IST-2003-511670

MOVEMENT

Modular Versatile Mobility Enhancement Technology

Specific Targeted Research or Innovation Project

IST

Periodic Activity Report N°: 1

Publishable executive summary

Period covered from: 01/09/2004 to: 31/8/2005

Start date of project: 01/09/2004 Duration: 36 months

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Project coordinator organisation: fortec, Institute 'integrated study' – TU Vienna

The MOVEMENT project aims at the development of a modular versatile mobility enhancement technology. The core is formed by an intelligent mobile (robotic) platform which can attach to a user definable selection of application modules (e.g. chair, manipulator, information and communication terminal) which are more or less inconspicuous mainstream articles but will become powerful assistive devices when the mobile platform attaches to them.

Introduction

As mobility is a challenging key factor for personal independence and self determination and because it is inseparably linked to our quality of life, MOVEMENT stands for the transfer from the existing state of the art to a user oriented, modular as well as market compatible system approach to enhance societal mobility.

In our "Information Society", mobility can be described in three dimensions:

- MOVEMENT of PEOPLE: Transfer of persons to locations they want to access.
- MOVEMENT of OBJECTS: Transferring objects to facilitate an interaction with the person.
- MOVEMENT of INFORMATION: Access to and transport of information in the "Information Society".

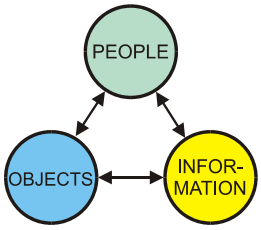

Fig.1: Interaction Triangle: Mobility in the "Information Society"

In a society where the percentage of old and disabled people is increasing at a significant rate, securing all three dimensions of mobility must be a social and technological goal of the highest priority. The MOVEMENT project will address all three dimensions of mobility in the "Information Society" by research into and development of realistic and practical modules for moving people, objects and information. Present state-of-the-art solutions such as conventional wheelchairs and stationary terminals or fixtures will be replaced by an expandable system of intelligent and interacting modules, which supports the personal mobility of old and disabled people.

Motivation

Due to the continuously increasing life expectancy of people in western countries, the percentage of motor impaired people is constantly increasing. Less recent Europe-wide statistics denoted that 1% of the population is in need of a wheelchair and an additional 5.6% of people need some kind of walking aid. When also taking persons with chronic and age related diseases (poly-arthritis, rheumatism etc.) into account, recent statistics show much higher figures. In March 2003, the German Statistics Office calculated that 1.56 Million

German citizens (1.9 % of the population) depended permanently or temporarily on a wheelchair. For Europe as a whole this translates to 7.1 Million people. The increasing wheelchair usage due to ageing is shown in Fig. 2 (left). Analyses in the USA have shown that only 50% to 60% of people in need of a power wheelchair are in fact able to use state-of-the-art equipment. An additional 20% to 25% could be accommodated if more intelligent controls and user interfaces were available (Fig. 2, right).

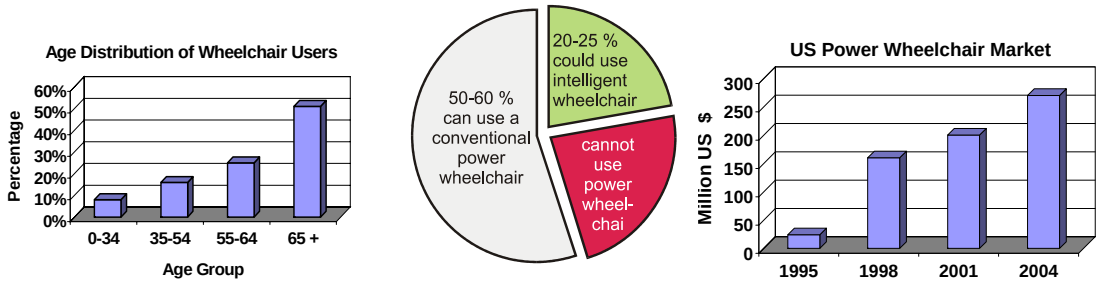

Fig. 2: Distribution of wheelchair users to age groups (left); usability of conventional wheelchairs and market segment for intelligent wheelchairs (right);

Loss of motor abilities (manipulation and locomotion) especially affects the aged female population not only due to their higher life expectancy, but also as a result of gender-specific chronic diseases. Whereas 31% of the male population aged 75-84 report mobility problems, the figure for the female population is as high as 52%. As the decrease in motor ability is gradual and slow, there is no pressing reason to begin using a wheelchair. Thus, the major part of the ageing population is shying away from using conventional mobility aids (crutches, walkers, wheelchairs) due to their stigmatising effects, even if walking causes increasing stress, fatigue and pain and despite the risk of falling and the consequences thereof.

Project Aims

The last decade saw the evolution of more and more complex wheelchairs demonstrating capabilities for navigation, manipulation and transport. However, theses systems never made it to commercialisation, since they are bulky and difficult to operate. They need to be engineered for each individual human and are still all in all very costly.

Recognizing the drawbacks, MOVEMENT aims at developing a new solution for supporting personal mobility which meets the users' expectations for an inconspicuous, non-stigmatising, tailor-able, ready to use and affordable mobility aid. As a consequence, the objectives of the project are:

- Addressing all three aspects of mobility (moving people, objects and information) by a fully modular set of assistive devices that can be freely assembled depending on the user's needs.
- Providing a concrete solution which can be placed on the assistive technology market soon after completion of the project.
- Pursuing an active dissemination and demonstration strategy by which users, care-givers and the health system is informed about the product under development, leading to awareness creation on a European level.

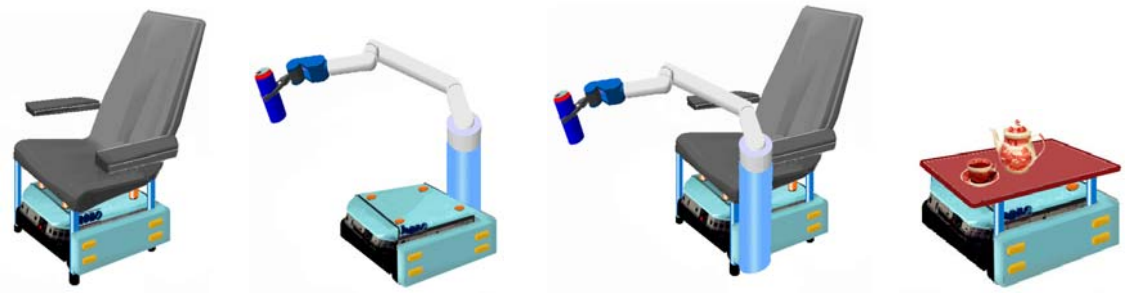

Fig. 3: Typical combinations of MOVEMENT-modules for moving people and moving and manipulating objects.

To achieve these goals the consortium integrates research and commercial know how from recent developments in the required fields of industrial automation, transport and wheelchair technology, manipulation and robotics devices, perception and control engineering, human computer interface technology, assistive technology and gerontechnology.

Work Progress

The project started with a specification for the interaction of the modules that were already defined very specifically in the project's work plan and the modelling of scenarios of use for the indoor environment, a restriction necessary because of the need to concentrate on a predictable and reproducible test setup first, that, nevertheless, offers challenging obstacle detection tasks (e.g. tables and other furniture).

User panels in Austria, Italy and the Netherlands were formed, taking into consideration users with mild, moderate and severe mobility restrictions from both the disabled and older age group. The developed concepts were presented to them and they were asked to give ratings to the different parts of the concept and their application.

The results of the user panels confirmed the overall concept of a modular system and provided important hints for the direction of development and the specification of the interaction of the system components.

After this approval of the project idea and its specification the core of the MOVEMENT system, the concept for the mobile platform was defined first. Taking into consideration the numerous requirements regarding payload, safety, automatic docking etc. a platform concept was developed based on existing know-how on autonomous robotic platforms.

In parallel, investigations on suitable sensor systems were carried out and the results were documented in a deliverable. First work on an appropriate development and evaluation environment for the MOVEMENT sensor system is done. Furthermore, concepts for sensor data fusion and data structures for storage and post-processing are under development.

Further work led to the elaboration of deliverables containing the concept for the different modules to be developed and the interfaces between them. By defining an XML-based wireless protocol a separate deliverable prepared the field for the communication channels that later on will be used to exchange status and command messages within the system.

In a similar way like the moving platform itself the docking mechanism between this platform and the application modules plays a central role in the project. Therefore a specific deliverable was prepared describing the mechanical and electrical properties of this important connecting part without which the modular concept could not be realized.

In the next work period the concepts for the shared control between user and system and for the system management will be developed and a first prototype of the platform will be produced. Navigation of this prototype setup will be supported with first prototypes of the MOVEMENT sensor system.

Close to the end of the 2nd year first prototypes of a moveable chair and the information terminal shall be evaluated in use with the mobile platform. From these tests it is expected to gain important information for the subsequent prototype stages with additional modules.

MOVEMENT consortium

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Vienna University of Technology, Automation and Control Institute and Institute “integrated study”
ARC Seibersdorf Research GmbH, Business Units 'Mechatronic Automation Systems - WPA'and 'Rehabilitation & Inclusion - MRI'

Netherlands
iRv Institute for Rehabilitation Research

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Belgium
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MOVEMENT Homepage

http://www.fortec.tuwien.ac.at/movement
offers up-to-date information on the project status and download of public project deliverables.