TECHNICAL ASSISTANCE FOR SEVERELY DISABLED PERSONS WITH INTEGRATED TELE-HELP

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Abstract: Alternative and Augmentative Communication (AAC) devices in combination with Environmental Control Systems (ECS) offer remarkable benefits for severely and multiple impaired persons. The authors have extended such an assistive system by integration of a remote control interface based on a protocol defined by the DE-4208 RESORT project. This extended ECS/AAC system has been installed at trial sites and was tested with disabled users and care persons under real life conditions. Experimental service centres provided technical support for the disabled users and the carers. Remote configuration, Tele-Help, Tele-Training and support of disabled users including single switch and head stick users and care persons were tested quite successfully.

Introduction

One of the main reasons for severe motor- and multiple impairments is cerebral palsy. Here different brain regions can be affected resulting in random combinations of disabilities (motor, cognitive, communication, intellectual etc.).

For severely motor impaired persons the implementation of so called *Environmental Control Systems (ECS)* can mean all the difference between inability and independent living. The ECS establishes a custom tailored interface between the user's residual abilities and his or her physical environment by providing the possibility to operate electrical appliances, communications devices, doors and windows and a host of other things by remote control.

The goal of *communication aids (Augmentative and Alternative Communication = AAC)* is to facilitate interpersonal- and tele-communications for persons who are not able to communicate in the usual manner.

For both applications, ECS and AAC, multimedia PC technology constitutes an ideal tool by offering all the prerequisites for translating between the impaired user and the environment.

Technical Assistance System

For several years now our research group has been involved in the development and field-testing of a combined ECS and AAC system we named AUTONOMY. It is based on a PC hardware platform (notebook or a handheld computer) and on the MS-Windows operation system. The input/output hardware can be chosen from a wide range of standard and special devices to meet the specific needs of the disabled user. A set of peripheral hardware components links the system to the physical environment.

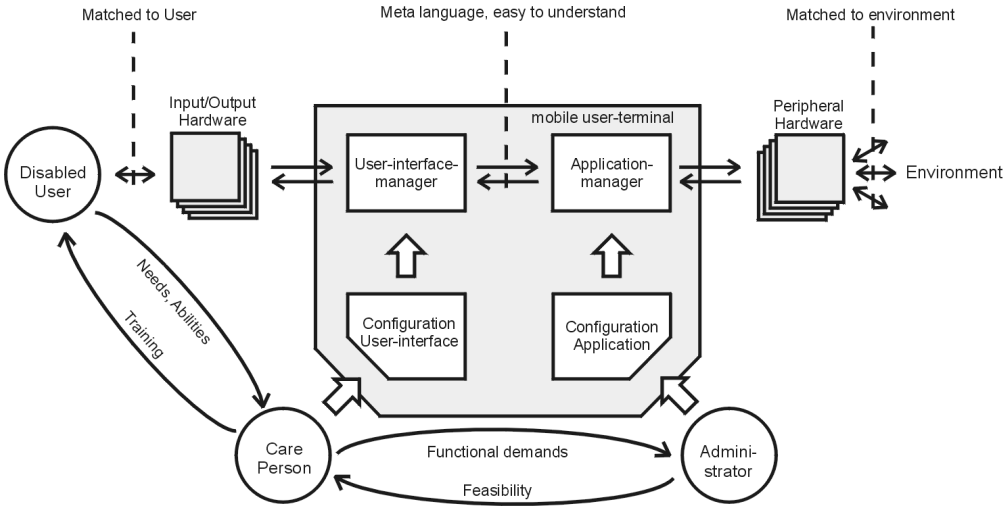

Figure 1: Block diagram of AUTONOMY system showing interaction between system components and user groups

AUTONOMY was implemented into a smart-room at a support centre for severely and multiple impaired children at Axams [9], Tyrol. By using the EIB (European Installation Bus) for the electric wiring and infra-

red remote control technology, all appliances in the room can be remote-controlled via the system. When operating AUTONOMY as an ECS the teacher or therapist will create a dedicated system-configuration. The icons directly correspond to environmental commands (switching on the lamps, starting the CD-player, get the toy-train running, switch off everything).

For AAC purposes configurations showing communication symbols on the screen can be created. Activating an icon by direct selection or scanning will result in a spoken or printed message.

Concept of AUTONOMY

As a main innovation AUTONOMY offers three different user-interfaces for the three distinctive user groups [3,4,6] working with the system (Fig.1):

(a) The end-user (the person with special needs, who is using the assistance system).

(b) The facilitator (e.g. a therapist, pedagogue or family member) responsible for the configuration and adaptation of the user-interface.

(c) The integrator carrying out the technical set-up of the system.

The co-operation between these three groups of users is essential for optimisation and successful use of the system. The three interfaces/tools (user-interface, configuration tool and setup/test tool) are tailored to the very specific needs and abilities of the three different user groups according to the specific roles they play in setting up, configuring and operating the entire system.

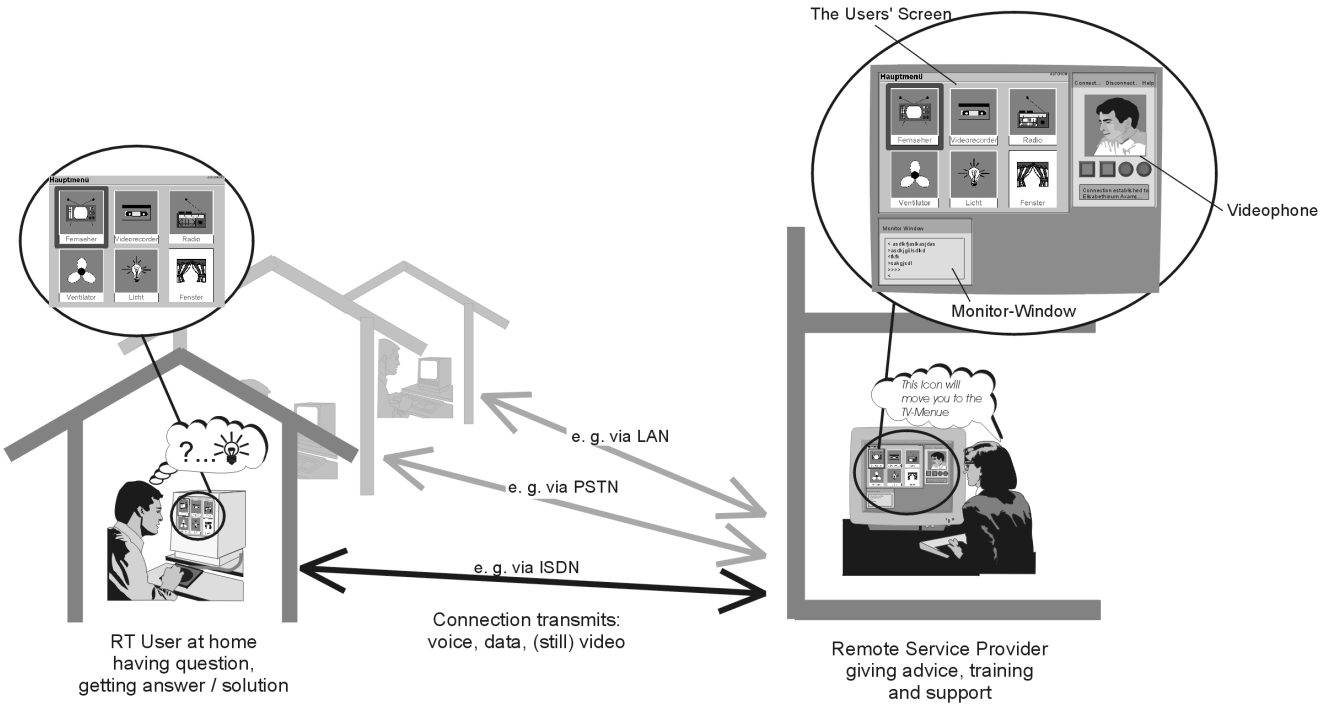

Figure 2: Remote service provision for PC based RT systems

Figure 1 shows the interaction between the system components and how the different user groups utilize dedicated user-interfaces. The user-interface-manager and the application-manager are internally linked with one another by an easy to understand meta language. This ensures that after the integrator (= system administrator) has set up the application configuration and the peripheral hardware the facilitator (= care person) can refer to non-cryptic (non-technical) terms when configuring the user-interface.

The task of the facilitator is to enable the impaired person to discover and exploit new areas of self-determination and independence. He/she will need a versatile and easy-to-use tool which enables him/her to create not only various user interfaces but also creative procedures for working with the communication and environmental control functions in a didactic and therapeutic manner.

Up from a certain degree of impairment motor- and multiple disabled persons rarely are able to use conventional environmental control and augmentative communication systems. To attain this ability, in many cases customer tailored user-interfaces plus a long-time training process is necessary. Even learning the relation between reason and effect and experiencing self-effectiveness (being able to make something happen in the environment) is the first big challenge and often an entire new experience.

Hence, a technical system capable to meet the needs of these users has to fulfil three criteria: (1) give optimal support to the training-process; (2) support the facilitators with a tool to easily adapt the system to the rapidly changing user needs; (3) be capable to grow from first experiencing self-effectiveness up to a multi-functional multi-purpose technical aid.

Discussion

One of the main goals in developing AUTONOMY was to provide a configuration interface which enables even complete computer illiterate persons to create client tailored user interfaces and application. The concept received perfect acceptance from teachers and therapists and meanwhile several hundred different configurations were set-up at the test site [7]. The extensive use of AUTONOMY at the support centre in Axams also showed that the system offers additional therapeutic benefits beyond pure AAC and ECS [9].

Especially cognitive and motor impaired children encounter severe problems in experiencing the principle of reason and effect. As their possibilities to handle objects by themselves and perceive what will happen ("...will it drop to the floor and crash when I release it?") are restricted they encounter a deficit along these lines.

The smart-room can help to teach these basic principles. Properly configured, accessing an icon by hitting a switch can cause to start a firework of sound and light. It occurred that children needed such experiences to conceive the concept of reason and effect for their first time.

A next step in therapy can be basic communication training for non-speaking children. The usage of an AAC system is often hard or impossible to explain to severely impaired children. The therapists at Axams, therefore, started to combine AAC with ECS. This has been easy to achieve, as AUTONOMY integrates both function in one platform and under the same user interface.

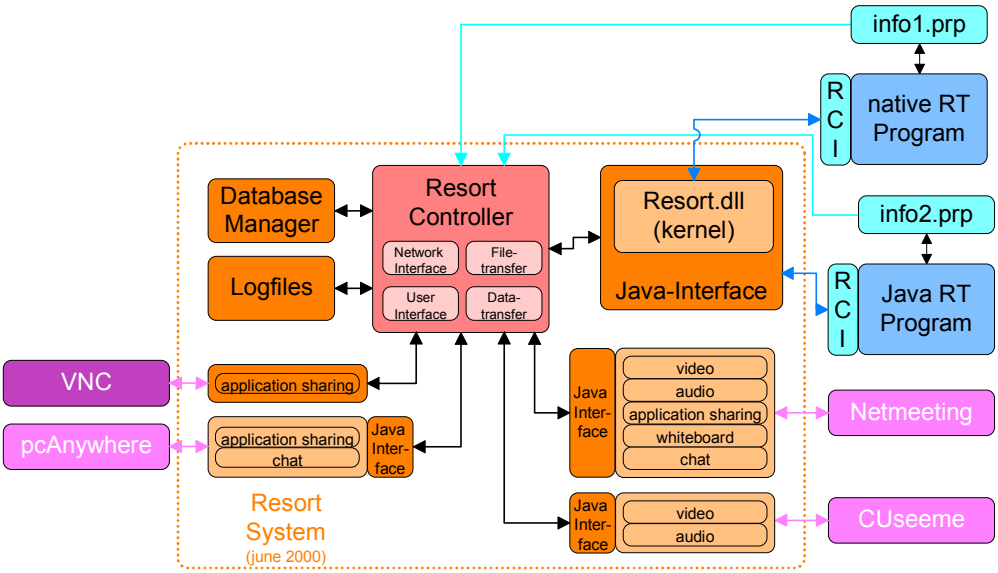

Figure 3: Modules and Interfaces of the RESORT prototype system. Different available third party products for audio, video and data conferencing can be used. The current prototype uses H.323 and T.120 implemented by Microsoft Netmeeting v3 product. For RCI specification refer to [5].

Motivation for Remote Support

The response from the field tests on the one hand led to the development of a lowcost version of AUTONOMY [2] which is also suitable for private applications. On the other hand it motivated the launch of the EU-supported R&D project RESORT [5,8,10].

The objective of this project is to develop a telematic link (Fig.2) between the user or the care person on one side and a service provider (technician, therapist, other experts) on the other side. The link will not only provide video-telephony capabilities but also remote supporting the user's PC. Problems with the system, updating of software or changing configurations can be handled in this way. Following the AUTONOMY philosophy the telematic linking will be as easy as clicking on an icon.

The RESORT system provides the following functionality: (a) RCI (Remote Control Interface) for "real time synchronisation" of RT systems (b) easy-to-use scaleable User Interface (c) real time communication and interaction: audio and video, H.323 compliant (d) database access (e) file transfer (f) synchronisation of file systems (g) text communication (h) platform independency (i) security and offers three different modes of operation:

(1) In the telephone mode RESORT provides hands free communication between user and service provider. If the bandwidth is large enough an additional video link can be established.

(2) In the pupil-teacher mode an additional data-link is established. The service provider will load exactly the same RT application as the user is running. The two applications - at the user's site and at the provider's site - will be synchronised via the data link.

(3) In tele-service-mode the service provider will have the possibility to down- and upload files from and to the user's PC, modify configurations and test the changes he/she has made.

Implementation

The core of RESORT has been implemented in Sun Java 1.3. The system exploits existing technologies for tasks like video / audio transmission according to H.323 specification and desktop/application sharing according to T.120. These applications are invoked, but not re-developed. Specific new features such as the RCI technology which allows real time synchronisation between local and remote RT systems (even when using automatic scanning) have been developed.

The user interface of the Resort controller can be tailored according to the needs of the users. Although the full functionality is always available, the degree of complexity of functions and information shown to the individual user can be varied within a wide range.

RCI stands for Remote Control Interface which implements a link between the RT system and the so called RESORT controller (RC). The RCI and the RESORT protocol allow synchronisation in real time. This is possible as only small data messages are transferred instead of changed screen contents. This method dramatically reduces the required bandwidth [1] and enables the RESORT system to provide real time monitoring of single switch users. The Resort controller module (RC) is linked to (a) communication modules for video, audio and chat, (b) to the database, (c) to the RT system and (d) via network interface to the remote RC. As network protocol IP is used. TCP/IP for control messages, UDP mainly for audio and video. In order to test and demonstrate the benefits of the system 2 existing RT systems have been equipped with a Resort interface.

In order to ensure a high level of flexibility several internal interfaces (Fig.3) were introduced. The outcome is a highly modular system which allows to exchange specific parts without the need of adapting other parts. This increases the independence from 3rd party products for audio, video, application sharing, desktop sharing, etc.

The prototype system was demonstrated in 14 workshops organised for care persons, disabled users, manufacturers and service providers in Austria, Germany, The Netherlands and Scotland. Additionally real life tests have been carried out [5].

Results and RESORT Interest Group (RIG)

The RESORT prototype system demonstrated a lot of benefits which will help to overcome existing barriers in the field of RT service provision. Additionally to the RESORT prototype software the RESORT protocol has been developed which allows other manufacturers of assistive technology (AT) systems to adopt the RESORT protocol for their products in order to strengthen their position in the RT market.

RESORT not only aims at technical service delivery but also at pedagogic and therapeutic support via the telematic channel. In order to ensure ongoing research and development a RESORT Interest Group (RIG) currently is being set up. The RIG will provide a framework for disabled users, care persons, manufacturers, service providers, and researchers to continue the engagement in the area of remote service provision. Interested parties are invited to watch the progress of RIG by visiting the RESORT home page [5].

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