Integration technology for integrated systems of assistive devices

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Introduction

Technology in general can directly improve the quality of life for older people and people with disabilities. Access by elderly and disabled people to generally used technology and technology based on services is a major challenge in facilitating their integration.

In order for technology to serve the needs of older people and people with disabilities it is important to take their requirements into account throughout the development process. It is also important to incorporate needs for older people and people with disabilities into the development process of all equipment and services available in the market. The rationale behind this 'design for all' principle is that for larger markets almost all users can benefit from easy useable systems and that services can become accessable to and useable by as large a group of people as feasible, including older people and people with disabilities.

Apart from this general market products older people and people with disabilities create a demand for specialised technologies which address specific or particular needs there a requirement for the development of so called 'assistive devices' exists. Assistive devices are divided into two types:

1. Devices that are available in the general market and require an interface, adaption, modification which allow older people and disabled persons to have access to mainstream facilities.

2. Devices, products, services for specific compensation of limitations experienced by older people or some people with disabilities like vision, hearing, speech, mobility, environmental control, cognition etc.

Based on user needs analysis the integration of assistive devices becomes more and more important. The state of the art is that integrated systems are operated through differing and incompatible control systems. Users are confronted with switches, buttons, nobs, handles, keyboards, which often clash with the actual users capabilities.

Integrated assistive devices need to be controlled in a coordinated manner. This requirement is growing to be even more important while emerging intelligent mobility aids, environmental controls, interactive multimedia, wide area communications and other end effectors are coming available.

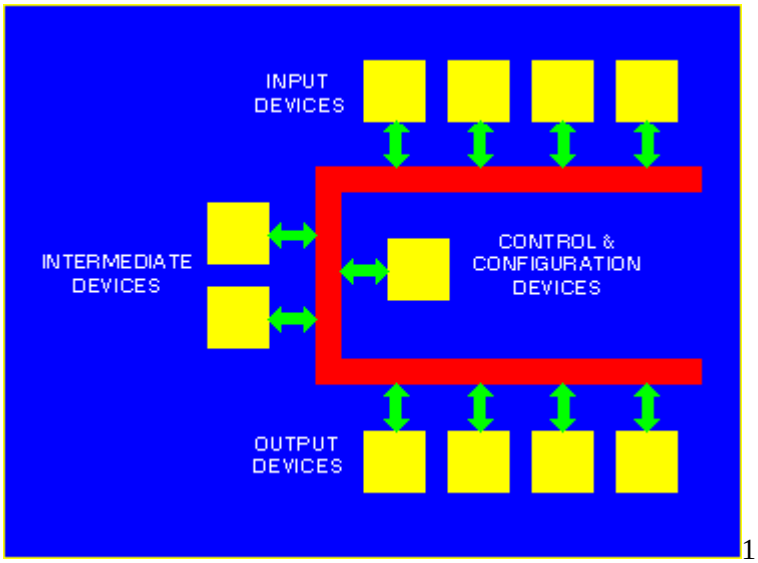
Method

Integration needs to be done according to a (standardised) method. This is cost effective, while all the players in the field can speak the same language. The (end) user, the facilitator (carer or intermediary), the system integrator and the system maintainer. Integration of assistive devices deals with multi-disciplinarity. Disciplines like ergonomics, human factor engineering, information technology, mechatronics, rehabilitation engineering etc. are all relevant backgrounds for integrated solutions.

With the end user placed in the activity center, control of mobility and the environment as well as communication needs or control of a fixed environment and communication are the subjects to deal with.

Integration of assistive devices for control and communication (end-effectors) with optimal control devices (input-devices) is the subject of integration.
Only one 'open' bus system to interconnect these devices is available; M3S, the general purpose interface for the rehab field. M3S is a proposed standard digital communication bus, based on underlying standards (CAN). It deals with the electrical connection and the communication protocol. The ergonomic/mechanical integration design is left open, as is the look and feel of the human interface.

The M3S system



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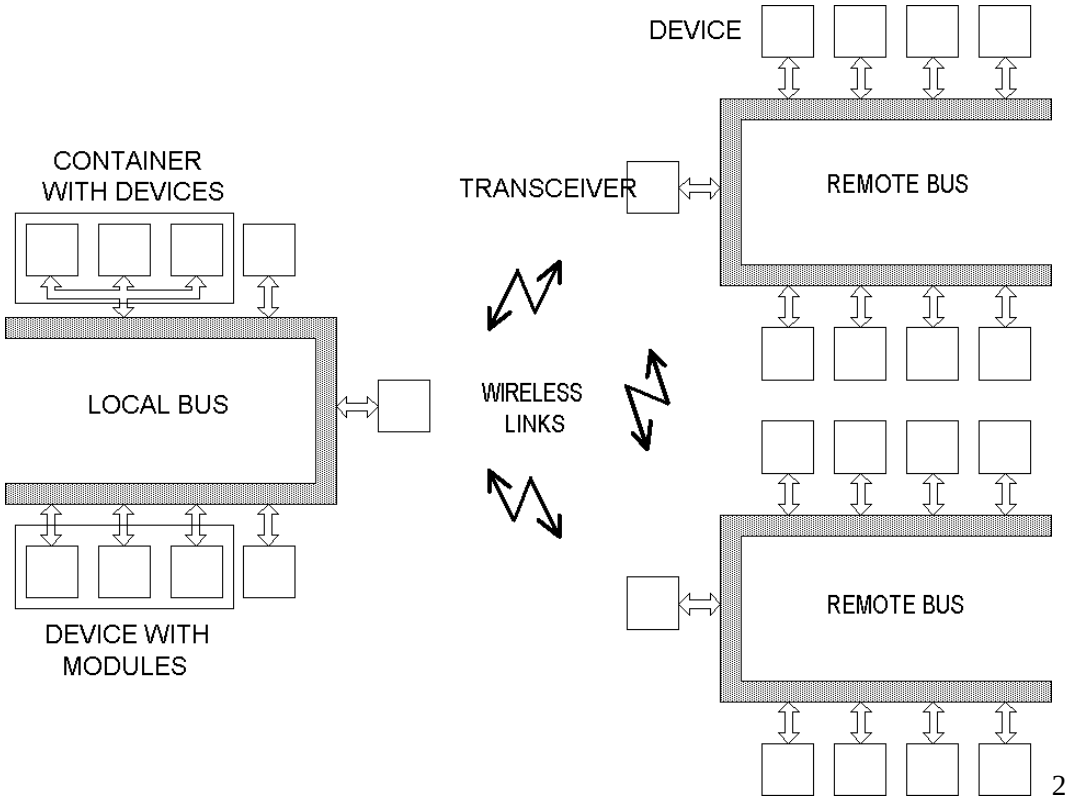
A general M3S system is shown in the figure above. There are three types of devices that can be connected to a M3S system, namely input devices and end effectors and intermediate devices. Examples of input devices are joysticks, switches and speed recognisers while wheelchairs, robotic manipulators, and speech synthesizers are environmental controllers are examples of end effectors. An example of an intermediate device is a navigator unit. Each system includes a configuration and control function (CCF), usually in a separate module known as the CCM. If the CCF can be integrated into an existing device on the bus the overall system costs will be reduced. The CCM is responsible for configuring the system and for safety monitoring. It also contains a menu structure from which the user can select any of the options available on the system. The M3S architecture was designed so that devices can be added to a system at a later stage without any complicated adaptations. This implies that a devices on the system cannot have any knowledge of the other devices present prior to being connected. It also means that devices must be able to communicate via the bus in a generic way. All the devices on a M3S bus therefore contain internally stored configuration information which describes the specific behaviour of the device in a format that can be understood by the CCM. On connection to the system, the CCM uploads the configuration information from the device. The CCM is then aware of the device and is

able to establish a method of linking the device to other devices on the bus.
The data that devices can send or receive on the M3S bus are described in terms of input or output actions and are referred to as device degrees of freedom (DOFs). Each DOF may either be sent to the bus, in which case it is called an input DOF (IDOF), or it is read from the bus in which case it is an output DOF (ODOF). Each device is therefore characterised by the number of DOFs and the capability of each DOF.

Extended functionality

Homes will become nodes on international information networks. Householders (also people with disabilities) will have a need for services which give them more convenience, more knowledge, more fun, more independence. The inside of homes will be installed with electronic communications and control means and with communication means to the outside world.



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When a user needs a wheelchair (equipped with M3S) he will be able to control the environment in each room in the house or in his or her working environment. So is communication arranged.

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