Preface

Prosperity and growth of humankind over the 21st century has been marked with progressively improving quality of life, due in no small part to our embrace and development of Assistive Technologies. Though probably too general a term, it is often referred to as rehabilitative, adaptive, augmentative, or alternate technology. In truth, Assistive Technologies has come to include all applications of science towards sustaining and evolving the aforementioned quality of life. Basically, this may be achieved in two ways depending on the recipient. A perfectly normal human being may be augmented in some way to exceed his or her boundaries of capabilities. Alternatively, a person who suffers from some form of disability or impairment may be artificially enhanced and assisted to carry out daily routines indifferent from any other fully functional human being. The goal of the studies presented in this book centre on the latter.

Towards this end, we can elaborate further by identifying the target groups that Assistive Technologies may benefit directly. At the time of this writing, developed countries are facing an inevitable change in demographics, hinted by falling birth rates and increasing population of retirees. By 2014, concern over the state of health and wellbeing of the average human citizen has taken centre stage, alongside needs for more effective working environments as well as accessibility for disabled people in the 21st century.

The application areas for Assistive Technologies are absolutely huge, and it would be impossible to enlist each and every one in this book. However, in light of the current community in need, there are specific areas that this book will designate with substantial impact in 2014. For the elderly, this includes technologies geared towards therapy for tackling motor deficits, tracking activity decline particularly for patients with Alzheimer’s disease, and fall detection. These past few years have seen gradual emergence of assistive robotics and activity tracking systems for monitoring and caring for children with cognitive disabilities. Also in the realm of assistance over cognitive disabilities, new developments have offered an alternate view on identifying and modulating social interaction impairments, as well as enabled safer navigational help. As mentioned earlier, the advent of ICT infrastructure development and online persistence has sparked new ventures and possibilities for enabling behaviour change and increased privacy for therapy and wellbeing monitoring on the go. In the same way, even the workplace may have the possibility of context-sensitive assistive technology that helps boost productivity.

In order to contribute to the target application areas, several key technologies have been highlighted. These include emergent trends in 2014, such as the new focus on neuro-rehabilitation as an application of rehabilitation engineering on motor learning, an alternate view of autism based on impairment classification, the rise of commercially available assistive companion robots, and waves of embedded devices and architectures that are integrated with the Internet (such as the Internet of Things). Predominantly strong assistive technologies, such as Context-Aware Assistive Technologies (CAAS), Telemedicine, and digital intervention, have been bolstered with updated Information Communication Technologies (ICT)
infrastructures and the proliferation of Social Networking, such as Facebook, Google+, and Twitter. These have helped propel health-monitoring services, e-therapy, and productivity awareness systems to greater heights. Special attention should also be paid to recent advances in video-based monitoring hardware, such as Microsoft Kinect, which combines depth sensors and video imaging for unprecedented monitoring capabilities. Having these systems commercially available has ignited an explosion of human tracking and environmental surveillance projects throughout the globe. This book will cover selected studies that demonstrate the potential of this technology for assisting in injury prevention and CAAS.

The purpose of this book is to present the state of the art of Assistive Technologies geared towards aiding people with disabilities in 2014. Again, it is not meant to be an exhaustive catalogue of current research work, but it is meant to be more of an updated preview of applications and cases worldwide that aims to help people with physical and cognitive disabilities. Contained herein are 13 chapters:

Chapter 1 investigates neuro-rehabilitation for stroke patients. Neuro-rehabilitation is based on the assumption that motor learning principles can be applied to motor recovery after injury, and that training can lead to permanent improvements in motor function in patients with motor deficits. The authors investigate the emerging technologies for neuro-rehabilitation for stroke patients, focusing mainly on robotic exoskeletons and active FES-assisted therapy, which could provide repetitive training-based therapies and have been developed to aid or control the upper and lower limb movements in response to the user’s intentionality. The authors also present how the therapy could be implemented with a natural control to command above external devices from electromyography.

Chapter 2 investigates ambient assisted living for elderly people. In general, one of the basic targets addressed by the wide research area of Ambient Assisted Living (AAL) focuses on automatic and privacy-preserving systems to monitor elderly people in their home environments. In this chapter, the low-cost Microsoft Kinect®, which can provide high-resolution depth and visual sensing, has been utilized for automatic monitoring. The authors present two use cases that employ the sensor to generate a numerical representation of the Get Up and Go Test outcome and implement an automatic fall detection algorithm based on depth frames analysis with the sensor in a top configuration.

Chapter 3 investigates communication between people with Autism Spectrum (AS). The authors argue that the AS symptoms can be considered to be the impairments; however, in the right environment, they can be advantageous. A set of symptoms is made up from a number of different scales, called Social-Behavioural Traits (SBTs). With the assistance of the Empathising and Systemising Quotients, SBTs can be used to describe people who are empathic (higher EQ, lower SQ) or autistic (higher SQ, lower EQ), while the TIWWCHNT and STABS scales can describe people who are neurotic (High TIWWCHNT) or psychotic (High STABS), respectively. On the other hand, the C-IQ scale can be used to describe the brain capacity to use or overcome the effects of these. The authors propose a Phantasy Distribution Model (PDM) to explain how Serotonergic-Dopamagenic Asynchronicity (SDA) can cause these different personality types to be impairments and how technology can influence SDA for the better.

Chapter 4 presents on ICT-mediated physical therapy for improving stress urinary incontinence. Stress Urinary Incontinence (SUI) relates to involuntary urine leakage caused by physical activity and/or efforts that significantly affect women’s quality of life. The pitfalls of the conventional SUI treatment are the requirement of a conscious effort by the patient to follow it correctly, high costs, time, and/or schedule. The authors discuss ICT-mediated physical therapy treatment programs to improve SUI symptoms, providing benefits like maintaining total confidentiality, accomplishing a higher adherence to the treatment, keeping a low budget for the patients, and saving the health system’s economic resources.
Chapter 5 explores assistive technology for children with physical and cognitive disabilities. The said disabilities include impairment of motor skills, locomotion, and social interaction, which is commonly attributed to children suffering from Autistic Spectrum Disorders (ASD) and Cerebral Palsy (CP). The authors present their findings on robotics applications for assisting children with said disabilities in the areas of assisted locomotion training, passive stretching and active movement rehabilitation, upper-extremity motor function, social interactivity, therapist-mediators, active play encouragement, as well as several life-long assistive robotics in current use.

Chapter 6 investigates context-aware assistive systems for the workplace. CAAS is able to make use of projectors to display the feedback within the corresponding area of the workspace (in-situ). The authors introduce a precedent implementation of CAAS and its inherent problems and provide an improved model of CAAS.

Chapter 7 investigates assistive interventions for physical and mental wellbeing. The author discusses the emergence of digital interventions for improved living. A relatively new research field of Persuasive Technology is discussed. The chapter presents a review of early digital interventions and the emergence of behavior change. It also highlights potential benefits that could be realized by designing and implementing carefully designed behavior change and assistive technologies. In addition, several key challenges, promises, and pitfalls are briefly outlined. The presented knowledge would help designers, researchers, and practitioners in designing and evaluating assistive technologies that aim to promote physical and mental wellbeing.

Chapter 8 explores tracking the functional decline of people with physical or cognitive disabilities. Ambient intelligent environments are achievable as we live in a ubiquitous world surrounded by context-sensitive information and smart devices that are able to capture information about our surroundings unobtrusively. Making use of the rich information from the ambient intelligent environments can enable recognition of activities conducted by elderly people, thus allowing the tracking of any functional decline. The authors highlight the existing methods for unobtrusively recognising the activities of daily living within a home environment for people with physical or cognitive disabilities. This is particularly important for patients with Alzheimer’s Disease. The chapter also discusses what makes a successful environment for carrying out accurate activity recognition. The authors also propose the taxonomy of the key characteristics required for robust activity recognition within a smart environment with real-life scenarios.

Chapter 9 investigates mobile navigation systems for pedestrians with cognitive disabilities. The system determines the shortest route from the existing location to the desired predefined destination from a set of routes obtained from Bing Maps and Google Maps. Hence, the guidance to the destination is provided in the form of atomic textual and auditory instructions, together with visual cues. The authors discuss the experimental evaluations with two subjects with Down syndrome in an authentic urban setting and conclude with a reflection on the design of the system and the findings.

Chapter 10 explores the influence of social network sites for strengthening assistive technologies for health. The chapter presents the usage, acceptance, and user behavior related to social networking sites. Through understanding, the phenomenal success of Facebook could provide valuable information for developing health behavior change interventions. An evaluation using structured questionnaires was conducted to understand users’ online behavior, particularly enjoyment and entertainment, desire to be connected, reciprocation, information quality, need for admiration, and influence of task obtrusiveness.
The evaluation was targeted at university students and staff and received 105 reliable responses. Consequently, the total number of reliable responses was 105. The analysed results indicate that enjoyment and entertainment, reciprocation, and admiration have the strongest influence on individuals’ behavior. The results could pave the way for future research into this interesting area.

Chapter 11 investigates critical behaviour monitoring for children with special needs. This chapter presents ways to prevent physical injury for children with special needs, or specifically children with Autism Spectrum Disorder (ASD). The prevention is achievable by real time monitoring of children’s behavior in the classroom. A prototype has been developed for this purpose. The critical behavior recognition model is integrated with a low-cost infra-red sensor, Microsoft Kinect, to acquire the skeletal signals for recognizing human activities. Presently, the model is able to identify 17 different activities and notify the caregiver via SMS and/or email if any unusual or critical activity is detected. This ensures immediate response and action to be taken to prevent injuries or situation from getting worse.

Chapter 12 presents a case study on Dance and Movement Therapy (DMT) for children with autism spectrum disorders in Kuching, Sarawak. The authors attempted to verify the validity and feasibility of adopting DMT as a supplementary and complementary component of an existing intervention framework. This chapter also supplies an outline on how DMT can be appropriately adapted by practitioners for special children. The authors aimed at new practitioners, such as parents, teachers, and educators, looking for a preliminary resource to aid in the preparation of practical undertakings as well as thinking about implementing DMT into a child’s routine or programme. This preliminary trial study in Kuching, Sarawak, has brought forth the conclusion that there is a solid potential for DMT to be introduced in the local setting and perhaps South East Asia or beyond due to its adaptability and “fun” factor.

Chapter 13 presents an investigation of unobtrusive COTS EEG-based assistive technology for people with movement disabilities, especially those who are paralyzed or cannot move independently. EEG was first recorded by a German neurologist named Hans Berger, who proved that an electrical signal can be recorded from the human scalp without opening the skull. The authors reviewed related works that apply EEG devices for people with movement disabilities. The focus of this chapter is given to the Commercial-Off-The-Shelf (COTS) devices, and the authors envision the use of COTS EEG devices as a feasible and affordable solution. The outcome indicates that the emergence of COTS EEG-based devices has become an opportunity as well as an attractive technology to be considered for the intended application domain.

This book is intended for a wide spectrum of audiences, from university researchers and healthcare practitioners to educators, caregivers, parents, and guardians of people with disabilities who are interested in exploring the current trends in ICT for Assistive Technologies. The landscape of possibilities has never been more exciting than it is now in 2014, and it would be our pleasure to provide a stepping-stone for future researchers and practitioners to contribute to this worthy field of sustaining life potential via Assistive Technologies.

Lau Bee Theng
Swinburne University of Technology, Malaysia