

# RESNA '94

June 17-22, 1994  
Nashville, Tennessee

J.M. Mantus, Feneia

*Tuning in to the 21st Century through  
Assistive Technology  
Listen to the Music*

MUSIC CITY  
USA  
NASHVILLE

INDEPENDENCE  
PRODUCTIVITY  
INCLUSION  
RECREATION  
ADVOCACY  
EMPOWERMENT  
EMPLOYMENT  
EDUCATION



PROCEEDINGS

HOME SYSTEMS TECHNOLOGY FOR ELDERLY AND DISABLED PEOPLE  
PRESENT STATUS, R&D METHODOLOGY AND FUTURE DIRECTIONS

RESNA '94

M.45-47

José M. Ferreira  
INESC - Largo Mompilher, 22  
4200 Porto - PORTUGAL

Martyn Cooper and David Keating  
University of Reading - Whiteknights  
P. O. Box 225 - Berkshire RG6 2AY - UK

## ABSTRACT

The ability to perform everyday tasks, in the home, is a major need expressed by a large number of elderly and disabled people. The independent living that this leads to is aspired to by many. Although environmental control systems have traditionally been used to help them meet this need, several advantages can be identified if general home systems technology, with suitable user interfaces, is employed instead. This paper identifies the major issues in this approach, presents a brief overview of the state of this technology, discusses the requirements in terms of R&D methodology and outlines future directions in this area.

## BACKGROUND

The needs of disabled and elderly people in the home are essentially the same as the needs of us all. However the way these needs are met may have to be different. A large number of disabled and elderly people need assistance for such common actions as switching on the lights, controlling white and brown goods, and many other simple tasks. This situation limits their independence in daily living, a problem that traditionally has been minimised by using environmental control systems. However, since each manufacturer develops its own proprietary solutions, adding new devices to the system is frequently not as simple as it should be. Lack of interoperability prevents higher manufacturing volumes and the limited scope of these systems make them not attractive to the general public (further contributing to increased prices).

Market issues are indeed one of the most important questions that have to be addressed, since cost is usually the ultimate factor that determines whether or not a good product is successful in this under resourced sector. It is interesting to note that the single objective of the European TIDE (Technology Initiative for Disabled and Elderly people) programme has been stated as to "stimulate the creation of a single market in rehabilitation technology in Europe" [1]. Market issues in this area can only be successfully addressed if the manufacturers agree to work within defined standards, in order

to assure equipment interoperability and low prices. Rehabilitation technology developed to improve independence at home can only meet these objectives if the wider technology domain of "home systems" is adapted to the specific requirements of disabled and elderly people.

A Home System (HS) specification defines a "comprehensive communication system interconnecting several kinds of electronic products used within the home" [2]. A commonly accepted, non-proprietary HS specification will ensure interoperability of equipment regardless of the manufacturer and at the same time will contribute to wider public acceptance. The market for HS products has however consistently been under most expectations essentially due to a lack of an internationally accepted standard [3]. This is still a largely unsolved issue, since different development directions were followed in Japan, US and Europe.

Japan is probably the country where HS technology is more coherent, since the first activities were initiated as early as 1980 by the Institute of Electric Engineering of Japan [4]. A home bus study committee was set up in 1982 and the Home Bus System (HBS) standard was published in 1988. Over one million HBS standard systems are now installed in Japan.

A less coherent approach is found in the US, where such different systems as the Smart House, CEBus and de-facto standards as X-10 and Echelon are available [3].

A number of specifications are also available in Europe, including Batibus and Instabus EIB [5]. The work towards a common European HS specification started in the late 80's, but the main effort started only in 1989 with an ESPRIT (European Strategic Programme for R&D on Information Technology) project entitled Home Systems (EP 2431), which released the first version of the ESPRIT HS specification. Approximately one dozen ESPRIT projects are currently active in this domain, involving more than 50 companies developing Conformance and Development Tools as well as Software and Hardware Modules [6]. Version 1.1 of the HS specification was released in 1992 by the European Home Systems Association (EHSA), which was founded to promote and support the development and standardisation of this specification.

## STATEMENT OF THE PROBLEM

General HS technology, according to the definition presented in the previous section, aims to achieve two main goals [7]:

- To enable a service requiring several products to work together (which identifies the need for clusters of interconnected products)
- To provide a simple way to operate sophisticated products (which is indeed one of the major consumer concerns)

A HS able to fully meet these two requirements will provide three major benefits to the user:

- It will allow remote control over much of the equipment within the house
- It will allow several products to perform some type of co-ordinated operation or service (security, for example, may require the co-ordinated operation of different products, which may however be also used for other purposes)
- It will make possible a true modular functionality, where products can be added or removed at any time

Work done in this field in the last five years has produced the specifications of a flexible hierarchical architecture, and a communications network, which are able to provide these three benefits [2].

The practical advantages for the common consumer are of three main types: added comfort, improved security / safety and economy (mostly due to optimised energy consumption). However, for many disabled and elderly people, the important issue is that HS technology is capable of improving their independence in daily living, which definitely represents an important contribution to their quality of life. Moreover, and since HS technology addresses the general consumer electronics market, it brings the additional benefits of low-cost and wide availability products. Allowing the community of disabled and elderly consumers to fully benefit from these promises can, however, be ensured only if two main requirements are satisfied:

- The range of HS-compatible products available must be able to satisfy their specific requirements
- The range of user interfaces available must be compatible with different types of disabilities

## APPROACH

The R&D methodology underlying any HS project aiming to meet the two requirements specified above can be summarised in one single statement:

- Led by the end user's requirements and not by the technology.

Moreover, and since these two requirements generate R&D tasks that can proceed in parallel, the approach to develop effective rehabilitation technology products in this area must include four main activities, in time order:

- Identification of the end user requirements: The multi-disciplinary team responsible for this work must relate the requirements of their specific end user groups to all the information already available from other projects [8,9]
- Technical specification: Again led by a multi-disciplinary team, this activity represents a first opportunity for system validation, since rehabilitation technology professionals and end users are provided with a formal specification of the proposed solutions
- Applications and user interfaces development: This activity includes the two main R&D tasks corresponding to the requirements set up in the end of the last section. It is mainly an engineering led activity, although end user involvement is essential to provide guidance on many implementation details. Unnecessary duplication of R&D efforts can be assured by a proper survey of previous work, both in the general HS technology field and in previous projects specifically concerned with the adaptation of HS technology to disabled and elderly users [10]
- Evaluation: This activity comprises the implementation of solutions at end user sites, which must be accompanied by an adequate training program. A formal evaluation methodology will then enable the assessment of benefits [11]

End user involvement is a key issue throughout all activities, since it is essential to guarantee that the developed solutions are effectively led by end user requirements and not by technology driven factors. In response to an open call for proposals set up during 1993 within the European TIDE programme, a two and a half year project following this approach was selected for funding by the Commission of the European Communities. Started in January of 1994, this project is entitled HS-ADEPT (Home Systems - Access of Disabled and Elderly People to this Technology) and involves end user organisations, R&D institutions and industrial partners from four European countries. The workplan of the HS-ADEPT project closely follows the four main activities previously described.

## IMPLICATIONS

The implications of HS technology in the daily life of many groups of disabled and elderly people extend over a wide number of issues, the most important of which is however its very

significant contribution towards greater independence. This is indeed a key issue, with further implications which range from the end users (improved self confidence, better quality of life, etc.) to the State itself (in terms of social support measures, financial issues, etc.). It is also important to note that the benefits of adapting HS technology to the specific requirements of disabled and elderly people, by making use of technologies and products addressing the wide consumer electronics market, effectively contributes to increase the awareness towards the importance of a single market in rehabilitation technology products.

## DISCUSSION

This paper has identified the major issues concerning HS technology for disabled and elderly people, presenting a brief overview of the state of this technology and discussing the requirements in terms of R&D methodology. It is however important to refer that HS technology, both for disabled and elderly people or for the general public, is still in its infancy. This is not only in the acceptance of internationally adopted standards, but also in the extraordinary potential that will result from the marriage with advanced telecommunication networks, namely the Broadband Integrated Services Digital Network (B-ISDN) [12]. This marriage will enable the development of a wide variety of telematic services, ranging from entertainment to education and tele-working. The multi-billion dollar market associated with sophisticated interactive video services will become a reality in the medium range future (10 to 20 years say, depending on government regulations, world-wide standardisation efforts, etc.), but it is as yet unclear whether it will be possible to guarantee that this huge technological leap forward will contribute to yet further barriers for disabled and elderly people or be made accessible to them. It seems clear that it is possible to adapt HS technology to the specific requirements of people with special needs and still benefit from its success in the general consumer electronics market, but a large effort will certainly be required to make sure that the next step in this (r)evolution will accommodate requirements other than those of the perceived mass markets.

## REFERENCES

- [1] Commission of the European Communities (DG XIII/C/3), TIDE 1993-1994 Workplan, March 1993.

- [2] European Home Systems Association, Home Systems Specification, Release 1.1, March 1992.
- [3] P. Bord, "Home Automation International Environment," Actes de la Troisième Conférence Euro-Domotique, February 1993, pp. 107-114.
- [4] K. Yamamoto, "Home Automation in Japan," Home Systems in a Global Environmental Workshop, November 1992.
- [5] T. Riley, "Emerging Standards in the 90's: A Strategy for Success," Actes de la Troisième Conférence Euro-Domotique, February 1993, pp. 81-82.
- [6] R. Torrenti, "The ESPRIT Home Systems Projects," Actes de la Troisième Conférence Euro-Domotique, 1993, pp. 71-75.
- [7] D. Fanshawe, "Resource Management in the Home System," Proceedings of the ESPRIT Conference, 1991, pp. 506-511.
- [8] D. Poulson and S. Richardson, "Issues in the Uptake of Adaptable Smarter Home Technology," Proceedings of the ECART Conference, May 1993.
- [9] R. Torrenti, "Home Systems and Handicapped / Elderly People: A Necessary Coherent Approach," Proceedings of the First TIDE Congress, April 1993, pp. 157.
- [10] J. Falcó, J. Dolz, A. Mediano, J. Artigas and A. Roy, "Smart Homes for Disabled and Elderly: Adaptation and White Goods Modification," Proceedings of the ECART Conference, May 1993.
- [11] M. Lundman, "Methodology issues in R&D in rehabilitation technology," invited speech at the ECART Conference, 1993.
- [12] A. Stienstra, M. Vaalen and J. Wage, "Telecommunications and the Introduction of Home Networks for the Residential Market," European Transactions on Telecommunications, Vol. 3, No. 1, February 1992, pp. 55-63.

## ACKNOWLEDGMENTS

The authors are grateful to the Commission of the European Communities for the funding which enabled the HS-ADEPT project.

José M. Martins Ferreira  
INESC / University of Porto  
Largo Mompilher, 22  
4000 Porto - PORTUGAL  
Tel. 351-2-2094025  
Fax: 351-2-318692  
E-mail: jmmf@porto.inescn.pt

# Home Systems Technology for Elderly and Disabled People:

Present Status, R&D Methodology and Future Directions

**José M. Ferreira**  
INESC / University of Porto  
Pr. República, 93  
4000 Porto - PORTUGAL  
Tel. 351-2-2094242  
Fax: 351-2-2094270  
E-mail: jmmf@inescn.pt

**Martyn Cooper and David Keating**  
University of Reading  
Whiteknights - P. O. Box 225  
Berkshire - RG6 2AY - UK  
Tel. 44-734-316610  
Fax: 44-734-318220  
E-mail: cybmc@cyber.reading.ac.uk

RESNA '94 - Nashville, Tennessee, USA

JMF / MC / DK

## Outline of the Presentation

- Background and current status
- R&D methodology
- The HS-ADEPT project: User needs survey  
and technical aspects
- Future directions
- Conclusion

JMF / MC / DK

## Background

- A fundamental objective of rehabilitation is to enable disabled and elderly people to live independently
- The needs of disabled and elderly people in the home are essentially the same as the needs of everyone else

JMF / MC / DK

## HS: Goals and Benefits

- **Main goals:**
  - To provide a simple way to operate sophisticated products (which is one major consumer concern)
  - To enable a service requiring several products to work together (there is a need for clusters of interconnected products)
- **Benefits to the user:**
  - Allows remote control over much of the equipment within the house
  - Allows several products to perform some type of co-ordinated operation or service
  - Enables a true modular functionality, where products can be added or removed at any time

JMF / MC / DK

## **HS: Practical Advantages**

- **Added comfort, improved security / safety, economy**
- **Improved independence in daily living for people with disabilities**
- **low-cost and wide availability products (beneficial to people with special needs, if their specific requirements are met and if adequate user interfaces are available)**

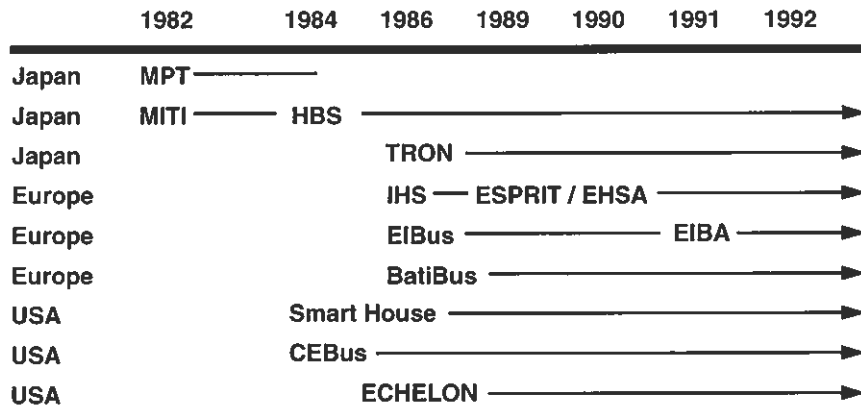
JMF / MC / DK

## **Environmental Control Systems in Europe**

- **Fragmented market (the users are not able to select the different elements that best meet their needs from different suppliers)**
- **Direct control using infrared or direct wired systems (mostly on/off control or control of devices with existing remote control)**
- **No feedback to the user to confirm control action or give systems information**

JMF / MC / DK

## The International Environment



Thomas Heimer, "Recent Developments in the Diffusion and Implementation of Intelligent Home Technology," *BESTA Conference, 1994*

JMF / MC / DK

## HS: R&D Methodology

- One major aspect: R&D work must be led by the end user requirements and not by the technology
- Four main areas of work:
  - Identification of end user requirements
  - Technical specification
  - Applications and user interfaces development
  - Training and evaluation

JMF / MC / DK

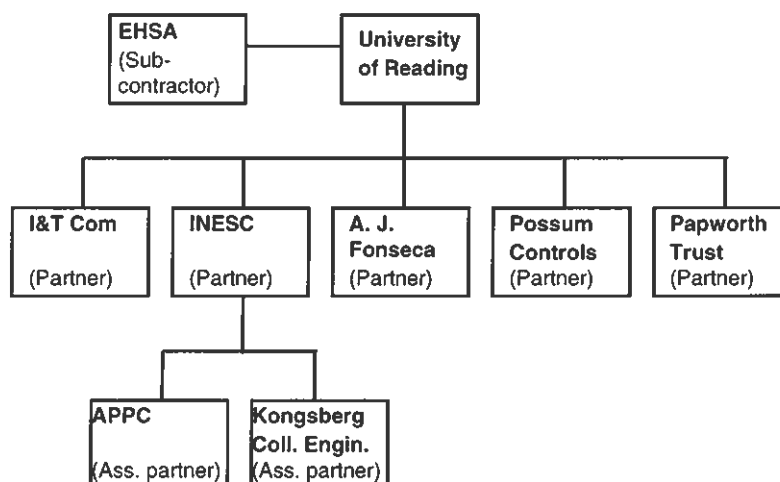


## The HS-ADEPT Project

- **HS-ADEPT: Home Systems — Access of Disabled and Elderly People to this Technology**
- **HS-ADEPT is partially supported by the European Commission under the TIDE programme (January 94 - June 96)**
- **Objective: Develop the emerging HS technology and make it accessible to disabled and elderly people**

JMF / MC / DK

## The HS-ADEPT Consortium



JMF / MC / DK

## User Needs Survey

- **Pre-selected populations at Papworth Trust and APPC participated in detailed personal interview**
- **56 people interviewed at Papworth**
  - Aged 20 to 80+
  - 50 % wheelchair users
  - 41 % living in residential care home
  - 41 % living in accommodation with warden services
  - 18 % living independent of such services
- **29 people interviewed at APPC**
  - Mostly aged 20 to 29
  - All living with relatives

JMF / MC / DK

## User Needs Survey: Key Results

- **Control of the home environment is more important than home automation**
- **Dependency on “computerised home” is seen as a backward step from dependency on human carers**
- **Key areas for development:**
  - Access through internal doors for wheelchair users
  - Control of windows / shutters / curtains
  - Lighting control
  - Control of the heating system

JMF / MC / DK

## Proposed Developments

- **User interfaces**
  - TV display system
  - Large button controller
  - Rehabilitation switch controller
- **System elements**
  - Security and safety alarm system
  - Router between mains and twisted pair bus
- **Devices**
  - Front door unit
  - Power switches
  - Door / window actuators
  - Lamp fittings and switches

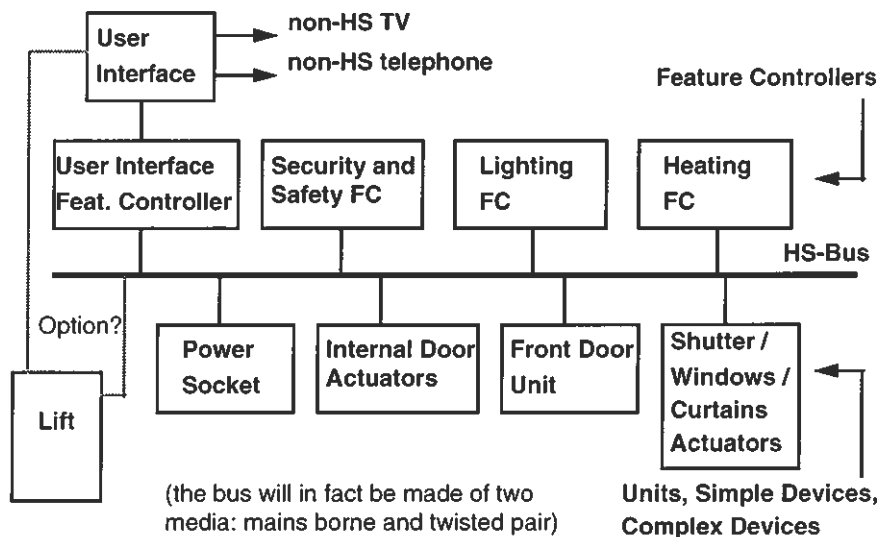
JMF / MC / DK

## HS Specification

- **The system will be implemented according to the European Home Systems specification:**
  - It is a non-proprietary specification supported by many key European manufacturers (during definition and subsequent product development)
  - Implements full “plug-and-play” (simple installation, modular expansion and heterogeneous upgrade capability)
  - Supports different physical media (mains, twisted pair, coax, RF, infrared)
  - The specification is maintained by the European Home Systems Association (EHSA) and can account for particular requirements in rehabilitation or any other specialist field

JMF / MC / DK

## System Overview



## Future Directions

- HS technology, both for people with special needs and for the general public, is still in its infancy
- Standardisation is one key aspect to enable a much delayed mass market
- There is a potential synergy resulting from the HS infrastructure and the advanced telecommunication networks that will soon become available

JMF / MC / DK

## Telematics and Smart Homes

- **The telematic services that will be available in the near future will enable important services for people with special needs:**
  - Personal alarms / home security
  - Remote home monitoring / management
  - Remote care / rehabilitation / support
  - Informal interpersonal communications
  - Teleworking
  - Distance learning
  - Information access
  - Remote transaction
  - Entertainment / leisure participation

Kevin Culler, *Report on Requirements: Methods and Data Sources*, TIDE Project 1113 (MART), 1994.

JMF / MC / DK

## Conclusion

- **HS technology represents a promise of improved independent living at reasonable cost for disabled and elderly people**
- **Telematic services and applications represent complementary opportunities and a wide synergy can be expected from its intersection with HS technology**
- **Effective benefits from developments in these fields will still require a number of issues to be addressed**

JMF / MC / DK