Preface

BACKGROUND

"There is no true progress if technology is not within range of everybody" Henry Ford

Human beings are active by nature and involve in significant activities and occupations that allow them to satisfy their needs according to their interests and desires.

This definition is valid as long as there exists a correct interaction between the corporal factors (structures and functions), the features of the individual (activities), and the environmental elements (participation), as defined in the social model of the International Classification of Functioning, Disability, and Health (CIF). Contextual factors are so important for personal development that their diminished integration can lead to the restriction of the person's social participation.

Day after day, people with functional diversity face environmental obstacles, barriers, and difficulties that complicate their normal interaction and participation in activities that are important to them.

Between 10 and 20% of the world population suffer from some type of disability, i.e. approximately 600 million people. Almost 43% of them subsist on less than $1 a day, and 70% of them reside in developing countries. These numbers give an idea of the inequality that is common to this population group.

Undoubtedly, the "technological revolution" has allowed the development of new devices and products that have optimized our systems of information, socialization, and communications. But this revolution has also contributed to the increase of the above inequality and has led to what is now known as the "digital breach", which separates those that can normally use technology and those than cannot.

In order to end this situation, technological development must consider not only the demands of the activity but also contextual factors and person-specific features and needs. It is in this context that "support technology" has appeared and known its largest growth in 30 years. This denomination is used to refer to all devices, services, strategies, and practices that were created and applied to mitigate the difficulties of disabled people.

People with functional diversity use support technology in a wide range of areas, such as daily life, education, work, free time, and activities of social participation. Support technology can be a fundamental tool to guarantee their participation, integration, and equality of opportunities, but only if real interaction exists between the human being and the technology. The features of the device, the identification of significant activities, and the perspective of the user must intercommunicate and respond to their specific context.

The efficiency and efficacy of support technology depend on its ability to adapt to the needs and desires of the user, respond to the purposes it was designed for, and integrate with the user's personal environment.

"Technology is not a purpose in itself, but a means between the knowledge society and global development".

BOOK ORGANIZATION

Recent years have shown remarkable progress in the development of assistive technologies, especially in the field of Information and Communications Technologies (ICT). This situation has facilitated their incorporation as basic resources for promoting personal autonomy. The aim of the 1st chapter, entitled "*Assistive Technologies, Tools, and Resources for the Access and Use of Information and Communication Technologies by People with Disabilities*", is to provide information about assistive technology, and specifically those directly related to ICT.

A growing number of individuals with severe physical disabilities do not have access to communication or environmental interaction. The 2nd chapter, "*Nascent Access Technologies for Individuals with Severe Motor Impairments*", introduces three emerging access technologies for individuals with severe disabilities: near-infrared spectroscopy, electroencephalographic measurement of visually evoked potentials, and infrared thermographic imaging of the face. We present the physiological underpinnings of each technology, the necessary instrumentation, and the relevant scientific evidence to date.

The 3rd chapter, "*Elderly People, Disability, Dependence, and New Technologies*", shows the potential impact of new assistive technologies to help the elderly stay in their own home, allowing them to improve their quality of life and independence. It is important to draw attention to the characteristics of the elderly and their situation regarding the increase in life expectancy and aging-related aspects such as disability and dependence.

The 4th chapter, "*Augmentative and Alternative Communication Devices: The Voices of Adult Users*", reports on data collected through interviews with adults who use aided communication. In these interviews, the adults highlight the complex factors that influence their use of aided communication and their aspirations and expectations of aided communication. They discuss the limitations and the potential of new technologies and explore how these developments have an impact on their participation in meaningful social interactions.

Smart ICT systems, essentially based on multisensory approach, are becoming of great interest in the field of perceptive impairments. The 5th chapter, "*Innovative Smart Sensing Solutions for the Visually Impaired*", addresses examples of multisensory systems that support the daily activities of visually impaired people. The proposed architectures adopt low cost sensors, dedicated signal processing, and smart algorithms. The latter approach, which moves the design focus from expensive hardware to smart paradigms, allows for boosting system performances especially in terms of reliability and redundancy of the information to be provided to the user.

The Etiology of Persistent Developmental Stuttering (PDS) is still a largely unknown subject despite centuries of research and modern neuroimaging techniques. A new etiological model of PDS is presented and discussed in the 6th chapter, "*An Advanced Concept of Altered Auditory Feedback as a Prosthesis-Therapy for Stuttering Founded on a Non-Speech Etiologic Paradigm*". Two major asseverations are that PDS is a non-innate and a non-speech based disorder. The implications of the model have guided the design of a new adaptive AAF device.

It has been demonstrated that rhythmic sensory stimulation facilitates locomotive function in patients with Parkinson's disease. In the 7th chapter, "*The Role of Sensory Rhythmic Stimulation on Motor*

Rehabilitation in Parkinson's Disease (PD)", we review the current knowledge on the use of sensory stimulation as a tool to improve motor performance in parkinsonian patients with a focus on gait. The different sensory modalities (auditory, visual, and somatosensory) are considered and some methodological principles reported in the scientific literature to better administrate stimulation are taken into account.

Transcranial magnetic stimulation (TMS) is a procedure in which electrical activity in the brain is influenced by a pulsed magnetic field. The early clinical uses of TMS were restricted to the field of neurology, where it was used to examine conduction in the central and peripheral nervous system by stimulating neurons. More recently, TMS and repetitive TMS (rTMS) have been used to investigate aspects of cortical processing, including sensory and cognitive functions. The 8th chapter, "*Transcranial Magnetic Stimulation (TMS) as a Tool for Neurorehabilitation in Parkinson's Disease*", introduces the basic principles of the technique and reviews some works on the therapeutic use of rTMS on Parkinson's disease.

The 9th chapter, "*A Feedback Controlled FES in Rehabilitation*", shows how a feedback control functional electrical stimulation (FES) system was proposed to prevent quadriceps weakness and drop-foot of the hemiplegia during gait training. The proposed knee locker device with closed-loop FES system is capable of providing a hemiplegic patient with regular walking restoration after appropriate gait training.

The 10th chapter, "*Human-Centered Metal Hydride Actuator Systems for Rehabilitation and Assistive Technology*", reviews the motivation for the development of some of the leading artificial muscle-like actuators, outlines a new and unique actuator using metal hydride materials, and describes its applications for joint rehabilitation, prevention of disuse syndrome, transfer assistance, and seat lift for wheelchair in quality-of-life technology.

Many disabled users consider the Web to be their primary source for information, employment, and entertainment. However, there are millions of people who have disabilities that affect their use of the Web. To understand the needs of disabled users is to understand the needs of everyone. The 11th chapter, "*Web Accessibility: Current Trends*", first examines the intersection between accessibility, disability, and technology; it then presents current practical trends towards achieving Web accessibility; finally, it discusses future trends.

The 12th chapter, "*Catering for Personal Autonomy with E-Mentoring Supported by Recommendations*", presents a technology solution based on a recommender system. In order to support the needs of people with intellectual disabilities towards their work integration and independent life, we addressed two challenges: i) facilitating the mentoring work for human mentors, and ii) reproducing some of this support and offering it dynamically when specific actions of the users are detected in the environment.

The 13th chapter, "*Blind User Interfacing: Requirements, Models, and a Framework*", presents the requirements for blind user interfacing, the changes to be made to the human-computer interface models, and a framework that improves the development of dual user interfaces. The framework includes a set of guidelines for interface design, a toolkit for the low effort implementation of dual user interfaces, and a programming library for speech and Braille. A case study of the development of one such dual interface application is also presented.

The 14th chapter, "*Sensors in Assistive Technology*", reports on the development of an eyeglass-type infrared-controlled computer interface for the disabled. The system is designed for individuals with spinal cord injuries and disabled people whose movements are severely restricted. The infrared transmitting module can be easily mounted on eyeglasses or artificial limbs.

Brain-computer interface (BCI) technologies translate brain activity into action and thus allow the user to control devices directly without motor activity. The 15th chapter, "*Non-Manual Control Devices: Direct Brain-Computer Interaction*", consists in a review of basic principles and methodologies underly-

ing BCI operation, and a discussion between two practical examples: BCI-based control of a humanoid robot for physical manipulation of objects, and BCI-based interaction with the popular global navigation programme Google Earth.

Wireless sensor networks and systems are the most powerful technologies applied to control and supervising systems. The 16th chapter, "*Wireless Sensor Networks and Systems*", is focused on their use for disabled and elderly people. It will show a study about the four main wireless technologies used for this purpose and a survey with the benefits when they are applied. It demonstrates that Zigbee is the most often used technology, but that in some cases WLAN is the best technology.

Scanning keyboards are a type of Augmentative and Alternative Communication (AAC) devices used by many individuals with speech and motor disorders in their day-to-day communication. A scanning keyboard refers to an on-screen keyboard operated with a scanning input method. User models, in conjunction with automatic design space exploration methods, provide efficient ways to design and evaluate scanning keyboards. A review of the related works reported in the literature, including their limitations and scope for further research, is presented in the 17th chapter, "*Model-Based Approaches for Scanning Keyboard Design: Present State and Future Directions*".

The 18th chapter, "*Projects from the Orange Foundation in Favor of People with Obstacles to Communication*", takes a look at the most important projects carried out by the Orange Foundation in order simplify communication for people with disabilities. It tries to demonstrate how, by using different technologies and playing with them, those people can get a better communication experience.

The 19th chapter, "*Occupational Therapists' Perceptions about the Non-Use of Recommended Assistive Technology (AT)*", presents findings from a study which aims at obtaining occupational therapists' perceptions about the non-use of assistive technology (AT). Therapists identified the client-, AT- , and intervention-focused factors found to influence AT use. Overall, results support the need for therapists to use a client-centered approach during the provision of AT in order to facilitate optimal use by clients.

Many systems and devices have been developed in order to improve the quality of life of the disabled and elderly people. The 20th chapter, "*Sensors and their Application for Disabled and Elderly People*", introduces a classification of the sensors, their main circuits, their basic principles, and the most well known sensor applications for the disabled and elderly. It is very useful in facilitating the development of sensors in this area.

A modern society must offer individuals the possibility to access all resources available, especially elderly and disabled people. The progress of remote ICT has led to spectacular advances such as Telegerontology, a system that not only includes the basic principles of accessibility and usability, but also those of gerontology attention, i.e., the capacity to assess the patient before the intervention. This new branch is introduced in the 21st chapter, "*Telegerontology: A New Technological Resource for Elderly Support*".

The 22nd chapter, "*Experiences Using Information and Communication Technologies with Elderly People*", describes an experiment conducted with new technologies in the Red Cross Elderly Day Care Centre of A Coruña, using the In-TIC software and a specific methodology for intervention with elderly individuals. The implementation of these types of experiences may improve accessibility to ICTs for the elderly and help to encourage their social integration and occupational performance.

The 23rd chapter, "*Experiences Using Information and Communication Technologies with Children Affected by Cerebral Palsy*", shows the experience of using information and communication technologies in a centre specialized in Cerebral Palsy. Specifically, the intervention was carried out with In-TIC software, developed by the IMEDIR Centre (University of A Coruna). The participants in this experience

are people with cerebral palsy who attend the ASPACE Center and have potential abilities to benefit from the application of the new technologies.

RELEVANCE AND CONCLUSION

This book is addressed to people who are related to support technologies and the promotion of the personal autonomy of persons with functional diversity. Professional experts, students, and teachers will be able to extend their knowledge on this matter by receiving a general vision on the latest advances in research and learning from the experiences of people who believe in the power of new technologies to raise the level of independence and autonomy of the disabled to their highest level.

It is our wish that this book may be useful to all readers, but in particular persons with functional diversity, who constitute the essence of our work and dedication.

The impact of technology in our modern world is undoubtedly positive. If technology is put at the disposal of persons with functional diversity, the possibilities of application become almost infinite.

According to the World Health Organization (WHO), health must be defined as a state of complete physical, mental, and social well-being, rather as the mere absence of illnesses; people with functional diversity suffer from physical, cognitive, sensorial, and/or social limitations in the activities that constitute the daily life of all human being, i.e. Basic Daily Life Activities, Instrumental Daily Life Activities, Education, Work, Free Time, and Sleep.

There are various frameworks, models, and conceptualizations regarding technologies that increase personal autonomy, but Information and Communications Technologies that are developed for and by the persons implied really contribute to improve their personal autonomy, independence, and quality of life.

This book is based on the contributions of people who describe their experiences with technologies, products, services, and research, and allow us to compare, analyze, and summarize a wide range of technological applications for people with functional diversity.