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Compose Autonomy!- An Adaptable User Interface for Assistive Technology Systems

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Abstract. The paper introduces „AUTONOMY“, an assistive system developed by the authors. The goal of this system is to contribute to the autonomy of motor- and multiple impaired persons in daily life and to empower them to live a more *selfdetermined* and *independent* life *at home* (and not in an institution). AUTONOMY is a multifunctional modular system designed for the home environment. It consists of a mobile user-terminal connected to an individual set of peripheral modules via a bus system. The peripheral modules perform the interaction between the system and the environment of the user. The paper gives a short overview of the whole system and concentrates on the user-interface. As the system should be usable for a wide range of motor- and multiple impaired persons it is evident that there are very strong demands on the user-interface.

1 Introduction

The AUTONOMY-system supports:

- communication (remote control of the telephone, AAC, synthetic speech etc.)
- environmental control and manipulation of objects
- ensuring personal safety and security (telealarm unit, dead-man’s device, operating intercom etc.)
- access to computers and networks

All these functions are integrated in one single modular system and can be accessed via one common mobile user-interface [3].

2 Demands on the User-Interface

The user-interface has to be matched to the user on the one hand and to the supported functionality of the system on the other hand. Motor- and multiple impaired persons with any combinations of impairments should be supported. This calls for:

- All devices to be addressed and all commands to be performed have to be represented in menues. Note that the contents of this menues are depending on the individual hardware-configuration of the system.
- It must be possible to represent devices, commands and system messages in one or more of the following ways:
  - individually selectable graphical symbols
  - individually selectable text strings
  - individually selectable acoustic messages.

- A multitude of input devices (special switches, pointing devices, speech input) and selection techniques (scanning, direct selection by pointing or coded input and so on) has to be supported.

Therefore, a tool is needed to perform the possibility of composing an individual user-interface for every individual user.

3 A Problem of Former Systems

The necessity to develop highly flexible and individually configurable user-interfaces has already been recognised by different authors. One outcome, for example, is the versatile communication system „BASKO“ introduced by Bühler and Heck [1].

The main problem of these systems is the complexity of the configuration process which can only be carried out by a skilled technician. A technician, however, is not competent in recognising the special abilities and needs of the user. It is the area of expertise of occupational therapists to adapt devices to the special needs of disabled users and to train them in using the devices. In most cases this job has to be done by a technician - who in this case is not the competent person. The outcome is a lack of adaptation and adequate training which leads to a low acceptance of existing systems.

To avoid this problem an innovative system structure to support the co-operation of therapists, technicians and disabled users has to be developed. It has to be recognised that there are three different groups of users who are handling the system: the person with special needs, who is using the assistive system, the technician who will need a tool to do the technical setup of the system and the therapist who will need an easy-to-use tool to do the setup and adaptation of the user-interface. With this in mind the concept of AUTONOMY has been developed.

4 The System Architecture

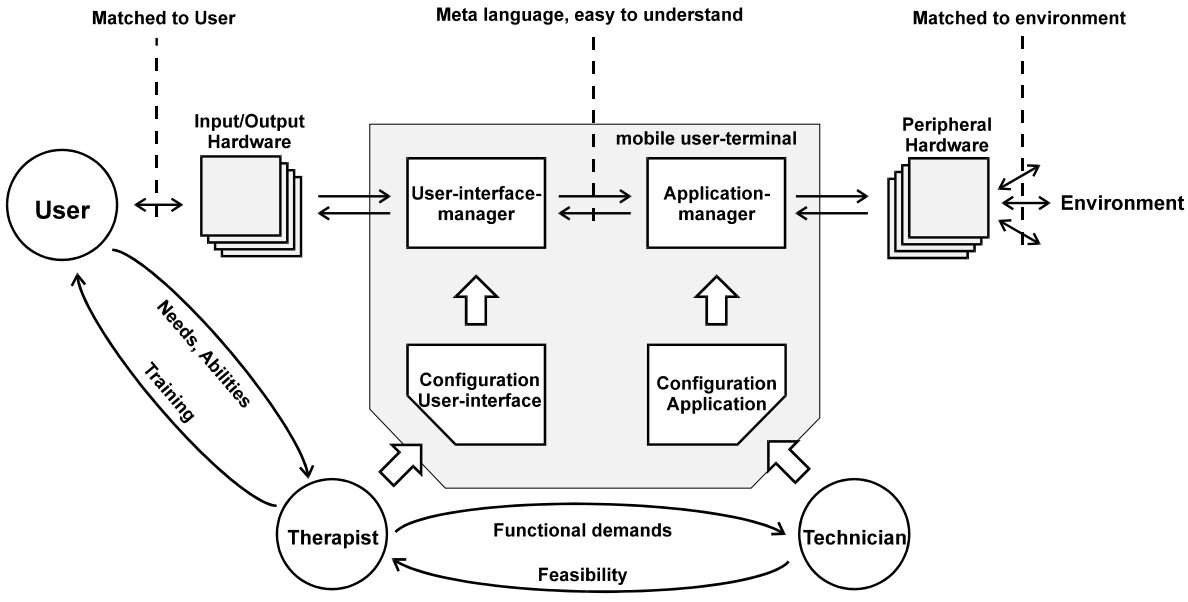

Fig. 1: System architecture of Autonomy

The system consists of a PC-compatible mobile user-terminal. This user-terminal is wireless linked to peripheral modules performing the interaction with the environment (Examples are remote control modules, modules for handling the telephone and intercom etc.). Special peripheral modules offer the possibility to establish links to other systems like M3S-based systems, the EIB (European Installation Bus), RAID-workstations etc.

On the side of the user the mobile user-terminal is connected to input/output devices like special switches, touch screens, visual and acoustic displays and so on. The software handling this input/output hardware is the user-interface-manager; the software driving the peripheral hardware is the application-manager.

Both, the user-interface-manager and the application-manager get all information to establish the user-interface respectively the link to the environment from an extensive database. These two databases are set up by using dedicated configuration tools.

Note, that user-interface and application are strictly separated from each other and are linked via a communication process using an easy-to-understand meta language. Hence, the setup of the user-interface and the application can be done separately [5].

5 Setting up the System: The Human Co-operation in Practise

This section describes how the different involved persons will interact when establishing the assistive system.

First the therapist - who knows the abilities and needs of the user very well - will tell the technician which functions the system should perform. The technician will then set up the system on the application level and will define all commands and messages the application part shall support in an easy understandable meta language. (Examples are: „TV-increase volume“, „intercom - hook“ or „telephone - ringing“).

Now the technician is not needed any more, the interactive setup of the user-interface can be done by the therapist in co-operation with the user. It can be started with a very simple user-interface covering just a few of the functions of the system. The performance and complexity can then be increased step by step and can be adapted to the user whenever necessary.

6 Composing the Individual User-Interface

6.1 The Concept of Multimodal Icons

The user-interface of the AUTONOMY-system is based on the concept of multimodal icons. An icon is a structure which combines methods of multimodal representation (e.g.: graphics, background colours, sound-cues, text,..) with commands to control the environment respectively with messages from the environment or with communication methods (e.g.: BLISS, synthetic speech,...). If the user wants the system to do something, he/she selects one of the icons using one of the input devices and one of the input methods mentioned above. After the selection the icon itself interacts with the environment. The icon, therefore, can be considered as the actual link between the user and the environment.

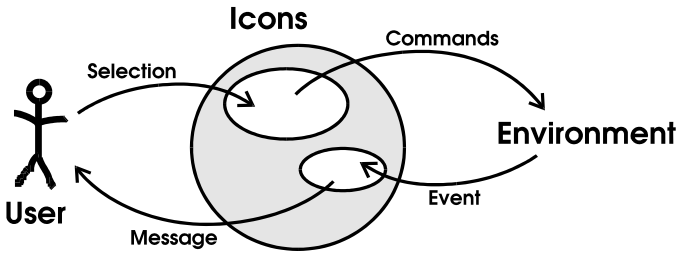

Fig. 2: The icon’s linking function

In the opposite direction, events (e. g. like „telephone is ringing“) trigger the selection of an icon and are presented to the user in the same multimodal way as a message.

6.2 Composing the User-Interface step by step

The user-interface is composed of menus containing icons. Menus and icons can be created, linked and placed using the therapist's user-interface toolkit. This is a MS-Windows application performing What-you-see-is-what-you-get functionality. First the therapist places the graphical representation of a new icon onto the screen. Functions to be performed by the system are associated to icons by command lists. The icon can also be configured to produce synthetic speech. To determine the multimodal representation, a piece of text and pieces of pre-recorded speech or sounds can be chosen and associated to the icon. The next steps concern the graphical and acoustic representation of the icon. The background colour of the graphic symbol can be changed as well as the pieces of pre-recorded speech or sounds which are used during and after the selection phase of the icon.

6.3 Benefits of the Flexibility of the Introduced Concept

The introduced concept has special benefits for multiple impaired persons:

- *Speech and language impairment*: The system can be used as a complete alternative and augmentative communication-system using pictures, letters, words or phrases in combination with speech synthesis [2], [4]. A built-in editor supports the building of sentences and phrases by the user.
- *Cognitive Impairment:* The system can be used to set up a simplified user-interface for many devices. For example using a touchscreen as input device and icons showing photographic images of the persons to be called makes using the telephone as easy as possible: Just touch the person's picture and the system will take care for the rest.
- *Low vision:* Support through high-contrast enlarged graphical symbols.
- *Blindness:* A pure acoustic user-interface can be set up.

7 Evaluation

In the middle of 1995 the first users will be trained for using the system in real life condition. The system will be evaluated in co-operation with occupational therapists, physicians, technicians and persons with disabilities in order to verify if it is able to reach its goal: to contribute to the autonomy of people with special needs in daily life.

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