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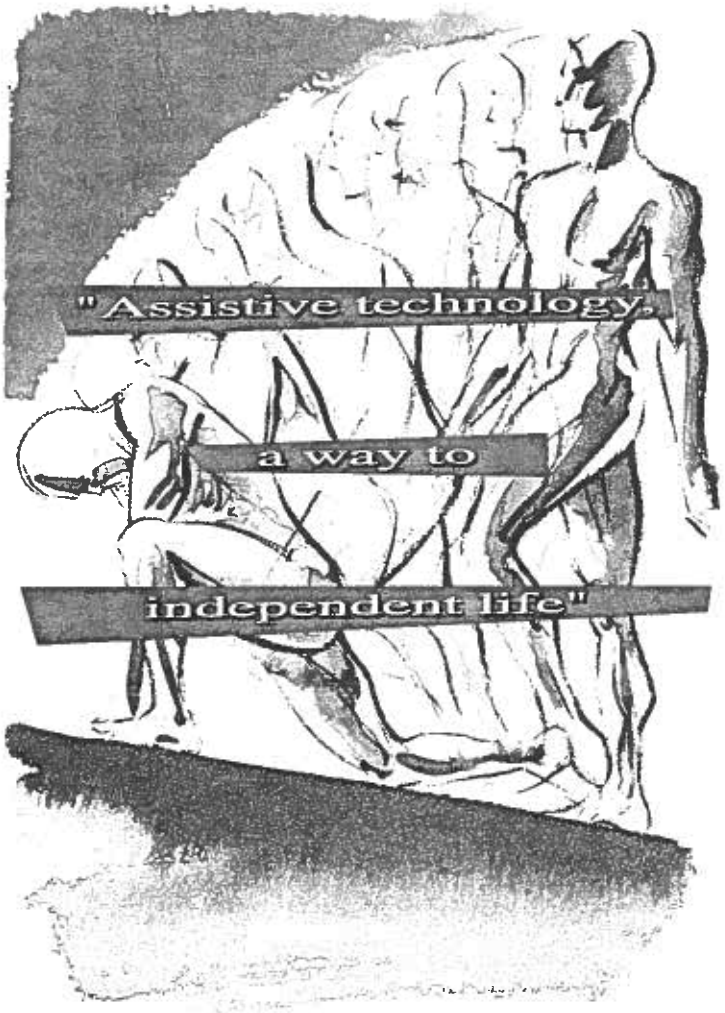

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PROCEEDINGS

SMART HOMES AND THE HS-ADEPT PROJECT: APPLICATIONS AND USER INTERFACES

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ABSTRACT

Smart homes is becoming a mainstream technology that is able to replace traditional environmental control systems, mainly because it holds the promise of providing a wider choice of equipment at a lower cost. Following a brief introduction to smart homes, the HS-ADEPT project will be presented, with an emphasis on the applications under development and on the user interface alternatives that will be provided.

INTRODUCTION

Smart homes is an expression frequently used to refer to residential buildings where a communications infrastructure (bus), with (various degrees of) distributed intelligence, allows the provision of co-ordinated services by pieces of equipment or sub-systems which would otherwise remain isolated. Domestic energy management will probably constitute one of the major driving forces that will bring these emerging *home systems* to a mainstream technology [1], but additional comfort and improved safety / security are complementary benefits leading to market success. The expression Home Systems (HS), or European HS, is also used to refer to the specification which resulted from an European-wide cooperation (the ESPRIT 2431 project, Home Systems, 1989-1992), and which is presently competing for market acceptance [2,3].

As a result of previous cooperative efforts at European level, but mainly because it is based on an open specification supporting "plug-and-play" features, the HS specification [4] met the technical requirements set up by the HS-ADEPT consortium and was selected as the base technology for the development of this project.

THE HS-ADEPT PROJECT

The HS-ADEPT (Home Systems — Access of Disabled and Elderly People to this Technology) is a TIDE bridge phase project running from 1994 to 1996, where integrated home systems are being developed to meet the requirements of people with special needs [5,6]. The technical specification for this project was based on the result of a user needs survey which was done at the two end user organisations present in the consortium.

The project philosophy is that it is led by the users' requirements (and not by the technology itself) and that the applications under development should lead to products addressing the general home systems market and not only the niche market of traditional environmental control systems. Besides applications development, the other main area of R&D addresses the development of adequate user interfaces (both areas will be described in the following sections).

APPLICATIONS

The applications under development in HS-ADEPT are the lighting sub-system, the safety / security sub-system, control of internal and front doors, and of windows / curtains / shutters, all with local or remote control. Additionally, remote control of power sockets enables a limited integration of non-HS compliant devices.

The communication infrastructure is based on two different media: twisted pair (TP of type 1), which is able to meet the mandatory safety requirements, and power line (PL), which presents the advantage of requiring minimal re-wiring. Figure 1 illustrates the first prototypes developed for TP1, available since February 1995.

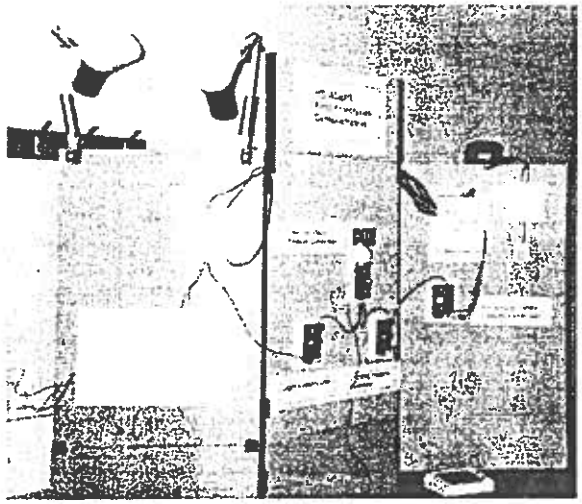

Fig. 1: HS-ADEPT — first prototypes.

USER INTERFACE ALTERNATIVES

A feature controller is the HS term for the device connected directly to the bus that contains the intelligence that manages a particular sub-system. The user interface feature controller (UIFC) developed in the HS-ADEPT project is key to presenting information to and receiving commands from the user in a readily understood fashion. There is a user interface feature controller in each room of the house. The nature of the IR link between the portable user interface and the UIFC is such that the user can only communicate with a particular UIFC from within the room in which it is located. Within its software the UIFC maintains a dynamic model of all the devices located in the same room, together with any other devices elsewhere in the house that may require remote control, e.g. the front door entry system. The UIFC also effectively monitors bus signals and where appropriate informs the actual user interface of the occurrence of a particular message. Hence context specific menus can be displayed.

CONTEXT SPECIFIC MENUS

Most systems that offer the user control over many different actions do so by presenting the user with a series of menus grouped together in related lists. In systems with many options it can often be difficult for a disabled person who finds the control action problematic or slow, to have efficient control. This is compounded if many control actions are required to navigate through a set of nested menus. This can be alleviated, in certain situations, if the appropriate menu is displayed to the user automatically. One example from the HS-ADEPT project is that if a visitor rings the front door bell then the menu relating to using the intercom system and remotely controlling access through the front door is automatically displayed.

LOCATION SPECIFIC OPTIONS WITHIN A FIXED MENU STRUCTURE

In the domestic environment there are many similar devices located in different rooms of the house, for example: lights, windows or curtains. In these cases a simplification of the menu structure can be achieved by having the same menu for all rooms. The particular device activated being the one located in the same room as the user effecting the control action. In one of the user interfaces of the HS-ADEPT project the frequently used control options are located on a default menu. Which device is actually addressed depends on the room the user is located in and choices made at installation. For example a room may contain more than one light but the user can select at installation (or later re-configuration) which light or combination of lights is operated from the default menu in that room. Other menus can give the user full control of the individual devices in the room but this use of a default menu minimises the control actions required to operate the most frequently used devices in the home.

TECHNICAL REALISATION OF USER INTERFACE SUB-SYSTEM

Within the developments of the HS-ADEPT project the focus is on how the user controls devices or sub-systems (e.g. lights, heating system or front door access) attached to the Home System without being concerned with the detail of the system. The key elements of the user interface sub-system are:

1. Portable User Interface
2. Bi-directional Infrared (IR) Link

3. User Interface Feature Controller (UIFC)

The portable user interface is the device that the disabled person will most usually use to receive information from the Home System or send commands to it. The system has been conceived such that it is possible to quickly develop a whole range of these suitable for people of differing abilities or indeed use existing devices, such as AAC units or IR environmental controls, with built in infrared communications that can learn the appropriate signals. Within the project two separate interfaces for people with a range of physical disabilities are being developed.

The bi-directional IR link enables the user to have control of the system from anywhere within the house. This depends on having an IR receiver/transmitter, integral with the user interface feature controller, in each room. The bi-directional nature of this link enables general system information to be presented to the user and feedback to be given to them that a requested action has indeed taken place. This is particularly important if controlling devices in a different room to where the user is located. The bi-directional nature also allows the context specific menus described above to be implemented. It is important that the protocol employed for the infrared communications is secure and immune to noise. It is highly undesirable that a noise signal, from direct sunlight for example, is interpreted as a valid command, particularly as this could possibly open the front door or compromise security or safety in another way.

Conclusion

Led by the requirements identified during the user needs survey phase, the HS-ADEPT project is developing a number of applications which use a mainstream technology to improve the independence of disabled or elderly people. A major objective of this project is to create the necessary conditions for using this emerging technology as an alternative to the (more expensive) traditional environmental control systems.

The configuration of the user interface sub-system enables substantial simplification of the menu structure. The key means of achieving this are through the appropriate application of context specific menus and location specific control as described above. The HS-ADEPT development team believe they have devised a means of simplifying control of complex Home Systems particularly appropriate for disabled users. The projects developments begin comprehensive field trials in the homes of 3 disabled people in the UK and at a rehabilitation centre in Portugal in the spring of 1996.

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