information may be of local nature (e.g. intranet in care centres) or global (e.g. news, weather, ...). Additionally, communication via email or other messaging systems may be used with any internet browser. Internet radio gives the user the possibility to hear music or to get vocal information.

By incorporating the Microsoft Internet Explorer a common feature rich internet browser is accessible for the MOVEMENT users. It is possible to use the standard features of the browser with all input devices supported by the UI. Typing in text (new URLs, email text, keywords for searches, ...) needs a keyboard style input device. Onscreen keyboard features may be incorporated for this purpose within the UI.

2.3 Text-to-speech communication

The communication over distance must not block the view on the importance of the local voice communication. People with difficulty to form clear voice utterances can make use of PC-based speech generation to express themselves. Again, the structure of the UI could be easily adapted to control external devices for this purpose but it is also easy to fully integrate the generation of speech into the UI SW.

If onscreen keyboard features are incorporated in the UI free text-to-speech generation could be used. For the demonstration currently only fixed phrases selectable via easily recognisable icons are implemented.

3 The SW Structure for Communication

3.1 General

For ease of reading the ICT application and the UI module will further on become subsumed in this document under the term “UI” because they are based on the same principles realised in the MOVUI SW. If it is important to make a distinction between the two implementations, it will be indicated clearly.

The UI is based on the concept of the AUTONOMY system and uses parts of its code. AUTONOMY is an outcome of international and national research projects and is owned by TUW so the source code is available.

The base structure and the base functionality of AUTONOMY already meet some of the needs of the main goals of the UI and already proved its flexibility in practical use. It was therefore decided to use it as baseline for the MOVEMENT UI.

Some of the features needed for the UI are:

- Easy-to-use (hands-free) telephony
- Sending and receiving messages
- Seamless integration of a web browser
- Configuration changes “on the fly”
- Launching of external programs

In the following an overview on the structure of the UI supporting the integration of communication will be given.

3.2 UI Structure

The basis of the UI is the kernel, which is connected to all other incorporated technologies via dedicated drivers.

The input devices (such as single switch, multiple switch, digital joystick, pointing devices, emulated devices via the MOVEMENT system ...) are connected via input drivers. Adaptations to the behaviour of input devices (e.g. which single switch will have which function) are done within configuration files.

Feedback will be provided again via a driver layer. Options for the feedback (e.g. type of voice used for speech) may also be set within configuration files.

All MOVEMENT related driving and control functions are centralised in one specific MOVEMENT driver that acts as input and output driver. Using this driver information to the MOVEMENT system and events from the MOVEMENT system are handled.

Enhanced communication (voice calls, internet, email, ...) is done via specialised drivers and the usage of existing technology such as Skype or Microsoft Internet Explorer. Due to the driver structure, other products or product changes can be incorporated with little effort.

Output devices (e.g. IR on the ICT or a Homebus system via BS) will also be connected through drivers, making it possible to control external communication devices via MOVEMENT UI.

The TCP/IP connection to Internet (used for browsing and VOIP) is made via a WLAN link to the BS that acts as a gateway for the whole MOVEMENT system. All MOVEMENT SOAP communication is also handled over this WLAN link.

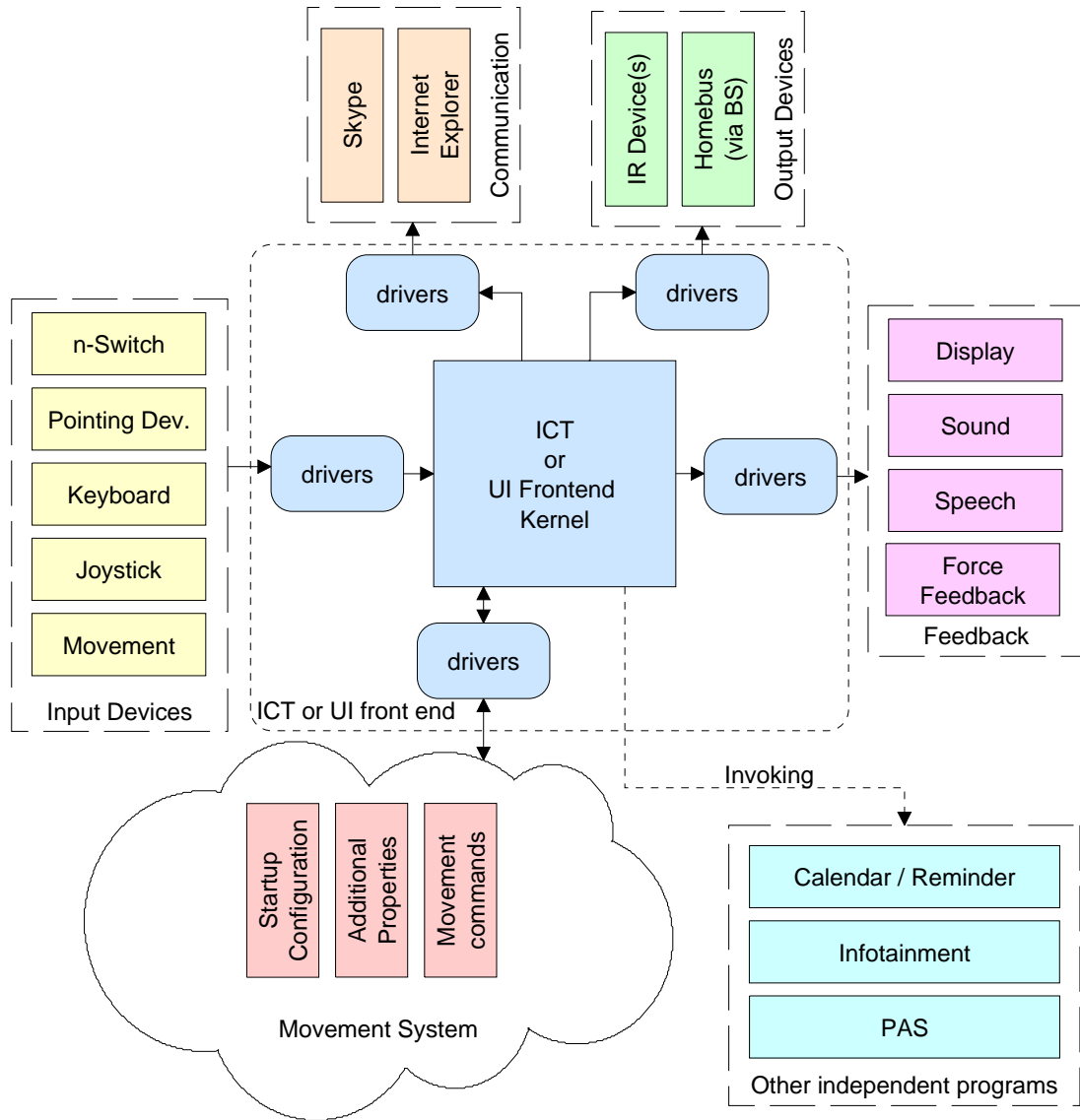


Fig. 3: General structure of the MOVEMENT UI

3.3 Configuration

The already very flexible general structure is supported by a flexible configuration structure, shown in Fig. 4. The drivers can read out some parts of the configuration and drivers may use command references from the configuration. Due to this feature, adding a new driver to an existing installation only needs a small adaptation of the configuration (telling the MOVEMENT UI to load the new driver and optionally setting some driver parameters).

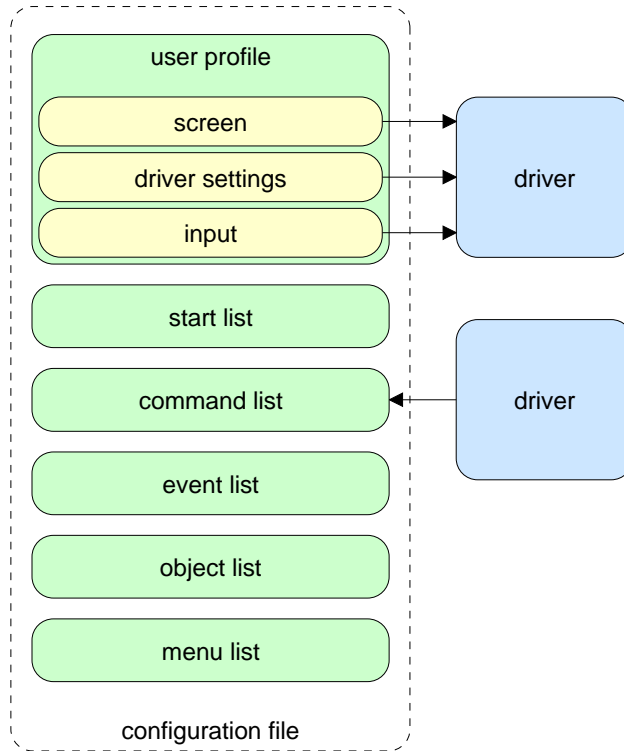


Fig. 4: General structure of the MOVEMENT UI configuration

3.4 Drivers

The UI itself offers already a very flexible output design via its configuration that allows to choose the appearance of the UI over a wide range taking into consideration already bi- or multi-modal input and output channels.

Furthermore, the project supports common standards for inclusion of input and output devices and AT technology. For this purpose, standard legacy PC interfaces like RS232 (direct or via USB converter) and USB, as well as CAN bus (for the chair UI) are supported in the UI. This way all technology that will normally run (via drivers) on a standard PC will also be supported in the UI.

The list of drivers to be used and the configuration for each driver are part of the user profile in the configuration. Each driver is defined by its name (the filename without the file-extension) and has a driver-dependent set of configuration data. The drivers are divided into the categories input and output and connect a wide range of devices and software modules to the Movement UI using a rather simple and well-defined interface taken over from the AUTONOMY application.

3.4.1 Input

For use as input devices, everything that can be connected e.g. via RS232 or USB and is able to generate mouse or keyboard events is directly supported (many special input devices for PC). In fact the basic requirements for navigating in the UI are reduced to a single select event (i.e. press of “enter” key or mouse click) when the auto scanning option is activated. This option moves the focus from the currently highlighted command icon to the next one after predefined (configurable) intervals such allowing to activate commands by pressing a single switch or other actuator when the icon of choice has the focus.

Input devices providing standard key or mouse events (e.g. cursor keys, tabulator key, mouse click) are integrated by means of two MOVEMENT input drivers provided together with the core system.

Technologies supported in this way include (exemplary list):

- Integramouse (USB)
- Eyegaze/Eyetrackers
- Speech Recognition
- Any other device performing a single action e.g. proximity switches
- Applications (e.g. other user interfaces or programs) that send simulated key events to the UI via the SOAP link or OS internal communication
- Devices connected to the BS which status can be checked by the UI via the SOAP link
- Curtis MC-2 family CAN bus devices that can be either used independently with their actuator counterparts and without involvement of the UI to control e.g. lights, seat adjustment etc. or be used as additional input devices into the MOVEMENT system. Examples are the joystick normally used for driving, the MC-2 head control, Sip&puff or Tash switch interface.
- Serial Key interfaces, either Windows native or via the 'General Input Device Emulating Interface' (GIDEI) compatible TUW module 'istuKeys'.

If the device in question does not provide standard key events (or a simulation of such events) or the mouse (for example some switch devices like Penta, Star or a joystick connected via SensorBox or similar RS232 interfaces), a MOVEMENT input driver tailored for the respective device can do the necessary translation.

Input drivers take events from input devices and convert them into a standardized set of input events. These input events are sent to the driver manager which converts them into Movement UI internal commands. Available input drivers up to now are:

- Keyboard

Driver type ID: "8193"

Device ID: "4"

The driver Keybd.ngd supports all kind of standard PC keyboard devices and can be configured to use almost any available key.

The used keys may be changed within the configuration. The default values are:

- carret up, down, left, right for up, down, left, right
- enter for select/fire
- Numpad 0 for next

- Mouse

Driver type ID: "8194"

Device ID: "7"

The driver Mouse.ngd supports all kind of pointing devices that act like a standard mouse device. The driver may be configured to support the touch (executing an object on click) and movepos (moving the focus to the object pointed to) functionality.

- SensorBox

Driver type ID: "8195"

Device ID: "5"

The driver SensorBx.ngd supports all input devices that are connected using the RehaKomm SensorBox device on a standard serial port. The pin assignment may be freely defined in the driver configuration.

3.4.2 Output

On the output side, sound and TTS support is built-in via dedicated drivers. An EC driver is provided for IR remote controls directly local at the ICT (as opposed to via BS).

If the device in question does need it, a MOVEMENT output driver can do the necessary translation.

The Movement UI hands a certain type of command without further processing directly over to the driver manager. The manager converts the data into a driver-internal format and sends the command to the drivers. Available output drivers up to now are:

- MPScan

Driver type ID: "2"

Device ID: "2"

The driver MPScan.ngd supports the infrared scan module from Meschik & Partner. This module can send any type of infrared code and thus control TV, DVD player, and a lot of other electronic devices.

- SAPI5

Driver type ID: "3"

Device ID: "6"

The driver SAPI5.ngd supports the SAPI5 interface for TextToSpeech output. The current version is not able to "collect" text for later talking but speaks every text immediately.

- Waveout

Driver type ID: "1"

Device ID: "1"

The driver Waveout.ngd supports the playback of all wave sound (compressed and uncompressed) files. The sound data may be either a standalone file or embedded in the command data block.

3.4.3 SOAP

The UI driver Movsoap.ngd uses the MOVEMENT SOAP protocol and is the connection to services on the BS and a link to commands from another UI to the ICT.

Driver file name: "movsoap.ngd"

Driver type ID: "16385"

Device ID: "3"

The driver can be configured to expect other services on the same IP as the UI, on explicitly specified URIs, or can look up the services via the SSCOUT, which URI either can be explicitly specified or calculated as lowest IP on the subnet the MOVUI is on.

The SOAP driver currently also implements EC driver service proxies for control of the environment and alert messages from the environment, see also MOVEMENT SOAP definitions.

The soap driver also implements one input service (controls sent to the UI), implementing basic UI navigation:

FIRE, SELECT, ENTER

LEFT

RIGHT

UP

DOWN

TAB, NEXT

With this interface the UI (on ICT) can be remote controlled from another UI (e.g. on Chair).

A separate detailed interface specification is available from TUW for the implementation of these drivers.

3.4.4 Launch external programs

The UI can launch any natively running PC application and such offers extendibility beyond the open MOVEMENT driver concept. Such applications are free to use all shared resources on the host but are otherwise on their own regarding user interaction.

It may be necessary to implement a way to control focus setting between the UI and the application with all the input devices used.

4 Communication prototype design

A PC-based ICT workstation, mounted on a table (similar to module table/container) that can dock to the mobile platform and “come to the user”, thus bringing to him/her information-based contents and tools, as well as a fully-featured version of the User Interface to the MOVEMENT System have been developed for MOVEMENT. Below pictures of the prototypes are described.

Fig. 5: MOVEMENT ICT and UI modules



ICT-Terminal showing communication screen, special input device (right), IR transmitter (right back) and microphone.



UI with joystick mounted on a Chair module showing the main menu. The lower left icon leads the user to the communication menu.

The communication extensions are implemented by the UI software.

The main requirements for the communication SW were threefold:

- Integrate the ICT application module into the MOVEMENT system and allow remote operation via the MOVEMENT UI (MOVEMENT docking and communication)
- Implement selected services in a way that they are accessible for users with varying abilities ranging from (remote) single switch input for severely handicapped persons to (direct) touch-screen operation for older persons providing consistent feedback (flexible multi-modal i/o)
- Keep the application open for integration of existing 3rd party solutions and add-ons (HW and SW) (exemplary implementation with flexible configuration, widespread platform)

The decision to go for a Windows type OS to allow existing I/O devices and software in the market to be integrated easily into the MOVEMENT ICT application resulted in the use of a touchscreen PC for the ICT and a smaller fully compatible UMPC for the UI.

As already described the ICT SW is based on the same architecture as the MOVEMENT UI SW (thus all services on the ICT can also run on the UI). Such a central standalone application acts as the interface between the user and the MOVEMENT system. The behaviour of the UI is fully determined by the configuration settings that define the screen layout and the reaction to user input and system events. In this way the UI can be adapted to the needs of individual users. The configuration is a plain text file that contains a description of the UI in XML. All input and output is done via a driver layer, allowing to add new functionality easily. One of the drivers is specific to the communication within the MOVEMENT system. This architecture facilitated a lot the implementation of communication services.

For the exemplary implementation within the project the three communication services

- Telephony communication
- Internet browsing
- Text-to-speech communication

have been selected after positive feedback from the users to the presented “transport of information” scenarios.

The three services are available from the UI or ICT Communication Menu.

Specifically, a new driver for telephony services via Skype (see <http://www.skype.com>), a proprietary but free VOIP conferencing solution and a new UI object for internet browsing via the Windows internal browser Internet Explorer were added to the UI SW package. Already for the first prototypes a driver for text-to-speech output via the Windows internal SAPI interface was implemented.

The screenshots presented below are only examples for prototype testing purposes of what can be done with the developed SW package. Because of the flexible structure of the UI SW, the layout of the UI screens, the icons and texts (e.g. for different languages) and the offered functionality can be chosen by modification of the XML configuration file. Such individual setups can be provided for every user and stored on the BS, the desired configuration can then be retrieved via SOAP from the BS via the UI e.g. by activating a specific icon on the UI.

4.1 Telephone communication

The specific goal for this communication service was to bring hands-free telephony to the user. While there exist several commercial telephony applications, either proprietary UI solutions or remote controllable PSTN or DECT telephones, none of them would have been easier to integrate into the specific MOVEMENT communication concept than the chosen VOIP solution. All that is needed is already included in the ICT HW: a PC compatible processor, internet connection via WLAN, microphone and speakers,

Telephone services offered:

- Calling a person by selecting an icon with the pre-stored name or number
- Calling a person by dialling a number
- Answering incoming calls

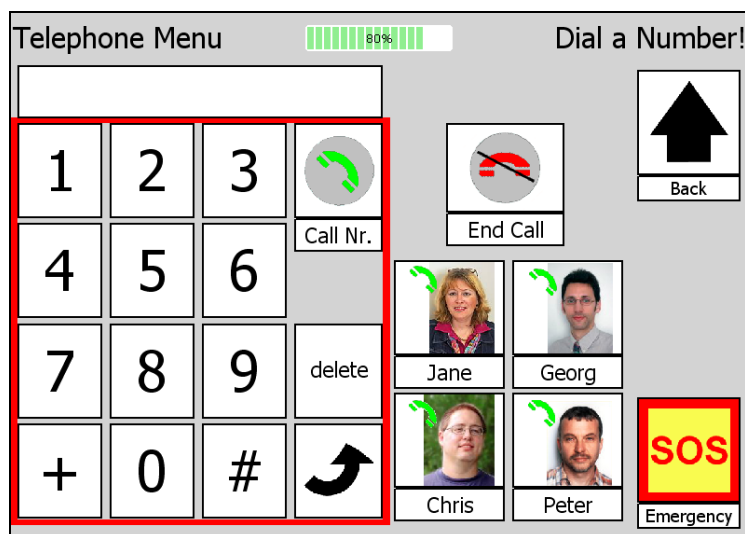


Fig. 6: Telephone menu within the UI

The developed telephone application is fully embedded into the MOVEMENT UI and such under full control of the user via his/her preferred input method. Besides this, other forms of telephony communication (via

other HW and/or SW) could of course be integrated by 3rd parties, but it will be necessary to make modifications (provide drivers) to integrate them as tight as required to achieve a uniform input/output behaviour according to the user preferences.

As can be seen from above screenshot there is a block with a number pad to enter arbitrary telephone numbers worldwide to call (this service has to be paid), but there is also a block of pre-defined phone contacts that can be called by simple selection of an icon with the image of the person to call. The latter will be especially advantageous for people with difficulty memorising phone numbers.

A function for ending a call and a text box holding the name or number of the currently selected phone contact complete the basic phone menu.

In the background the telephone service is handled via a driver to the Skype application (free proprietary VOIP solution).

In case there is an incoming phone call another menu comes up displaying the name or number of the caller and the icons necessary to accept or deny the call.

The basic service, as long as it involves only Skype internal contacts (e.g. inside an institution or with people at their Internet connected PCs) is free of provider costs except the Internet connection fees. If calls are made to numbers outside the Skype network (e.g. PSTN, GSM or any other phone providers) a subscription is required and a rather low connection fee is charged. If the user wants to be callable from any phone at a worldwide accessible phone number, again a subscription to this service is required. Costs are generally much below costs for standard phone services.

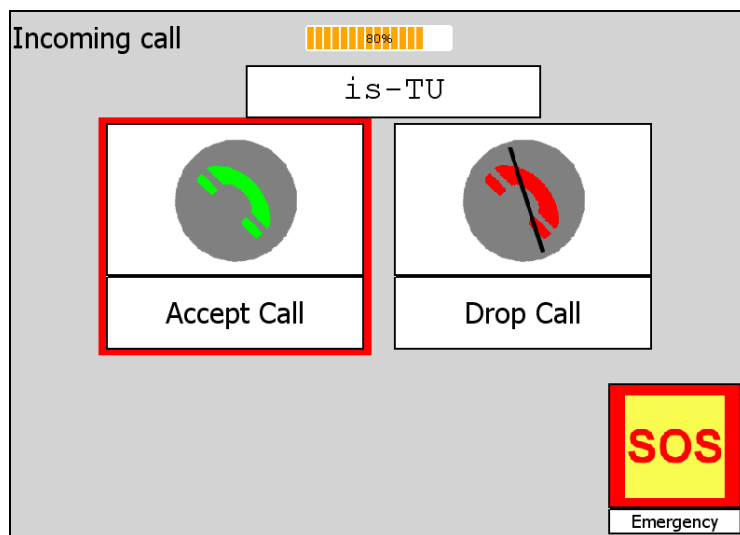


Fig. 7: Menu for incoming phone call

Note that another solution for the telephony service could be to use some remote controllable hands-free phone steered by means of the EC functions.

4.2 Internet browsing

The easiest solution for this communication service would have been to start the Internet Explorer (or any other browser) as a standalone application as already supported by the UI SW. This would also ensure the most advanced operation mode (as used on PCs) without factual limitations in functionality. However, since the UI should provide input possibilities that support users who are not able to use a mouse or a standard keyboard the operation of a browser has to be possible following the same paradigm as the rest of the UI. To integrate internet browser capabilities into the interface model chosen by the user a special internet browser object was implemented in the UI SW. This object wraps the browsing functionality (display of content and access to links) and allows placing the browser window inside the UI window under full control of the configuration. This way the user, even with the basic single switch input mode, has control over the browsing window. Annoying side effects (e.g. popup windows, dead ends for the user with the chosen input mode as are relatively widespread with nowadays websites) are avoided as much as possible. One thing to consider,

when setting up a configuration for a specific user, is the fact that some internet sites do not comply with web-accessibility standards. In such case (excessive use of frames, scripting, graphical plugins) it is possible that the respective page is not displayed properly or that navigation within the page is not possible. The UI however takes care that the user can always navigate back when such pages are displayed.

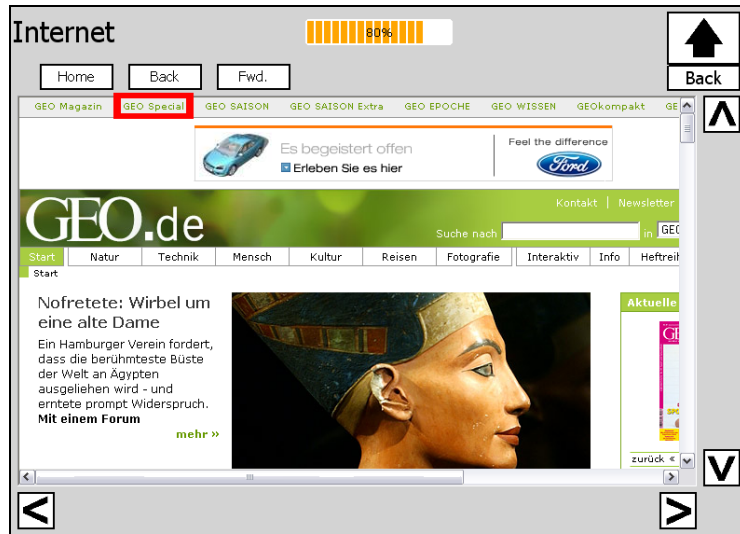


Fig. 8: Internet browser within the UI

In above figure the basic properties of the browser object can be seen. The object is placed on the screen in a certain arrangement with other UI objects and displays the content of the start page. A “home” (go to start page), “back” (go back to previous page) and “fwd” (go forward one page in browse history) icon are supplied so that the user can easily navigate in the browse history. A “back” icon leads back to the upper UI level as usual. The user is able to step through all the links of the displayed page by moving respectively activating the red marked rectangle with the input device (same as if the links were command icons placed on the UI). Scrolling within a displayed page is supported by dedicated scroll icons. Still at any time the touch-screen can be used to activate links as usual by “clicking” on them.

Despite the access to general web-based information (news, encyclopedias, forums) the browser object also opens the possibility for web-based tele-services to be integrated seamlessly into the UI, instead of starting external applications as of course also is possible from the UI.

4.3 Text-to-speech communication

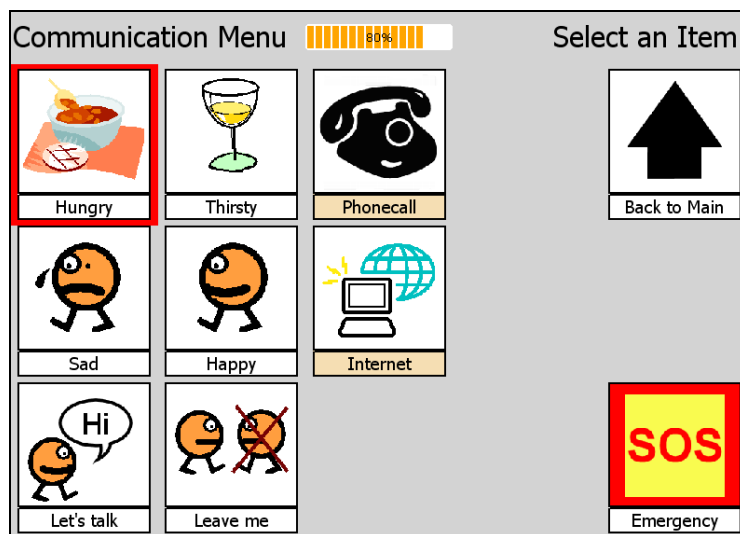


Fig. 9: Speech communication within the UI

Already in ICT.PT1 the communication menu held some exemplary icons which activation caused a specific text to be spoken with artificial voice. This is seen as a good communication aid for those users not able to speak themselves.

The text to be spoken and the icon associated with the text are fully configurable for every user, it is of course also possible (though not implemented) to speak text that is composed by the user or replay speech that was pre-recorded. Typically, icons representing expressions for the current mood of the user and for requesting something to be done are included in the speech menu.

4.4 Alerts from Environmental Monitoring

Although not strictly a user communication service the prototype also contains communication of environmental monitoring events to the user. Environmental Monitoring is accomplished with several sensors installed within the user's home environment. The sensor data is collected and analysed in the MOVEMENT module EC/EM, which is located on the Base Station. The evaluation of sensor values is done with basic algorithms for demonstration of the "alarming concept" within the MOVEMENT project.

The generated alerts are sent over wireless connection to the MOVUI and are displayed there immediately. The alerts can be given different priorities that influence the sorting order and presentation style.

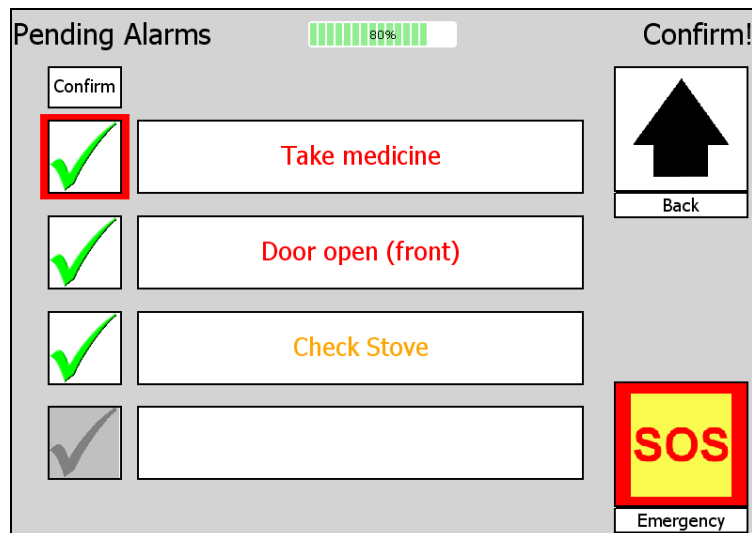


Fig. 10: List of alerts within the UI

The user has to confirm the alerts by pressing the image next to the alert text. Up to four alerts can be displayed on one page.

4.5 Communication functionality checklist

Function	Detailed description	Result	Solution/Comments
1: telephone function	1-1. Make call to predefined number/name (special icon)	OK	Note: costs for dial out, free within Internet (Skype users)
	1-2 Make call to arbitrary phone number (dial number)	OK	Note: not yet implemented to edit a name Note: costs for dial out
	1-3 Receive call by Skype name or phone number	OK	Note: costs for dial in (reserved phone number).
2: browser function	2-1. Browse to defined start page	OK	Note: not yet implemented to edit URI, start page defined by configuration
	2-2 Follow links, go back and forward in browse history	OK	n/a
3: speech output function	3-1. Speak predefined text via associated icon	OK	Note: not yet implemented to edit text
4: remote function	4-1 Remote operation from UI input	OK	n/a
	4-2 Local operation on ICT	OK	n/a
5: alert function	5-1 Alerts from environmental monitoring displayed	OK	n/a

4.6 Conclusions

The ICT as described is designed in a flexible way so as to offer basic communication services to the test users and for 3rd parties a powerful platform to implement communication services in a MOVEMENT compatible way. The full architectural background of the ICT and the UI SW is described in a detailed handbook that will be part of the information available for interested 3rd parties.

For the PT3 system a set of selected communication functions: telephone – web browsing – speech output was selected and implemented in an exemplary way. This basic set for communication already offers access to a wide range of information over phone, on the web and to the emerging area of web-based tele-services.

The key aspect was with the integration of communication services into the MOVEMENT system taking into consideration the needs of people with severe limitations in physical input operations, one of the main target groups of MOVEMENT. Integration of other communication services is easy because of the flexible underlying concept and can be done by 3rd parties.

The implemented communication services will be further tested by users as part of the final prototype testing (PT3) and demonstrated to interested parties.