Implications of the Emerging Home Systems Technologies on Rehabilitation and the HS-ADEPT Project

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Abstract. This paper gives a review of the current and anticipated developments in Integrated Home Systems and raises the implications these have in the field of rehabilitation. Firstly the systems under consideration are defined and their development world-wide outlined. The implications of this technology for rehabilitation are then raised and an outline is given of the TIDE Project HS-ADEPT (Home Systems — Access of Disabled and Elderly People to this Technology). Concluding comments are offered in the hope of stimulating the necessary interdisciplinary discussion.

1. Introduction

There is a new area emerging in the consumer electronics world, frequently referred as Home Systems, Integrated Home Systems, Smart Houses, or Intelligent Homes, that is more concerned with the integration of the electronic systems used in the home and services that could be provided through them, rather than the detail of a particular system or device.

In "Integrated Home Systems" the different consumer electronic devices in the home are able to communicate (co-operate), and thus function as a system rather than a collection of independent devices (e.g. if the security and safety system detects a fire at night it could not only raise the alarm but also access the lighting system to illuminate the exit route and unlock the doors). Further savings can be made by sharing devices between applications.

2. Implications for Rehabilitation

There are important implications of these technical developments for rehabilitation, although a significant market for the integrated home systems technologies in general will still have to be created. It will only be then that the technology will be sufficiently inexpensive to make its use for rehabilitation services cost effective.

The principal advantage of the integrated home systems technologies over the existing systems designed specifically for disabled people, such as the Possum or Steeper systems, is flexibility. This enables systems to be more readily tailored to individuals' needs, and increased choice of equipment to be offered to the users, leading to an increased potential for independent living through full control of the home environment.

Extending the time people with a degenerative condition are able to remain in their homes is another important implication. A person can be provided with different ways of "driving" a system appropriate to their current abilities without changing the whole system. Thus once the basic system is installed the only change that may have to be made as a patient's abilities decline is changing the "user interface". This will make adaptation less expensive, extending the time a person with a degenerative condition can remain in their own home. It also

minimises the amount of re-training the user would require as their condition changes.

Remote health monitoring may have important implications when integrated home systems become widespread. However once many homes have such systems installed a service can be envisaged whereby on discharge from hospital a patient can be loaned a health monitoring unit. This unit could be simply plugged into the existing integrated home system and send routine physiological measurements back to the hospital or report a sudden change in the patient's health direct to the hospital via the public telephone network. Such systems could lead to possible early discharge from hospital or allow some conditions to be treated by out patients services rather than hospitalisation.

"Plug and play" is important in this area, since its flexibility simplifies the use of such equipment by the patient and medical staff. The same unit could be readily configured to the requirements of a particular patient at the hospital prior to discharge, and then on their transfer home simply plugged into the existing home system. When monitoring is no longer required, the unit could be readily re-configured for use by another patient in their home.

3. Control of the Home Environment

There is currently a fragmented market for environmental control systems for disabled people, with many different suppliers of equipment. Because of the fragmented market and the incompatibility of equipment from different suppliers, users are not often able to select the elements that best meet their needs and so have to accept compromise solutions.

All the existing systems offer direct one way control, using infrared or direct wire connection mostly of on/off functions, such as door open, light on, etc. or control of devices with an existing remote control facility, such as TV, video or hi-fi. No feedback is offered to the user to confirm that the control action has been completed successfully, or give them information about the system or a particular device. This is particularly a draw-back should the user need to control equipment not in the same room as themselves.

Once established in the general consumer electronics market one of the principal advantages to the users of integrated home systems (compared to environmental control equipment) will be offering them choice over the appliances they have in their home. They will no longer be limited to a small range of adapted units but will be able to fully control any equipment compliant with the installed system.

If a non-proprietary or open system is adopted, then the users or professional care service providers will be able to select different elements of system from different suppliers. Thus if one supplier produces the best user interface for an individual, the rest of the system need not necessarily come from the same supplier and the best available system for the user can be selected by combining components from different suppliers.

The principal technical advantage is the general ability of integrated home systems to co-ordinate operations between sub-systems; e.g. the safety system will be able to automatically telephone the fire service in the event of a smoke detection alarm, open emergency exit doors and turn lights on along the best exit route. Also resources can be shared by different applications; e.g. sensors used as intruder detectors can also be used to select which doors to open automatically on the user's approach.

4. The Problem of Standards

Various standards of communications protocols, media specifications and systems infrastructure have emerged world-wide that could be used to implement an integrated home system [1:4].

Japanese Industry was the first to try and exploit the possibilities of systems integration of these products. The first systems and compliant products were developed there in the early

1980s. There are now over 10,000 homes equipped with HBS systems, but this is still very small compared with the projected mass markets for such technologies.

There has been a long history of home automation in the USA, but this has been predominantly a market of bespoke solutions for affluent people. There is also a significant hobbyist / DIY market, in most cases driven by small / medium locally based companies. Some of these companies specialise in adapting homes for people with disabilities. More comprehensive systems developed in the USA are "Smart House" and CE-Bus. There are demonstrators for the former system in most States but many of these are Smart House ready houses, having the basic cabling infrastructure installed but no products and services as yet.

In general there was a later start in Europe in the development of integrated home systems technologies compared with the USA or Japan; work really only begun in the late 1980s. France has been very active in these developments and in Europe is still the major player in the field, with large scale installations being supported by National and Local Governments.

Combined effort by many European electronics companies has developed the Home Systems (HS) specification [5]. This is a comprehensive specification of the communications media and protocols devised specifically for integrated home systems. The basic electronic building blocks for a system using this specification are just now becoming available (end 1994). There are at least 6 projects throughout Europe currently working on exploiting this system in creating products and services for the homes of disabled or elderly people.

The European Home Systems Specification is a non-proprietary specification, adopted by many key European manufacturers (involved in its definition and subsequent product development). It implements full "plug and play" (making initial installation simpler and less expensive), enables the customer to readily expand the system in a modular way, supports different physical communications / control media and supports continued specification development (important to account for particular requirements in rehabilitation or any other specialised field).

There is currently a problem of multiple standards, which places a risk on any choice of technology. However, and considering that a non-proprietary system is important in extending choice to disabled people, the European Home Systems Specification presents an additional advantage over its direct competitors.

5. The HS-ADEPT Project

The overall objective of the HS-ADEPT project is to develop the emerging Home Systems (HS) technology, making it accessible to disabled and elderly people. Appropriate end user interfaces will be developed and fully integrated Home Systems will be installed in the homes of disabled people. The philosophy of the project is that it is led by end user requirements and not by technology. Pre-selected populations at The Papworth Trust in Cambridgeshire, UK, and The Portuguese Cerebral Palsy Association (APPC) in Porto, Portugal, were surveyed by detailed face to face personal interviews to determine the priority areas of need that could be addressed by integrated home systems technologies for these people. In general those surveyed at the APPC were more severely handicapped in day to day tasks by their disabilities and their circumstances than those at Papworth.

The main benefit sought for disabled and elderly people through the developing home systems technology is control over the routine activities of their daily lives and their home environment, home automation being less important to this user group. Being dependent on a computer controlled house could be seen as a backward step from dependency on human carers. There was a fear expressed by some that if they became independent in the home through technology, this would lead to increase social isolation.

The key areas to be addressed, identified from the user needs surveys, were access through internal doors for wheelchair users, control of windows / shutters / curtains, lighting control,

control of the heating system and front door entry. A fully integrated security and safety alarm system, conforming to the HS specification, is to be produced that can be controlled by way of the Home Systems bus. The HS-ADEPT project will develop 2 different, customisable user interfaces, which will address the needs of people with a wide range of physical abilities, and enable access to the whole range of Home System control functions. These interfaces or controllers will be enhanced by the facility to display menus and control options, together with system information, on an unmodified domestic television set for the monitoring and control of the more complex applications.

When developed, the systems will be installed in the homes of the participating disabled and elderly people. The technical developments of the HS-ADEPT Project will thus be subject to a full evaluation by potential end users in their day to day lives over a period of months.

6. Concluding Comments

There is no doubt that the technology is coming. It is likely that Integrated Home Systems Technologies will break through into the mass consumer electronics market within the next 10 years, and hence the implications for rehabilitation need to considered by service providers in both health and social services now.

The exploiting of a general market consumer electronic products to alleviate handicap is admirable both in terms of social integration (the disabled person not having to use specially adapted equipment) and cost effectiveness (most system elements will be sold to a mass market beyond the disabled users). However, it has policy implications for Government or Charity funding of assistive technologies.

For many their carers are their friends, and a means of regular contact with the wider world. There is a fear expressed by some, that increased independence could lead to increased social isolation. The individual nature of an individual's needs and the choices in the way that those needs are met must be considered and appropriate clinical assessment services developed and resourced.

If these developments in integrated home systems technologies are going to realise their full potential in rehabilitation, then there is a need for discussion in both the development stages of applications and products and in the setting of policy for Health Authorities and Social Services. These discussions must involve potential users, care professionals, clinicians and therapists, the technologists and service administrators. It is hoped, by the authors, that this article will go some way to stimulate this discussion.

Acknowledgements

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