Effect of the Oculus Rift head mounted display on postural stability

Epure, Paula; Gheorghe, Cristina; Nissen, Thomas; Toader, Laurentiu-Octavian; Nicolae, Alexandru; Nielsen, Steven S. M.; Juul Rosengreen Christensen , Daniel ; Brooks, Anthony Lewis; Brooks, Eva Irene

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Paul Sharkey
Lena Pareto
Jurgen Broeren
Martin Rydmark

2 to 4 September, 2014

Gothenburg, Sweden

AN INTERNATIONAL SOCIETY FOR VIRTUAL REHABILITATION CONFERENCE

ICDVRAT 2014

The papers appearing in this book comprise the proceedings of the 10th International Conference on Disability, Virtual Reality and Associated Technologies, held between the 2nd and 4th of September, 2014 in the Gothenburg, Sweden. The papers presented reflect the authors' opinions and are published as presented and without change (formatting and minor editing excepted). Their inclusion in this publication does not necessarily constitute endorsement by the editors, ICDVRAT, or the University of Reading.

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For information, contact: ICDVRAT, School of Systems Engineering, University of Reading, Whiteknights, Reading, RG6 6AY, UK

Phone: +44 (0) 118 378 6704 Fax: +44 (0) 118 378 8220

Email: *p.m.sharkey@reading.ac.uk* Web: *www.icdvrat.org*

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Conference Schedule at a Glance

Tuesday, 2 September, 2014

08:00	Registration/Information Desk opens from 08:00
08:40	Welcome
09:00 – 10:00	Session I: Elderly Studies/Dementia
10:00	Coffee
10:30 – 11:30	Keynote I: Martin Rydmark *on* Neurological Care & Rehabilitation
11:30 – 12:30	Session II: Stroke Rehabilitation
12:30	Lunch
14:00 – 15:20	Session III: Behavioural and Psychological Disorders
15:20	Coffee
15:50 – 16:50	Session IV: Upper Limb Rehabilitation I
17:30	Reception

Wednesday, 3 September, 2014

08:00	Registration/Information Desk
08:40 – 10:00	Session V: Body Movement Training
10:00	Coffee
10:30 – 11:30	Keynote II: Nils-Krister Persson *on* Smart Textiles
11:30 – 12:30	Session VI: Evaluating Technologies
12:30	Lunch
14:00 – 14:40	Short Paper Podium Presentations
14:40 – 16:50	Poster Presentations *&* Interactive Demo Session
15:20	Coffee
c. 18:30	Boat Departs for Älvsborg Fortress, Gotheburg Archipelago Conference Dinner

Thursday, 4 September, 2014

08:00	Registration/Information Desk opens from 08:00
09:00 – 10:00	Session VII: Upper Limb Rehabilitation II
10:00	Coffee
10:30 – 11:30	Session VIII: Cognitive Training
11:30 – 12:30	Session IX: Real/Virtual Comparative Studies
12:30	Lunch
14:00 – 15:20	Session X: Haptics & Speech Training
15:20	Coffee
15:50	[*Conference Closed*]

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Session VIII Cognitive Training

Session IX Real/Virtual Comparative Studies

Session X Haptics & Speech Training

Short Papers

Internet address references within the papers presented in this volume were accessed and checked to be valid during the week 8–15 July 2014.

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Introduction

The purpose of the 10th International Conference on Disability, Virtual Reality and Associated Technologies (ICDVRAT 2014) is to provide a forum for international experts, researchers and user groups to present and review how advances in the general area of Virtual Reality can be used to assist people with Disability.

ICDVRAT is now in its 18th year, with biennial conferences in the series previously held in Maidenhead, UK (1996), Skövde, Sweden (1998), Alghero, Sardinia, Italy (2000), Veszprém, Hungary (2002), Oxford, UK (2004), Esbjerg, Denmark (2006), Maia & Porto, Portugal (2010), Viña del Mar/Valparaíso, Chile (2010) and LAval, France in 2012.

After peer review process, the International Programme Committee selected 33 Full Papers for presentation at the conference, collected into 10 plenary sessions: Elderly Studies/Dementia, Stroke Rehabilitation, Behavioural and Psychological Disorders, Upper Limb Rehabilitation I & II, Haptics & Speech Training, Evaluating Technologies, Cognitive Training, Real/Virtual Comparative Studies and Body Movement Training. There will be an additional 32 Short Papers presented at a Poster Session. The conference will be held over three days between the 2nd and 4th September at the Wallenberg Conference Centre of the University of Gothenburg, Sweden.

For the 2014 conference, there will be two keynote addresses, the first from Martin Rydmark of Gothenburg University, addressing the issues of remote communication, examination and training in neurological care and rehabilitation, and the second from Nils-Krister Persson of the University of Borås, on the topic of smart textiles as a future technology for the fields of disability and rehabilitation.

Abstracts from this conference and full papers from the previous conferences are available online from the conference web site *www.icdvrat.org*. We are also pleased to be able to provide the complete ICDVRAT archive on CD-ROM with this volume.

Acknowledgements

The Conference Chairs would like to thank the Programme Committee, for their input regarding the conference format and focus, and for their commitment to the review process, as well as the authors of all the papers submitted to the conference, the Organization Committee, Conference Sponsors, and the students who help out over the period of the conference.

On behalf of ICDVRAT 2014, we welcome all delegates to the Conference and sincerely hope that delegates find the conference to be of great interest.

Jurgen Broeren, Lena Pareto, Martin Rydmark and Paul Sharkey

Conference Sponsors

The main sponsors of ICDVRAT 2014 are:

The University of Reading, UK

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and

The Sahlgrenska Academy, Sweden

The Sahlgrenska Academy is the 2014 sponsor of the Keynote Speakers and the Conference Reception.

The organisers wish to express their gratitude to the other major sponsors of the conference:

International Society for Virtual Rehabilitation

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Additional help in publicising the conference has been gratefully received from vrpsych-l@usc.edu and the Business Region Gothenburg, amongst many others.

Conference Prizes

The conference awards 4 prizes: Best Paper, Best Student Paper, Best Short Paper and Best Student Short Paper.

Bright Cloud International Corp (www.brightcloudint.com) is the 2014 sponsor for Best Full Paper and Best Short Paper awards.

The International Society for Virtual Rehabilitation (www.isvr.org) is the 2014 sponsor for Best Student Full Paper and Best Student Short Paper awards.

Student papers are papers where the primary author is affirmed to be the student and where the paper is presented by the student at the confereence. These papers are identified prior to the conference on submission of the final paper.

This is Gothenburg

Text from Gothenburg Tourism Agency

Gothenburg, Sweden's second largest city, is found on the west coast of Sweden, right in the heart of Scandinavia. The city has got plenty to offer – with lots of great shopping, a flourishing restaurant scene and the stunning archipelago just around the corner. The archipelago is easily reached by a 30-minute tram ride from the city centre.

Gothenburg was founded in 1621 by Gustav Adolf II and since then has undergone an exciting journey from being a shipping and industrial city to a creative hub for innovation. Today, the city boasts a number of internationally successful companies within marketing, architecture, web design and special effects for the film industry. Local fashion from Nudie, Velour and Monki is becomingly increasingly common in international magazines.

The atmosphere in the city is one of "easy going" genuineness. A strong café culture reveals itself in the tonnes of cafés that often serve their own roasted coffee. Fika is a Swedish word you soon will learn to love! "There is a greater sense of freedom in Gothenburg. It is more about being original than being cool." Ebbot Lundberg – Soundtracks of our lives.

Shopping, Music & Food

Gothenburg fashion is characterised by a relaxed but stylish tone. Explore a mix of department stores, malls, trendy design boutiques and charming independent shops. The Scandinavian design tradition is characterised by minimalism design and functionality. In Gothenburg you'll find everything from the latest trends in fashion by local and international designers, to unique vintage and interior design. What's more, they are all within walking distance from each other.

During the summer, Gothenburg hosts a number of international music festivals and concerts right the centre of town: Way out West (MTV award for the most innovative festival 2011 and on the top ten list of festivals in Europe by the Independent 2012), Metaltown and Summerburst, just to mention a few. Intimate club gigs and DJ performances can be found at the city's bars and nightclubs.

Gothenburg was appointed the Culinary Capital of Sweden 2012 and thus strengthened its reputation as a gastronomic hotspot in Northern Europe. Closeness to the sea results in top-quality, fresh fish and seafood and there is a strong tradition among local chefs to work with locally-produced and seasonal raw ingredients. In the Gothenburg archipelago it's all about fish and seafood – best enjoyed by the ocean. Is there any better place to enjoy dinner or lunch than at a restaurant overlooking the sea or a city canal? Judge for yourself at the Conference dinner!



The West Coast Archipelago

The archipelago of Gothenburg stretches along the coast like a string of pearls. You don't have to travel far from the city to find charming villages, stunning nature and beaches. Seal safaris, sea-fishing and boat excursions are just some of the activities available on the west coast.

The islands are one of Europe's most beautiful archipelagos. They comprise around 10,000 beautiful granite islets, rendered almost smooth during the ice age. Idyllic villages have sprung up all along the coastlines of these fascinating islands. If you're looking for peace and quiet, you can simply stop for a picnic, hire a kayak or a bicycle. Marstrand Island boasts Carlstens fortress and is also known for its party scene and international sailing events. And do not forget the Älvsborgs fortress, located on a small island in the Gothenburg archipelago, the location of the 2014 Conference dinner.

Bucket List ~ Gothenburg

1. FESKEKÔRKA. The "fish-church", a market hall for fish and shellfish in a characteristic building from 1874, with a church-like design.
2. HAGA. A charming neighbourhood with pedestrian-only streets, well-preserved wooden houses, small shops and nice cafés from 17th century.
3. THE MUSEUM OF ART. Nordic art featuring Carl Larsson, Edvard Munch, Anders Zorn and many others.
4. LISEBERG. Amusement park, with the new roller coaster Helix: 1.4 km long, 7 inversions, 3 airtime hills and plenty of drops, twists and turns.
5. MAGASINSKVARTERET. A trendy neighbourhood shopping area for everything from interior design to vintage fashion.
6. NEW ÄLVSBORG FORTRESS. The fortress in the harbour inlet is one of the most well-preserved in Sweden.
7. SKANSEN KRONAN. A fortification built 1687-89 which is nowadays a spectacular outlook in the middle of the charming Haga district.
8. THE GOTHENBURG ARCHIPELAGO. You will see a glimpse from the boat taking us to the conference dinner at the New Älvsborg fortress.
9. THE GARDEN SOCIETY. One of the most well-preserved 19th century gardens in Europe and a green oasis in the middle of the city.
10. UNIVERSEUM. The biggest science centre in Scandinavia. Here you can discover space, the rainforest, the ocean and much more.

Proc. 10th Intl Conf. Disability, Virtual Reality & Associated Technologies
Gothenburg, Sweden, 2–4 Sept. 2014

Remote communication, examination and training in neurological care and rehabilitation

Martin Rydmark

The Sahlgrenska Academy, University of Gothenburg, SWEDEN

ABSTRACT

Organization and tools for home or remote ICT-based patient centered care for individuals with neurological disease or brain damage have been developed and tested on patients during the last 15 years by our research group; this will be briefly presented and further improvements are suggested. Neurologic disease and damage cause profound alterations to a person's life. The conditions are often life long and demand continuous treatment and rehabilitation, as well as support in the activities of daily life. Communication with health care as well as relatives and friends often become cumbersome and travel to and from 'doctors and rehabilitation' are tiresome. We have documented experience of developing systems and telemedical tools for rehabilitation of stroke victims; tools including serious games, 3D visualization and haptics. For Parkinson's disease we now develop tools for remote assessment of motor function together with experts in clinical care and the ICT industry.

BIO-SKETCH

Martin Rydmark, MD, PhD, is professor of Medical Informatics and Computer Assisted Education. He graduated MD and PhD from the Karolinska Institutet in the early '80s, became associate professsor of anatomy at Gotheburg University (GU) in '85, director of the medical faculty computer laboratory – Mednet – at the Sahlgrenska Academy (GU) in the early '90s, and, finally professor of Medical Informatics and Computer Assisted Education, at GU, in 2010. Presently, he heads a research group/network at GU, focused on ICT based R&D in neurological care and rehabilitation. Earlier research has been in the fields of image analysis, 3D reconstruction, multimedia and educational development.

Keynote: Nils-Krister Persson

Smart textiles – a future technology for the fields of disability and rehabilitation?

N-K Persson

Smart Textiles Technology Lab, Swedish School of Textiles, University of Borås, SWEDEN

ABSTRACT

Many things are smart these days; smartphones, smart cars, smart watches, smart materials - and smart textiles. What does this smartness really mean? And what has it to do with rehabilitation and medical devices? In this keynote, Nils-Krister will review the concept and the industry, taking a critical look at some examples of what hitherto have been presented in this genre and discussing ways to go from a gadget phase to a serious technology solving real world problems in many parts of care and medicine. Through a number of examples, the possibilities of smart textiles are shown, conducted with both international and domestic perspectives. The ultimate purpose of the talk will be to convince delegates that smart textiles should be considered an important factor within the fields of disability and rehabilitation.

BIO-SKETCH

Nils-Krister Persson, PhD, is the head of the Smart Textiles Technology Lab (STTL), the technological research body within the Smart Textiles initiative. Smart Textiles is a governmental financed research and innovation cluster in Sweden encouraging new advanced solutions in the textile related industry. Smart Textiles is based at the Swedish School of Textiles at the University of Borås. One of the primary directions of the Smart Textiles initiative is in the area of health and medicine. Nils-Krister is physicist from Lund University and holds a PhD in organic and biomolecular electronics from Linköping University. Research interests include conductive all-polymeric fibres, textile water purification systems, textile photonics for medical applications and dynamic textiles.

Proc. 10th Intl Conf. Disability, Virtual Reality & Associated Technologies
Gothenburg, Sweden, 2–4 Sept. 2014

Development of a real world simulation to study cognitive, locomotor and metabolic processes in older adults

R Kizony, G Zeilig, PL Weiss, I Baum-Cohen, Y Bahat, E Kodesh, M Bondi, I Mintz, M Kafri

Sheba Medical Center, Tel Hashomer, ISRAEL

University of Haifa, Haifa, ISRAEL

Tel Aviv University, Tel Aviv, ISRAEL

ABSTRACT

The purpose of this paper was to demonstrate a proof of concept concerning the design and implementation of a simulation that replicates a real world environment in order to evaluate a complex task of shopping within a mall while measuring cognitive, motor and metabolic aspects of the task. The paper presents the experimental protocol and results from four young healthy and two elderly adults who performed the Multiple Errands Test in both simulated and real world settings. These initial findings show the feasibility of the protocol in both environments.

A *screen shot of the simulation's set up at the Center of Advanced Technologies in Rehabilitation, Sheba Medical Center, Tel Hashomer, Israel.*

Kizony, R, Zeilig, G, Weiss, PL, Baum-Cohen, I, Bahat, Y, Kodesh, E, Bondi, M, Mintz, I, and Kafri, M (2014), Development of a real world simulation to study cognitive, locomotor and metabolic processes in older adults, *Proc. 10th Intl Conf. on Disability, Virtual Reality and Assoc. Technologies*, PM Sharkey, L Pareto, J Broeren, M Rydmark (Eds), pp. 1–8, Gothenburg, Sweden, 2–4 Sept. 2014.

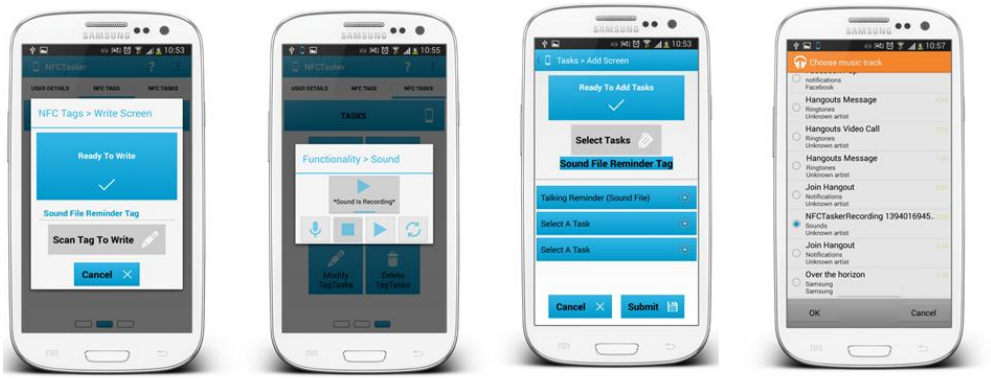
Computerised help information and interaction project for people with memory loss and mild dementia

S Jawaid, R J McCrindle

University of Reading, Whiteknights, Reading, UK

ABSTRACT

People have to perform many tasks and remember many different things during the course of their daily lives. Remembering them all is a challenge for everyone and especially so if a person has age associated memory impairment or some form of dementia. As technologies such as RFID (Radio Frequency Identification) and Near Field Communication (NFC) tags become more cheaply available and more seamlessly integrated into our lives as the Internet of Things (IoT), it makes sense to use these technologies to help people remember information or automate tasks. The CHIIP (Computerised Help Information and Interaction Project) project has created a framework that uses smartphones and sensor technologies to help people perform tasks that are relevant or specific to them quickly and efficiently within their homes or local environment.



Phone setup to enable information or actions to be associated with tags.

Jawaid, S, and McCrindle, RJ (2014), Computerised help information and interaction project for people with memory loss and mild dementia, *Proc. 10th Intl Conf. on Disability, Virtual Reality and Assoc. Technologies*, PM Sharkey, L Pareto, J Broeren, M Rydmark (Eds), pp. 9–18, Gothenburg, Sweden, 2–4 Sept. 2014.

Usability assessment of natural user interfaces during serious games: adjustments for dementia intervention

V Vallejo, I Tarnanas, T Yamaguchi, T Tsukagoshi, R Yasuda, R Müri, U P Mosimann, T Nef

University of Bern, SWITZERLAND

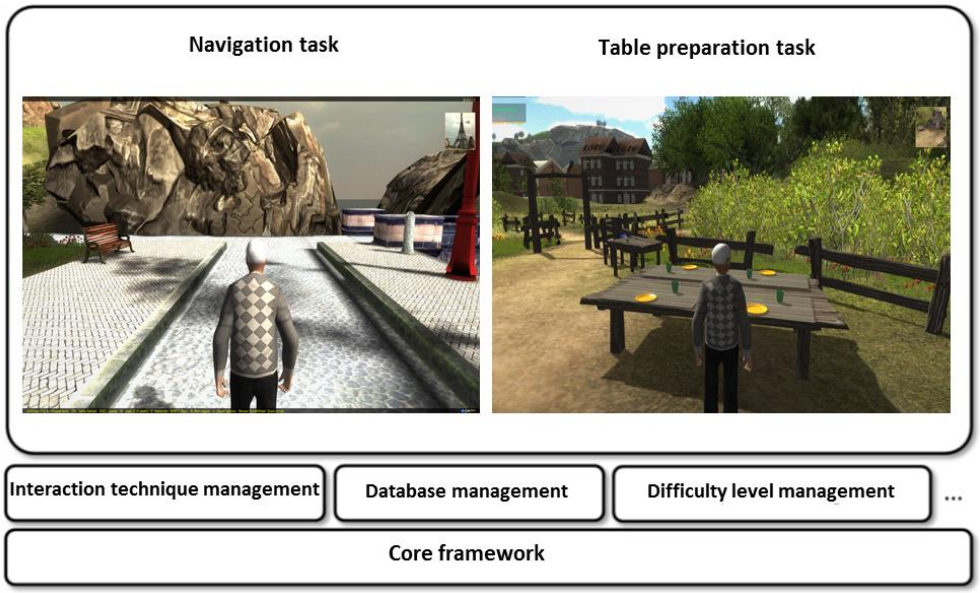
Tokyo University of Science, JAPAN

University Hospital, Inselspital, Bern, SWITZERLAND

University Hospital of Psychiatry, Inselspital, Bern, SWITZERLAND

ABSTRACT

Serious games based rehabilitation program needs a comprehensive and people-centred design for a better efficacy. In most studies benchmarking the computer-interaction interfaces is a prerequisite for adjusting the most appropriate user input for the rehabilitation application. The present study examines a comparison between three natural user interfaces and two standard computer interfaces in two different virtual reality tasks. The results illustrate that the acceptance and user-friendliness of a device regarding the completion of a specific task strongly depends on the task itself and on the abilities of the users.



A system framework of the 3D Virtual Memory.

Vallejo, V, Tarnanas, I, Yamaguchi, T, Tsukagoshi, T, Yasuda, R, Müri, R, Mosimann, UP, and Nef, T (2014), Usability assessment of natural user interfaces during serious games: adjustments for dementia intervention, *Proc. 10th Intl Conf. on Disability, Virtual Reality and Assoc. Technologies*, PM Sharkey, L Pareto, J Broeren, M Rydmark (Eds), pp. 19–26, Gothenburg, Sweden, 2–4 Sept. 2014.

An integrative virtual reality cognitive-motor intervention approach in stroke rehabilitation: a pilot study

A L Faria, A Vourvopoulos, M S Cameirão, J C Fernandes, S Bermúdez i Badia

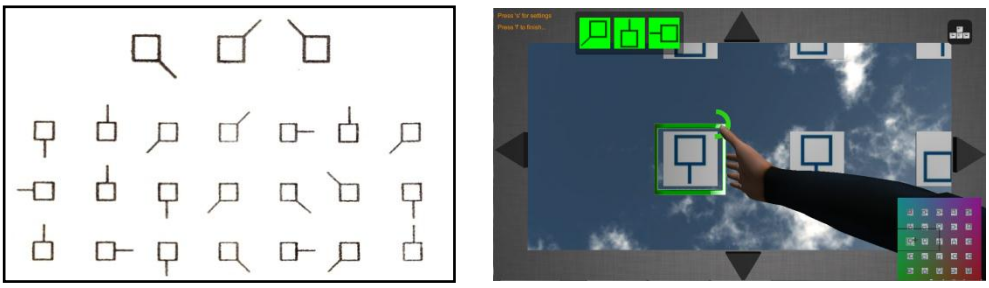
Universidade da Madeira, Funchal, PORTUGAL

Universidade de Coimbra, Coimbra, PORTUGAL

Hospital Nélio Mendonça, Funchal, Madeira, PORTUGAL

ABSTRACT

Stroke is one of the most common causes of acquired disability, leaving numerous adults with cognitive and motor impairments, and affecting patient's capability to live independently. In post-stroke it is imperative to initiate a process of intensive rehabilitation and personalized objectives to maximize functional cognitive and motor recovery. Virtual Reality (VR) technology is being widely applied to rehabilitation of stroke, however, not in an integrative manner. Like traditional rehabilitation, these new tools mostly focus either in the cognitive or in the motor domain, which can take to a reduced impact in the performance of activities of daily living, most of them dual-task. Assuming the existence of cognitive and motor recovery interdependence, RehabNet proposes a holistic approach. Here we present a one-month long pilot study with three stroke patients whose training was a game-like VR version of the Toulouse-Piéron cancellation test, adapted to be performed by repetitive arm reaching movements. A standardized motor and cognitive assessment was performed pre and post intervention. The first results on this intervention support a holistic model for rehabilitation of stroke patients, sustaining interdependence on cognitive and motor recovery. Furthermore, we observed that the impact of the integrative VR approach generalizes to the performance of the activities of daily living.



(a) *(b)*

Representation of the paper-and-pencil (a) and virtual (b) modalities of the Toulouse-Piéron test.

Faria, AL, Vourvopoulos, A, Cameirão, MS, Fernandes, JC, and Bermúdez i Badia, S (2014), An integrative virtual reality cognitive-motor intervention approach in stroke rehabilitation: a pilot study, *Proc. 10th Intl Conf. on Disability, Virtual Reality and Assoc. Technologies*, PM Sharkey, L Pareto, J Broeren, M Rydmark (Eds), pp. 27–35, Gothenburg, Sweden, 2–4 Sept. 2014.

Virtual reality-augmented rehabilitation for patients in sub-acute phase post stroke: a feasibility study

G G Fluet, A Merians, J Patel, A Van Wingerden, Q Qiu, M Yarossi, E Tunik, S Adamovich, S Massood

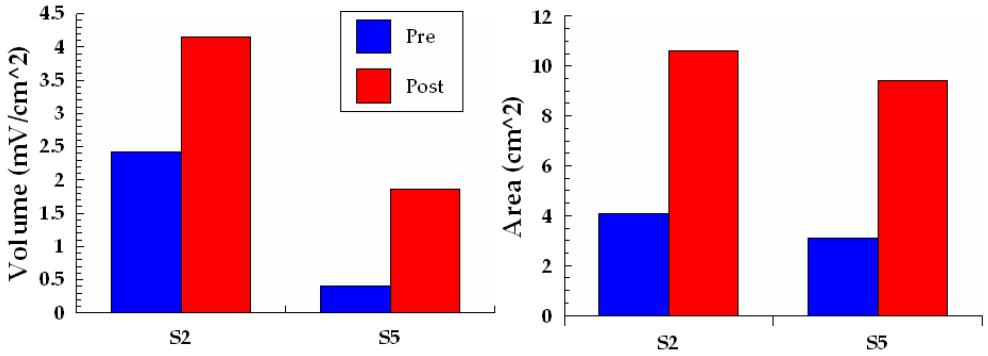
Rutgers University, Newark, NJ, USA

New Jersey Institute of Technology, Newark, NJ, USA

Saint Joseph's Wayne Hospital, Wayne, NJ, USA

ABSTRACT

Upper extremity (UE) rehabilitation is of utmost importance to the achievement of full inclusion and functional independence. Traditionally presented as well as technology-based therapeutic interventions have produced measurable changes in motor function and motor control but fall short of major reductions in disability. Animal models of stroke suggest that the first two weeks to one month post stroke may be a critical time period of increased brain plasticity. This study shows the feasibility of adding one hour of intensive robotic/virtual reality (VR) therapy to on-going rehabilitation in the acute phase of recovery post-stroke. All five of the subjects made substantial improvements in Upper Extremity Fugl-Meyer Assessment (UEFMA) scores (mean improvement = 6 points (SD=2)) as well as improvements in Wolf Motor Function Test (WMFT) time (average decrease = 41% (SD=35) after training with more consistent changes in the proximal arm portions of the WMFT and the UEFMA as well as in upper arm kinematics. Maps of cortical excitability indicate an increase in both the area of activation and the volume of activation of the first dorsal interosseous (FDI) muscle after a two-week training period.



Volume and Area of TMS maps of first dorsal interosseus muscle of paretic hand of two subjects (S2 and S5) measured before and after training.

Fluet, GG, Merians, A, Patel, J, Van Wingerden, A, Qiu, Q, Yarossi, M, Tunik, E, Adamovich, S, Massood, S (2014), Virtual reality-augmented rehabilitation for patients in sub-acute phase post stroke: a feasibility study, *Proc. 10th Intl Conf. on Disability, Virtual Reality and Assoc. Technologies*, PM Sharkey, L Pareto, J Broeren, M Rydmark (Eds), pp. 37–43, Gothenburg, Sweden, 2–4 Sept. 2014.

Quantifying cognitive-motor interference in virtual reality training after stroke: the role of interfaces

A Vourvopoulos, A L Faria, M S Cameirão, S Bermúdez i Badia

Universidade da Madeira, Funchal, PORTUGAL

Universidade de Coimbra, Coimbra, PORTUGAL

ABSTRACT

Globally, stroke is the second leading cause of death above the age of 60 years, with the actual number of strokes to increase because of the ageing population. Stroke results into chronic conditions, loss of independence, affecting both the families of stroke survivors but also public health systems. Virtual Reality (VR) for rehabilitation is considered a novel and effective low-cost approach to re-train motor and cognitive function through strictly defined training tasks in a safe simulated environment. However, little is known about how the choice of VR interfacing technology affects motor and cognitive performance, or what the most cost-effective rehabilitation approach for patients with different prognostics is. In this paper we assessed the effect of four different interfaces in the training of the motor and cognitive domains within a VR neurorehabilitation task. In this study we have evaluated the effect of training using 2-dimensional and 3-dimensional as well as traditional and natural user interfaces with both stroke survivors and healthy participants. Results indicate that 3-dimensional interfaces contribute towards better results in the motor domain at the cost of lower performance in the cognitive domain, suggesting the use 2-dimensional natural user interfaces as a trade-off. Our results provide useful pointers for future directions towards a cost-effective and meaningful interaction in virtual rehabilitation tasks in both motor and cognitive domains.

2-dimensional (a) and 3-dimensional (b) experimental setups. Inset images show the user's position relative to VR system and the allowed movements.

Vourvopoulos, A, Faria, AL, Cameirão, MS, and Bermúdez i Badia, S (2014), Quantifying cognitive-motor interference in virtual reality training after stroke: the role of interfaces, *Proc. 10th Intl Conf. on Disability, Virtual Reality and Assoc. Technologies*, PM Sharkey, L Pareto, J Broeren, M Rydmark (Eds), pp. 45–53, Gothenburg, Sweden, 2–4 Sept. 2014.

Cognitive stimulation through mHealth-based program for patients with Alcohol Dependence Syndrome – a randomized controlled study

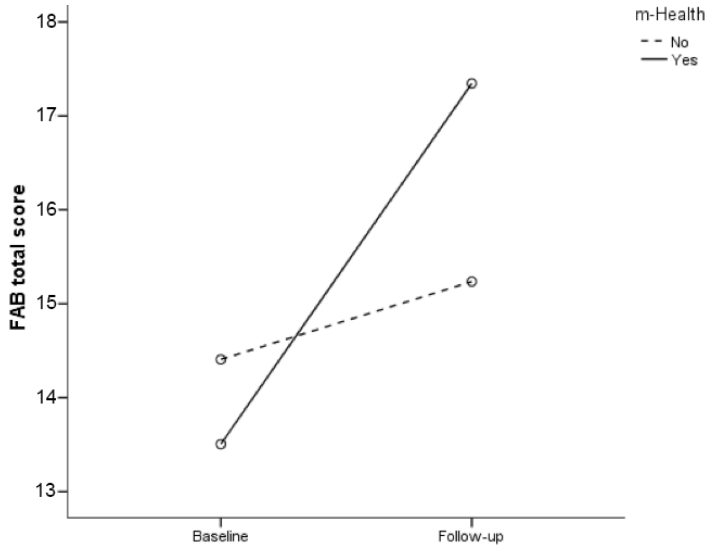
P Gamito, J Oliveira, P Lopes, R Brito, D Morais, S Rebelo,
D Silva, C Caçôete, A Deus

Lusophone University, Lisbon, PORTUGAL

São João de Deus Institute, Sintra, PORTUGAL

ABSTRACT

Alcohol abuse can impact on general cognitive functioning and more particularly on frontal lobe functions. One option available to reduce this impact may rest on rehabilitation paradigms that include cognitive stimulation programmes. This paper reports on a randomized controlled study where two sample of patients with alcohol dependence syndrome where enrolled: 1) on a mHealth-based cognitive stimulation program (CSP) within alcohol dependence treatment (experimental group) and 2) on the alcohol dependence treatment without CSP (control group). The CSP mHealth applications consisted on a serial of serious games designed to stimulate frontal lobe functions. Assessment was conducted with the Mini-Mental State Examination and the Frontal Assessment Battery. After 10 stimulation sessions the experimental group evidenced a significant improvement on frontal-lobe functioning when compared with the control group. As expected, no differences on general cognitive functioning were found between groups.



Improvements in FAB scores at follow-up for m-Health group.

Gamito, P, Oliveira, J, Lopes, P, Brito, R, Morais, D, Rebelo, S, Silva, D, Caçôete, C, and Deus, A (2014), Cognitive stimulation through mHealth-based program for patients with Alcohol Dependence Syndrome – a randomized controlled study, *Proc. 10th Intl Conf. on Disability, Virtual Reality and Assoc. Technologies*, PM Sharkey, L Pareto, J Broeren, M Rydmark (Eds), pp. 55−61, Gothenburg, Sweden, 2−4 Sept. 2014.

Virtual reality exposure for trauma and stress-related disorders for city violence crime victims

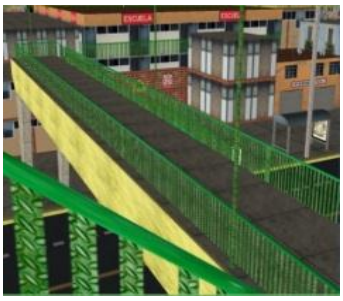
G Cárdenas-López, A de la Rosa, R Durón, X Durán

National Autonomous University of Mexico, Mexico City, MEXICO

ABSTRACT

The criminal violence is attached with mental health problems as depression and substance use and abuse. However one of most important psychological problems linked with the victims of violence is Posttraumatic Stress Disorder (PSTD) and Acute Stress Disorder (ASD). In Mexico, according to the ICESI in 2012, 11% (6,800/for each 100 thousands of habitants) of the population over 18 years experienced a crime. One in four of the people victim of violence develops PSTD symptoms. Due to this socially relevant problem and based on the efficacy of Virtual Reality (VR) treatments, it is important to design treatments involving the use of VR because it can help overcome some of the limitations of traditional therapy using exposure. The present study shows preliminary results of efficacy or virtual reality treatment for PTSD and ASD for crime violence. The clinical sample was conformed for 9 participants from city of Mexico, 6 participants with PTSD diagnoses and 3 participants with ASD diagnoses, aged between 18 and 65. All participants gave informed consent to participate. Treatment was delivered in 90 min individual sessions conducted once a week. Three virtual scenarios for PTSD exposure treatment were used. Improvement was seen in measures of stress, anxiety and depression in both treatment groups, which confirms the clinical efficacious for this technique to treat stress-related disorders.

City view.



Bridge view.

Taxi view.

Cárdenas-López, G, de la Rosa, A, Durón, R, and Durán, X (2014), Virtual reality exposure for trauma and stress-related disorders for city violence crime victims, *Proc. 10th Intl Conf. on Disability, Virtual Reality and Assoc. Technologies*, PM Sharkey, L Pareto, J Broeren, M Rydmark (Eds), pp. 63–71, Gothenburg, Sweden, 2–4 Sept. 2014.

Proc. 10th Intl Conf. Disability, Virtual Reality & Associated Technologies
Gothenburg, Sweden, 2–4 Sept. 2014
 ISBN 978-0-7049-1546-6

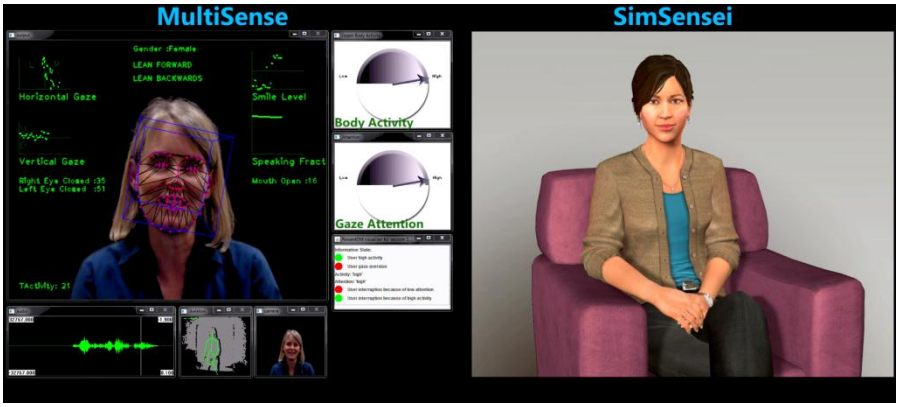
Detection and computational analysis of psychological signals using a virtual human interviewing agent

A A Rizzo, S Scherer, D Devault, J Gratch, R Artstein, A Hartholt, G Lucas, S Marsella, F Morbini, A Nazarian, G Stratou, D Traum, R Wood, J Boberg, L-P Morency

Institute for Creative Technologies, University of Southern California, USA

ABSTRACT

It has long been recognized that facial expressions, body gestures and vocal features/prosody play an important role in human communication signaling. Recent advances in low cost computer vision and sensing technologies can now be applied to the process of sensing such behavioral signals and from them, making meaningful inferences as to user state when a person interacts with a computational device. Effective use of this additive information could serve to enhance human interaction with virtual human (VH) agents and for improving engagement in Telehealth/Teletherapy approaches between remote patients and care providers. This paper will focus on our current research in these areas within the DARPA-funded "Detection and Computational Analysis of Psychological Signals" project, with specific attention to our SimSensei application use case. SimSensei is a virtual human platform able to sense real-time audio-visual signals from users interacting with the system. It is specifically designed for health care support and is based on years of expertise at ICT with virtual human research and development. The platform enables an engaging face-to-face interaction where the virtual human automatically reacts to the estimated user state and intent of the user through vocal parameters and gestures. Much like non-verbal behavioral signals have an impact on human to human interaction and communication, SimSensei aims to capture and infer from user's non-verbal communication to improve engagement between a VH-human and a user. The system can also quantify sensed signals over time that could inform diagnostic assessment within a clinical context.



SimSenswi.

Rizzo, AA, Scherer, S, Devault, D, Gratch, J, Artstein, R, Hartholt, G, Lucas, G, Marsella, S, Morbini, F, Nazarian, A, Stratou, G, Traum, D, Wood, R, Boberg, J, and Morency, L-P (2014), Detection and computational analysis of psychological signals using a virtual human interviewing agent, *Proc. 10th Intl Conf. on Disability, Virtual Reality and Assoc. Technologies*, PM Sharkey, L Pareto, J Broeren, M Rydmark (Eds), pp. 73–82, Gothenburg, Sweden, 2–4 Sept. 2014.

Cravings in a virtual reality room paired with chocolate predict eating disorder risk

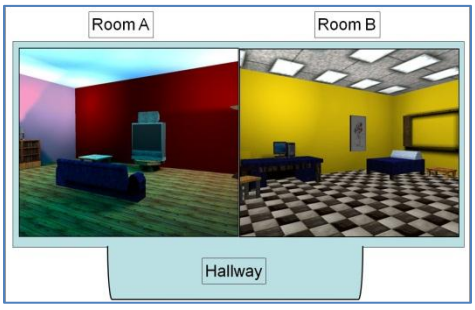
R S Astur, A W Carew, A Palmisano, B E Deaton,
F Kuhney, R Niezrecki, M Santos

University of Connecticut, Storrs, CT, USA

Connecticut Childrens Medical Center, Hartford, CT, USA

ABSTRACT

Pavlovian conditioning is a major factor in drug and food addictions. Previously, we have shown in humans that we can reliably establish a conditioned place preference to a virtual reality (VR) room that is paired with real life food reward. We examined whether the strength of this conditioned place preference is related to eating disorder risk. 31 food-restricted female undergraduates were recruited and placed into a VR environment consisting of 2 visually distinct rooms connected by a hallway. Participants underwent 6 pairing sessions in which they were locked into one of the two rooms and explored the VR environment. Room A was paired with real-life M&Ms for 3 sessions, and Room B was paired with no food for 3 sessions. After the conditioning, a test session was given in which participants were given free access to the entire VR environment with no food present. Additionally, participants completed a standard assessment of eating disorder risk, the Eating Attitudes Test (EAT-26). We observed a conditioned place preference only for the participants who were in the top 50 percentile for hunger. Self-reported hunger rating was significantly correlated with amount of time in the room paired with food. In regards to the eating attitudes, we observed that the higher the eating disorder risk, as evidenced by higher scores on the dieting subscale, and as evidenced by higher total risk scores, the lower they rated the room paired with no food. This suggests a unique conflict whereby stimuli that are not food associated are rated as less enjoyable, particularly the higher the risk for an eating disorder. Hence, novel measures and associations from a brief conditioning paradigm predict eating disorder risk and may suggest some implicit conflicts and processes involved in people with eating disorders. Future studies will examine people with eating disorders more directly as well as will examine whether these measures can direct treatment strategies and predict treatment success.



Both rooms were identical in shape, but contained different items, colors, patterns, etc.

Astur, RS, Carew, AW, Palmisano, A, Deaton, BE, Kuhney, F, Niezrecki, R, and Santos, M (2014), Cravings in a virtual reality room paired with chocolate predict eating disorder risk, *Proc. 10th Intl Conf. on Disability, Virtual Reality and Assoc. Technologies*, PM Sharkey, L Pareto, J Broeren, M Rydmark (Eds), pp. 83–88, Gothenburg, Sweden, 2–4 Sept. 2014.

Analysis of arm movement strategy in virtual catching task

T Yamaguchi, N Ishiura, P Richard, D A Foloppe,
F Veaux, M Dinomais, S Nguyen

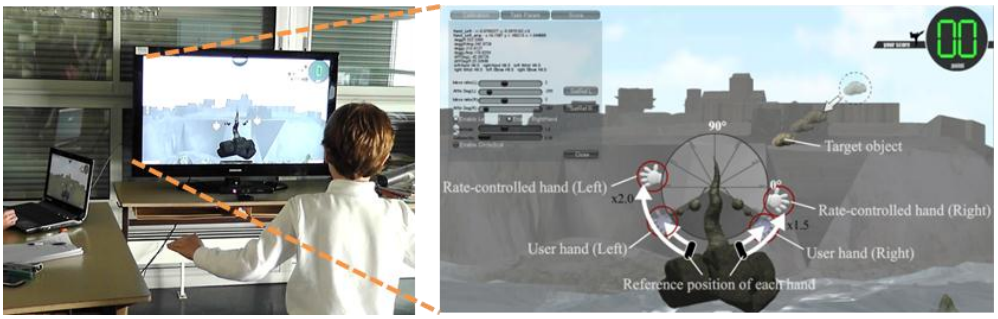
Tokyo University of Science, JAPAN

Université d'Angers, Angers, FRANCE

Centre les Capucins, Angers, FRANCE

ABSTRACT

In this paper, we explored how the arm movement pattern as well as the related strategy of the children with Cerebral Palsy (CP) and the healthy children can be changed in the virtual catching task on a previously proposed rehabilitation system. We recruited 50 healthy children from elementary school, and 3 children with CP as subjects to classify their arm movement pattern/strategy. As a result of the classification, we identified three arm movement stages: Initial position, Reaching path, and Waving form, as well as movement pattern strategy under each movement stage. Based on the classified pattern, we compared the differences in the time series changes of movement strategy between healthy children and the children with CP. The results show there is a significant difference in the strategy of arm movements in the Initial position between healthy and CP children.



An experimental setting of rehabilitation application (Left), and Screenshot of rehabilitation application – Control/Display Ratio is set up for both hands: 2.0 for the left hand, and 1.5 for the right hand. Both the left/right hand avatar disappear when the task begins. The degree of the object's direction is rotated counter-clockwise (Right).

Yamaguchi, T, Ishiura, N, Richard, P, Foloppe, DA, Veaux, F, Dinomais, M, and Nguyen, S (2014), Analysis of arm movement strategy in virtual catching task, *Proc. 10th Intl Conf. on Disability, Virtual Reality and Assoc. Technologies*, PM Sharkey, L Pareto, J Broeren, M Rydmark (Eds), pp. 89–97, Gothenburg, Sweden, 2–4 Sept. 2014.

Functional improvement of hemiparetic upper limb after a virtual reality-based intervention with a tabletop system and tangible objects

R Lloréns, C Colomer, E Noé, M Ortega, M Alcañiz

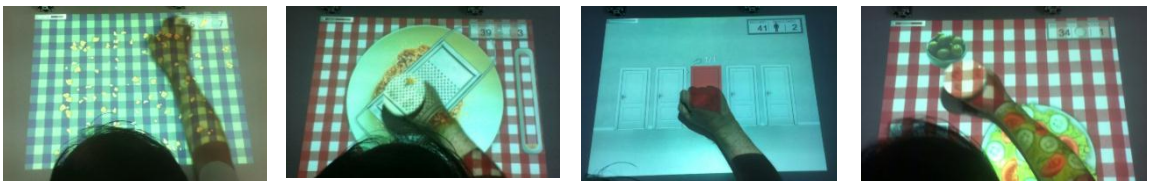
Universitat Politècnica de València, SPAIN

Hospitales NISA Valencia al Mar y Sevilla, Valencia, SPAIN

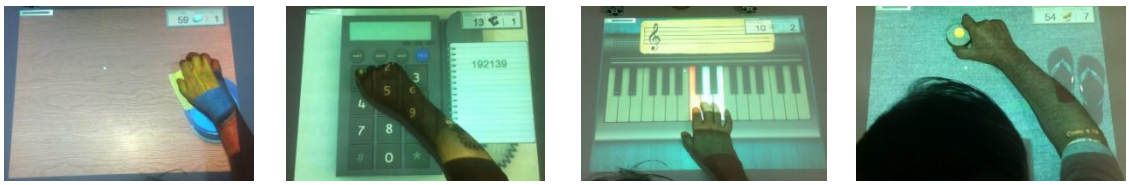
Univesity of Jaume I, Castellón, SPAIN

ABSTRACT

Rehabilitation of the hemiparetic upper limb after stroke is a common challenge for neurorehabilitation units. Recent advances in behavioural neuroscience and neuroimaging techniques have provided current insights of brain plasticity mechanisms that support the functional improvement after an injury to the brain. Different interventions have provided evidence of improvement associated to cortical reorganization. Initial studies report the benefits of virtual reality interventions to recreate enriched and controlled environments that promote brain plasticity mechanisms. This paper presents a novel virtual reality-based tabletop system that focuses on the motor learning principles to promote functional improvement of the hemiparetic upper limb in chronic individuals with stroke. The system allows users to perform a set of exercises that train different movements and skills interacting with or without tangible objects. A preliminary study to determine the clinical effectiveness and acceptance of a virtual reality-based intervention is provided.



(a) *(b)* *(c)* *(d)*



(e) *(f)* *(g)* *(h)*

Participant interacting with the UMBRELLA system.

Lloréns, R, Colomer, C, Noé, E, Ortega, M, and Alcañiz, M (2014), Functional improvement of hemiparetic upper limb after a virtual reality-based intervention with a tabletop system and tangible objects, *Proc. 10th Intl Conf. on Disability, Virtual Reality and Assoc. Technologies*, PM Sharkey, L Pareto, J Broeren, M Rydmark (Eds), pp. 99–107, Gothenburg, Sweden, 2–4 Sept. 2014.

Arm prosthesis simulation on a virtual reality L-shaped workbench display system using a brain computer interface

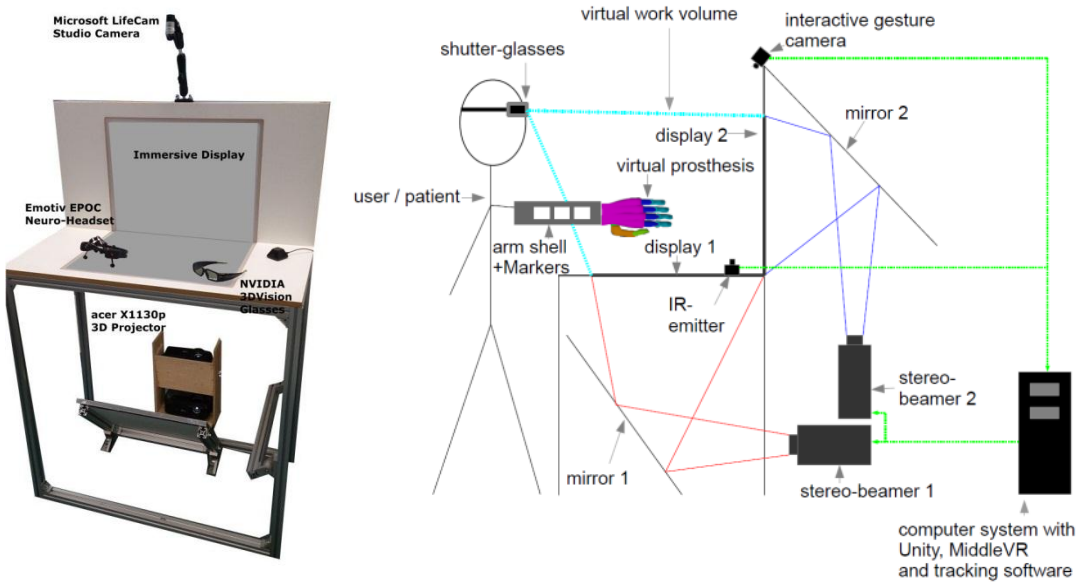
G Heisenberg, Y A Rezaei, T Rothdeutsch, W Heiden

University of Applied Sciences, Wiesbaden, GERMANY

University of Applied Sciences, Sankt Augustin, GERMANY

ABSTRACT

The work being described in this paper is the result of a cooperation project between the Institute of Visual Computing at the Bonn-Rhein-Sieg University of Applied Sciences, Germany and the Laboratory of Biomedical Engineering at the Federal University of Uberlândia, Brazil. The aim of the project is the development of a virtual environment based training simulator which enables for better and faster learning the control of upper limb prostheses. The focus of the paper is the description of the technical setup since learning tutorials still need to be developed as well as a comprehensive evaluation still needs to be carried out.



System setup and L-shaped workbench at the Bonn-Rhein-Sieg University. The right part of the image shows all components being used. The virtual prosthesis model is shown as an extension of the user's arm shell with markers.

Heisenberg, G, Rezaei, YA, Rothdeutsch, T, and Heiden, W (2014), Arm prosthesis simulation on a virtual reality L-shaped workbench display system using a brain computer interface, *Proc. 10th Intl Conf. on Disability, Virtual Reality and Assoc. Technologies*, PM Sharkey, L Pareto, J Broeren, M Rydmark (Eds), pp. 109–117, Gothenburg, Sweden, 2–4 Sept. 2014.

Effect of the Oculus Rift head mounted display on postural stability

P Epure, C Gheorghe, T Nissen, L O Toader, A N Macovei, S S M Nielsen,
D J Rosengren Christensen, A L Brooks, E Petersson Brooks

Aalborg University, Esbjerg, DENMARK

ABSTRACT

This study explored how a HMD-experienced virtual environment influences physical balance of six balance-impaired adults 59-69 years-of-age, when compared to a control group of eight non-balance-impaired adults, 18-28 years-of-age. The setup included a Microsoft Kinect and a self-created balance board controlling a skiing game. Two tests were conducted: full-vision versus blindfolded and HMD versus monitor display. Results were that five of the six balance-impaired adults and six of the eight non-balance-impaired adults showed higher degree of postural stability while using a monitor display. Conclusions are that HMD, used in this context, leads to postural instability.

Spider 8 data logger (left) and balance board (right).

Epure, P, Gheorghe, C, Nissen, T, Toader, LO, Macovei, AN, Nielsen, SSM, Rosengren Christensen, DJ, Brooks, AL, and Petersson Brooks, E (2014), Effect of the Oculus Rift head mounted display on postural stability, *Proc. 10th Intl Conf. on Disability, Virtual Reality and Assoc. Technologies*, PM Sharkey, L Pareto, J Broeren, M Rydmark (Eds), pp. 119−127, Gothenburg, Sweden, 2−4 Sept. 2014.

Virtual reality system for the enhancement of mobility in patients with chronic back pain

B Bolte, M de Lussanet, M Lappe

University of Münster, GERMANY

ABSTRACT

Back pain is among the most common health problems in the western world. While surgery can reduce pain and disability for patients with symptoms specific to spinal degeneration, for chronic back pain (CBP) patients exist a variety of therapeutic interventions, which are, unfortunately, not very effective. In addition, CBP patients tend to develop a fear of movement (kinesiophobia) and stiffness of the trunk that probably lead to further problems due to reduced physical activity. To address these problems, we propose a virtual reality system using head-mounted displays for the enhancement of mobility in CBP patients. We manipulate the visual feedback to change the motor behavior of participants by applying gains to alter the weight with which neck, back and hip rotations contribute to the orientation of the virtual camera. Users will not notice the manipulation if the gains are sufficiently small. In an evaluation study we showed that our approach has the potential to increase back movement amplitudes in control and CBP participants. Although we have used a specific task, the big advantage of our method is that any task involving body rotations can be used, thereby providing the opportunity to tailor the task to a patient's specific preference or need.

(a) *(b)*

Illustration of (a) the instrumentation and (b) the virtual basketball arena used for the evaluation study. The participant is wearing the head-mounted display, with a fixed infrared marker, on which the virtual basketball arena is shown. Yellow circles indicate the positions of the orientation trackers.

Bolte, B, de Lussanet, M, and Lappe, M (2014), Virtual reality system for the enhancement of mobility in patients with chronic back pain, *Proc. 10th Intl Conf. on Disability, Virtual Reality and Assoc. Technologies*, PM Sharkey, L Pareto, J Broeren, M Rydmark (Eds), pp. 129–137, Gothenburg, Sweden, 2–4 Sept. 2014.

The application of enhanced virtual environments for co-located childhood movement disorder rehabilitation

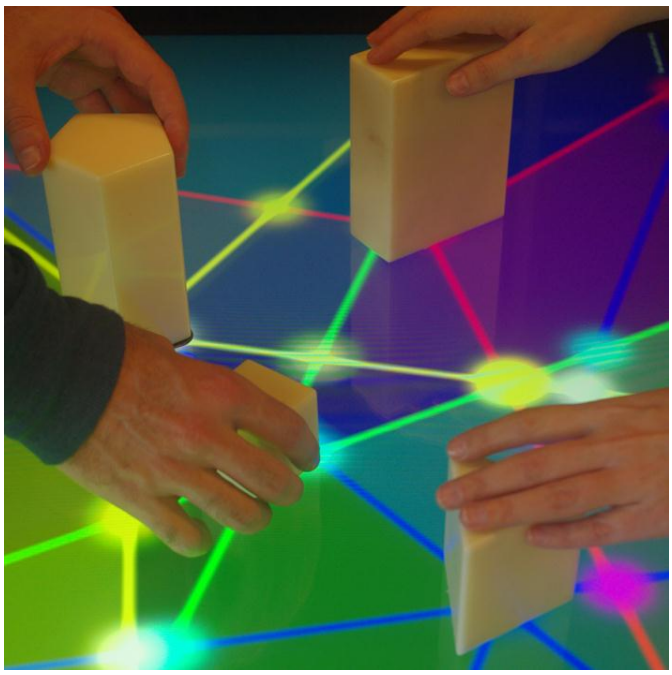
N H Mumford, J Duckworth, P H Wilson

Australian Catholic University, Melbourne, AUSTRALIA

RMIT University, Melbourne, AUSTRALIA

ABSTRACT

In this paper we discuss potential benefits and future directions in virtual reality rehabilitation for co-located motor training in children with developmental movement disorders. We discuss the potential for co-located VR to promote participation using cooperative virtual environments, facilitate social learning, and quantify levels of social interaction. We pay particular attention to the capacity of co-located systems to enhance levels of participation and the psychosocial outcomes of VR therapy. Finally, we offer directions for future research.



Two participants playing a musical tabletop game together using tangible user interfaces..

Mumford, NH, Duckworth, J, and Wilson, PH (2014), The application of enhanced virtual environments for co-located childhood movement disorder rehabilitation, *Proc. 10th Intl Conf. on Disability, Virtual Reality and Assoc. Technologies*, PM Sharkey, L Pareto, J Broeren, M Rydmark (Eds), pp. 139–145, Gothenburg, Sweden, 2–4 Sept. 2014.

Towards a mobile exercise application to prevent falls: a participatory design process

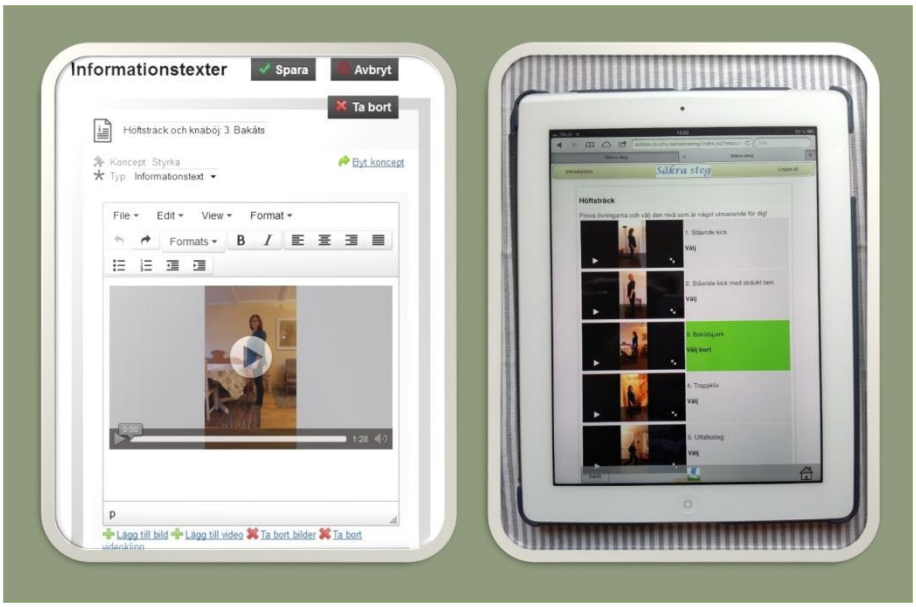
M Sandlund, H Lindgren, P Pohl, A Melander-Wikman,
B Bergvall-Kåreborn, L Lundin-Olsson

Umeå University, SWEDEN

Luleå University of Technology, SWEDEN

ABSTRACT

In this cross-disciplinary project senior citizens and researchers participated in the collaborative design and development of a mobile exercise application to prevent falls. The methods Form-IT and Participatory and Appreciative Action and Reflection were applied in a series of workshops, facilitating the creation of new knowledge and a socio-technical platform for an end-user development process. The participation of the older adults was key to understanding the broad range of preferences and motivational aspects. The outcomes emerged into prototypes, which were composed using the ACKTUS platform for end-user development, resulting in a dynamic application, easily adaptable to future needs and studies.



The ACKTUS platform was used to model the content and design the interaction in the prototypes, which allowed the participants to test hands-on. Through ACKTUS the responsible physiotherapist researchers are able to modify and further develop the application.

Sandlund, M, Lindgren, H, Pohl, P, Melander-Wikman, A, Bergvall-Kåreborn, B, and Lundin-Olsson, L (2014), Towards a mobile exercise application to prevent falls: a participatory design process, *Proc. 10th Intl Conf. on Disability, Virtual Reality and Assoc. Technologies*, PM Sharkey, L Pareto, J Broeren, M Rydmark (Eds), pp. 147–154, Gothenburg, Sweden, 2–4 Sept. 2014.

User evaluation of a virtual rehabilitation system during reaching exercises: a pilot study

M Al-Amri, D Abásolo, S Ghoussayni, D Ewins

Cardiff University, UK

University of Surrey, UK

Queen's Mary Hospital, Roehampton, UK

ABSTRACT

The aim of this paper was to evaluate the practicality of the Surrey Virtual Rehabilitation System (SVRS) for reaching exercises with children with CP. Five potential users or operators (two children with CP, a physiotherapist, and two clinical engineers) participated in the study. Using 11 closed-ended questions and an open discussion, the feedback collected indicates that the participants were generally positive about the practicality of the SVRS. Outcome measures obtained from data gathered during the session suggest that the SVRS can provide clinically relevant feedback on the performance of patients for themselves and their treating clinicians. In conclusion, the SVRS seems to be practical for rehabilitation purposes and further development and evaluation are warranted.

An able-bodied volunteer using the SVRS to perform the second reaching exercise. A: during the actual test and B: a screenshot of the VR environment..

Al-Amri, M, Abásolo, D, Ghoussayni, S, and Ewins, D (2014), User evaluation of a virtual rehabilitation system during reaching exercises: a pilot study, *Proc. 10th Intl Conf. on Disability, Virtual Reality and Assoc. Technologies*, PM Sharkey, L Pareto, J Broeren, M Rydmark (Eds), pp. 155–162, Gothenburg, Sweden, 2–4 Sept. 2014.

Locating objects in virtual reality – the effect of visual properties on target acquisition in unrestrained reaching

V Powell, W A Powell

University of Portsmouth, UK

ABSTRACT

Locating objects in virtual space is not the same as locating them in physical space. The visual properties of the virtual object can affect the perception of its spatial location, and hence the ability to accurately co- locate the hand and the object. This paper presents an investigation into the effects of object geometry and proximity brightness cues on the time-to-target of a virtual reality reaching and grasping task. Time-to-target was significantly affected by object geometry, but not by brightness cues. We conclude that object geometry needs to be carefully considered for applications where accurate co-location of hand and object are important.

The virtual orchard used in the study.

Powell, V, and Powell, WA (2014), Locating objects in virtual reality – the effect of visual properties on target acquisition in unrestrained reaching, *Proc. 10th Intl Conf. on Disability, Virtual Reality and Assoc. Technologies*, PM Sharkey, L Pareto, J Broeren, M Rydmark (Eds), pp. 163–171, Gothenburg, Sweden, 2–4 Sept. 2014.

Subjective perceptions when using motion tracking systems – a comparison among healthy subjects, individuals post-stroke, and therapists

R Lloréns, A Borrego, E Parra, V Naranjo, E Noé, M Alcañiz

Universitat Politècnica de València, SPAIN

Hospitales NISA Valencia al Mar y Sevilla, Valencia, SPAIN

Univesity of Jaume I, Castellón, SPAIN

ABSTRACT

Different tracking technologies allow users to interact with virtual reality environments. Most research regarding tracking systems has focused on studying their performance parameters, mainly accuracy. However, even though subjective parameters also determine the responses evoked by the virtual reality experience, least efforts have been made to study their influence. The subjective perceptions of healthy subjects, individuals post-stroke, and physical therapists after using three tracking technologies (optical, electromagnetic, and skeleton tracking) to interact with a virtual rehabilitation exercise were collected via questionnaire. Results showed that subjective perceptions and preferences are far from being constant among different populations, thus suggesting that these considerations, together with the performance parameters, should be taken into account when designing a rehabilitation system.

Tracking systems under study: optical; electromagnetic; and skeleton tracking.

Lloréns, R, Borrego, A, Parra, E, Naranjo, V, Noé, E, and Alcañiz, M (2014), Subjective perceptions when using motion tracking systems – a comparison among healthy subjects, individuals post-stroke, and therapists, *Proc. 10th Intl Conf. on Disability, Virtual Reality and Assoc. Technologies*, PM Sharkey, L Pareto, J Broeren, M Rydmark (Eds), pp. 173–180, Gothenburg, Sweden, 2–4 Sept. 2014.

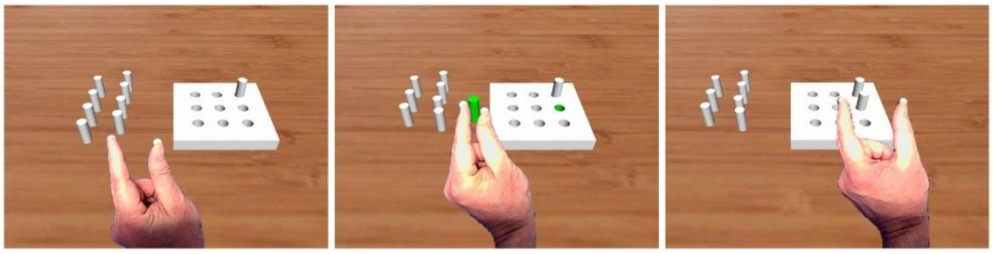
Virtualising the nine hole peg test of finger dexterity

J Collins, S Hoermann, H Regenbrecht

University of Otago, Dunedin, NEW ZEALAND

ABSTRACT

Using Virtual and Augmented Reality (VR/AR) approaches in physical rehabilitation can lead to better controlled, more client motivating, and more flexible forms of therapy. The Nine Hole Peg Test (NHPT) is a standard instrument in physiotherapy to practice and assess a patient's hand motor control abilities. A physical, wooden or plastic board with nine holes and cylindrical shaped pegs are used to perform this task. There are only limited ways of varying the degree of difficulty or to precisely measure progress with this physical setup. This study presents the development of a VR/AR version of the NHPT and evaluates the usability of three versions: (1) the real life wooden version, (2) a video-mediated version and (3) a computer-generated AR version built from low-cost off-the-shelf components. Our results show that all three conditions were successfully completed by all participants with the highest measured performance and perceived usability still achieved in the real life situation. This indicates that the implementation of currently available low-cost, off-the-shelf components is not yet reliable enough to suggest its use for therapeutic exercises or assessments that require very fine finger level interaction.



Reaching for a virtual peg (left), moving it towards its destination (centre) and releasing it (right).

Collins, J, Hoermann, S, and Regenbrecht, H (2014), Virtualising the nine hole peg test of finger dexterity, *Proc. 10th Intl Conf. on Disability, Virtual Reality and Assoc. Technologies*, PM Sharkey, L Pareto, J Broeren, M Rydmark (Eds), pp. 181–188, Gothenburg, Sweden, 2–4 Sept. 2014.

Development of a new scoring system for bilateral upper limb function and performance in children with cerebral palsy using the MIRA interactive video games and the Kinect sensor

I M Moldovan, A D Călin, A C Cantea, L A Dascălu, C A Mihaiu, O Ghircău, S Onac, O Rîză, R A Moldovan, L V Pop

Socio-medical services complex "Maria Beatrice", Alba-Iulia, ROMANIA

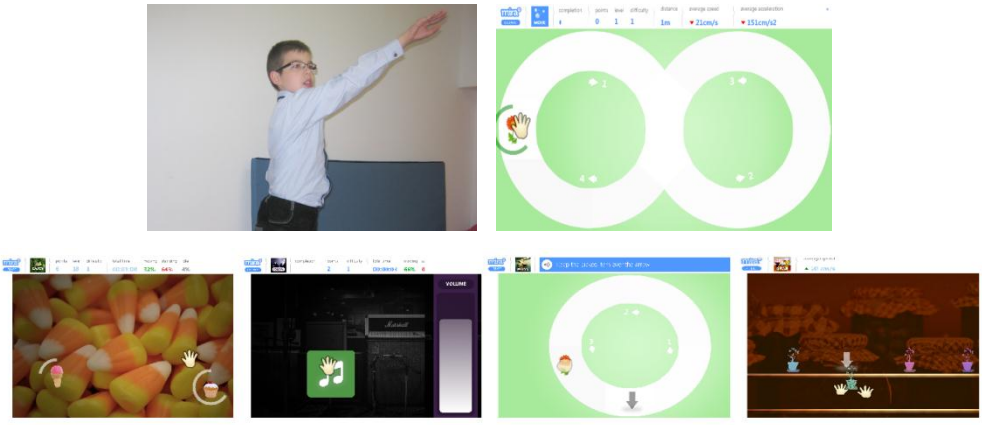
MIRA REHAB LIMITED, London, UK

Alba-Iulia Emergency County Hospital, ROMANIA

"Iuliu Haţieganu" University of Medicine and Pharmacy, Cluj-Napoca, ROMANIA

ABSTRACT

The aim of the study is to develop a reliable and valid occupational therapy scoring system for the assessment of bilateral upper limb function and performance in children with cerebral palsy (CP) using adapted MIRA (Medical Interactive Rehabilitation Assistant) interactive video games and the Kinect 360 Xbox sensor. MIRA is a software platform that uses the Kinect 360 motion sensor to interact with several video games adapted for children with cerebral palsy. 16 healthy children and 11 children diagnosed with cerebral palsy played four MIRA games that generate three performance quantifiers: distance (m), average acceleration (m/s2) and score (points). The reliability and the validity tests performed suggest that the scoring of the MIRA testing schedule is a reliable and valid occupational therapy tool for the assessment of bilateral upper limb function and performance in children with cerebral palsy.



Snapshots of the MIRA video-games; in order: a child with cerebral palsy while playing, Move - infinit path, Catch, Follow, Move - circle path and Grab. A short movie of MIRA testing schedule is available at http://www.mariabeatrice.ro/mira/mira-testing-schedule.

Moldovan, IM, Călin, AD, Cantea, AC, Dascălu, LA, Mihaiu, CA, Ghircău, O, Onac, S, Rîză, O, Moldovan, RA, and Pop, LV (2014), Development of a new scoring system for bilateral upper limb function and performance in children with cerebral palsy using the MIRA interactive video games and the Kinect sensor, *Proc. 10th Intl Conf. on Disability, Virtual Reality and Assoc. Technologies*, PM Sharkey, L Pareto, J Broeren, M Rydmark (Eds), pp. 189–196, Gothenburg, Sweden, 2–4 Sept. 2014.

Evaluating the Microsoft Kinect for use in upper extremity rehabilitation following stroke as a commercial off the shelf gaming system

L Shires, D J Brown, N Sherkat, J Lewis, P J Standen

Nottingham Trent University, UK

University of Nottingham, UK

ABSTRACT

Motion controlled video games have been shown to have a positive effect for physical rehabilitation on the upper extremity in stroke survivors when combined with conventional physical therapy. While much research in this area has worked with bespoke systems and games, some research has been done into using commercial off the shelf gaming systems (COTS) for use in upper extremity stroke rehabilitation. As COTS systems are designed to be used in the home they offer the possibility of providing survivors with low cost systems that they can use to carry out rehabilitation at home. The Microsoft Kinect for the Xbox360 is a multimodal gaming peripheral used to drive a full body skeletal pose estimation system. This allows users to interact with games using bodily motions and gestures. Unlike other current motion controlled gaming systems the Kinect is marker-less so does not require the user to hold or wear any peripherals. A list of important joint motions and movement synergies were identified by looking at leading stroke motor function tests for the upper limb. These have been verified by working with Occupational Therapists. A study group of Occupational and Physiotherapists were asked to record their experience of playing three Kinect mini-games from the Kinect Sports title and evaluate them with respect to their motor function requirements and exertion for each identified joint motion. Quality information was also gathered relating to the perceived usability and safety issues that could arise by presenting the device to a stroke survivor. Kinect provides opportunities for gross arm movement exercise, while the requirement for highly raised arm movements will present a potential barrier for stroke users. Fine motor control movements of the hand and fingers are not tracked sufficiently for effective rehabilitation of the hand. A probable risk of falling while using the Kinect, and potential injury from overexerting the impaired limb while playing existing games were also identified. We conclude that as the experience have been designed for able bodied users the games present significant barriers for using Kinect as a COTS system for stroke rehabilitation.

Kinect Sports for the Xbox360. [Rare, 2014].

Shires, L, Brown, DJ, Sherkat, N, Lewis, J, and Standen, PJ (2014), Evaluating the Microsoft Kinect for use in upper extremity rehabilitation following stroke as a commercial off the shelf gaming system, *Proc. 10th Intl Conf. on Disability, Virtual Reality and Assoc. Technologies*, PM Sharkey, L Pareto, J Broeren, M Rydmark (Eds), pp. 197–204, Gothenburg, Sweden, 2–4 Sept. 2014.

Adapting a humanoid robot for use with children with profound and multiple disabilities

P J Standen, D J Brown, J Hedgecock, J Roscoe, M J Galvez Trigo, E Elgajiji

University of Nottingham, UK

Nottingham Trent University, UK

ABSTRACT

With all the developments in IT for people with disabilities, few interventions have been designed for people with profound and multiple disabilities as there is little incentive for companies to design and manufacture technology purely for a group of consumers without much buying power. A possible solution is therefore to identify mainstream technology that, with adaptation, could serve the purposes required by those with profound and multiple disabilities. Because of its ability to engage the attention of young children with autism, the role of a humanoid robot was investigated. After viewing a demonstration, teachers of pupils with profound and multiple disabilities described actions they wished the robot to make in order to help nominated pupils to achieve learning objectives. They proposed a much wider range of suggestions for using the robot than it could currently provide. Adaptations they required fell into two groups: either increasing the methods through which the robot could be controlled or increasing the range of behaviours that the robot emitted. These were met in a variety of ways but most would require a degree of programming expertise above that possessed by most schoolteachers.

ST repeating back to the robot the utterance it has just emitted.

Standen, PJ, Brown, DJ, Hedgecock, J, Roscoe, J, Galvez Trigo, MJ, and Elgajiji, E (2014), Adapting a humanoid robot for use with children with profound and multiple disabilities, *Proc. 10th Intl Conf. on Disability, Virtual Reality and Assoc. Technologies*, PM Sharkey, L Pareto, J Broeren, M Rydmark (Eds), pp. 205–211, Gothenburg, Sweden, 2–4 Sept. 2014.

Assessment of convalescent brain-damaged patients using a virtual shopping test with different task difficulties

S Okahashi, H Mizumoto, A Komae, K Ueno, M Yokoyama,
A Nagano, K Seki, T Futaki, Z W Luo

Kyoto University, Kyoto, JAPAN

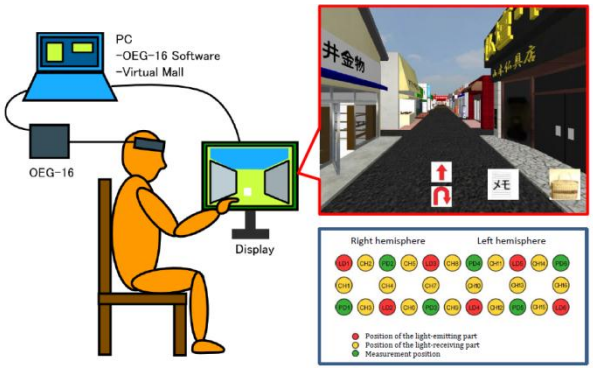
Kobe University, Kobe, JAPAN

Nishi Memorial Port Island Rehabilitation Hospital, Kobe, JAPAN

Ritsumeikan University, Shiga, JAPAN

ABSTRACT

We developed a Virtual Shopping Test for realistic cognitive assessment using virtual reality technology. The objective of this study was to investigate differences in task performance, brain activation, and subjective assessments in relation to the task difficulty level. Subjects were asked to buy two specific items in Task 1, four items in Task 2, and six items in Task 3 at a virtual mall. The tasks and questionnaires were conducted by convalescent brain-damaged patients and healthy adults. Hemodynamic changes in the prefrontal cortex (PFC) during activation due to the tasks were examined using functional near-infrared spectroscopy. The mean total time was longer for the patients than for the healthy subjects in all tasks. PFC responses in the patients were greater in Task 2 than in Task 1. The patients subjectively evaluated these tasks as more difficult than healthy adults. Although task performance as well as PFC responses were not significantly changed in the healthy adults, they could subjectively evaluate differences between the three task levels, whereas the patients could not, which indicated that patients could not clearly distinguish between differences in the difficulty of the tasks performed. Taken together, the results suggest that the difficulty of the 4-item shopping task may have been sufficient to cause brain activation in the brain-damaged patients.



Experimental system with a screenshot of the Virtual Shopping Test-Revised (VST-R) and fNIRS channel arrangement on the forehead.

Okahashi, S, Mizumoto, H, Komae, A, Ueno, K, Yokoyama, M, Nagano, A, Seki, K, Futaki, T, and Luo, ZW (2014), Assessment of convalescent brain-damaged patients using a virtual shopping test with different task difficulties, *Proc. 10th Intl Conf. on Disability, Virtual Reality and Assoc. Technologies*, PM Sharkey, L Pareto, J Broeren, M Rydmark (Eds), pp. 213–220, Gothenburg, Sweden, 2–4 Sept. 2014.

Case study series using brain-training games to treat attention and memory following brain injury

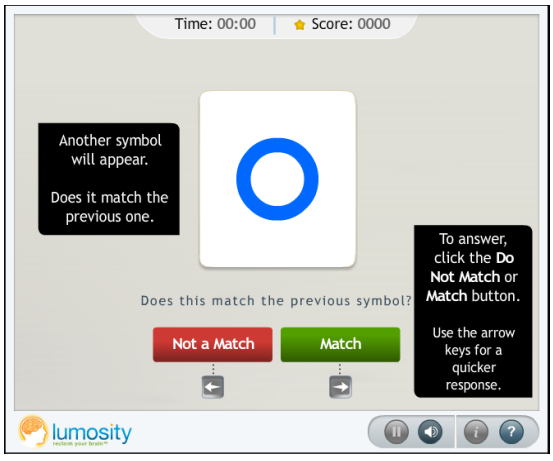
B B Connor, C Shaw

Independent Practice in Neuropsychology, Nevada City, CA, USA

Sierra Nevada Memorial Hospital, Grass Valley, CA, USA

ABSTRACT

Rehabilitation following acquired brain injury typically focuses on regaining use of the affected lower and upper limbs. Impairment of cognitive processes, however, is predictive of rehabilitation outcomes. Cognitive activities have become more readily accessible to the home user through web-based games that engage brain functions often disrupted by acquired brain injury. With cognitive testing, it is possible to "prescribe" brain training that targets the specific cognitive functions disrupted by an individual's acquired brain injury. Previous research has shown that individuals with acquired brain injury have difficulty finding the time to train on cognitive tasks at home, and are often confused and overwhelmed when attempting to operate computers without assistance. We asked if computer-based braining training were made available in a structured training format, at no cost to the participant, would acquired brain injury survivors benefit from using commercially available brain training? Three acquired brain injury patients were recruited. Pre and post training psychometric measures of memory and attention were obtained, as well as qualitative evaluation of the user experience.



Speed Match. This game challenges processing speed and reaction time. It is based on the n-back task. Speed training is designed to improve the ability to think quickly, accurately, and pay attention while others are talking. This screen shot appears courtesy of Lumosity.

Connor, BB, and Shaw, C (2014), Case study series using brain-training games to treat attention and memory following brain injury, *Proc. 10th Intl Conf. on Disability, Virtual Reality and Assoc. Technologies*, PM Sharkey, L Pareto, J Broeren, M Rydmark (Eds), pp. 221–229, Gothenburg, Sweden, 2–4 Sept. 2014.

A serious-gaming alternative to pen-and-paper cognitive scoring – a pilot study

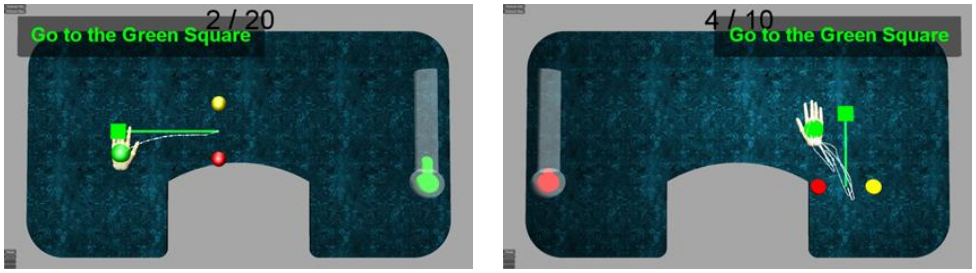
G House, G Burdea, K Polistico, J Ross, M Leibick

1Bright Cloud International Corp, Highland Park, New Jersey, USA

Memory Enhancement Center of America, Inc., Eatontown, New Jersey, USA

ABSTRACT

The majority of cognitive virtual reality (VR) applications have been for therapy, not cognitive stratification/scoring. This paper describes the BrightScreener™ and its first pilot feasibility study for evaluating elderly with various degrees of cognitive impairment. BrightScreener is a portable (laptop-based) serious-gaming system which incorporates a bimanual game interface for more ecological interaction with virtual worlds. A pilot study was undertaken to determine if BrightScreener is able to differentiate levels of cognitive impairment based on game performance, as well as to evaluate the technology acceptance by the target population. 11 elderly subjects were recruited by the Clinical Coordinator at the Memory Enhancement Center of America (MECA, Eatontown, NJ) site. They had an average age of 73.6 years, and averaged 14.5 years of education. Subjects first underwent clinical scoring with the standardised Mini Mental State Exam (MMSE). During the same visit they underwent a familiarization session and then an evaluation session on the BrightScreener. At the end of their visit, each subject filled a subjective evaluation exit form. Technologists were blinded to MMSE scores. Subsequent group analysis of the Pearson correlation coefficient showed a high degree of correlation between the subjects' MMSE scores and their Composite Game Scores (0.90, $|P| < 0.01$). Despite the small sample size, results suggest that serious-gaming strategies can be used as a digital technique to stratify levels of Cognitive Impairment. This may be an alternative to conventional standardised scoring for Mild Cognitive Impairment and Dementia.



(a) *(b)*

BrightArm training of residents in a dementia ward: (a) subject with intact working memory;(b) subject with no working memory due to Alzheimer's disease (Burdea et al, 2013a). ©Bright Cloud International. Reprinted by permission..

House, G, Burdea, G, Polistico, K, Ross, J, and Leibick, M (2014), A serious-gaming alternative to pen-and-paper cognitive scoring – a pilot study, *Proc. 10th Intl Conf. on Disability, Virtual Reality and Assoc. Technologies*, PM Sharkey, L Pareto, J Broeren, M Rydmark (Eds), pp. 231−239, Gothenburg, Sweden, 2−4 Sept. 2014.

Differences in effects when using virtual reality balance trainer or wobble board in terms of postural responses

I Cikajlo, S Bajuk

University Rehabilitation Institute, Ljubljana, SLOVENIA

ABSTRACT

The aim of this study was is twofold: firsts to examine whether the choice of balance training device has any influence on overall therapeutic outcome and secondly whether it affects postural strategy in patients with low-back pain. Six patients used Gamma trainer with virtual reality games and five patients used a wobble board. Before and after the treatment the postural responses were tested. 5 out of 11 patients improved their postural responses in terms of latency and stability. Contribution of the balance training to the improvement of postural responses was not statistically significant (ANOVA, $p > 0.05$), but differences in functional reaching test were statistically significant ($p = 0.0215$) for each group ($p = 0.0419$), while differences between the groups were not found significant ($p = 0.1257$). In spite of small number of participating subjects, we may suggest that balance training improves postural responses and functional reaching in people with low back pain regardless of the choice of the balance training device.

The Gamma device (left) consists of two pressure plates, which monitor the movement of the vertical component of the gravity force. The appropriate information is then displayed in the form of a moving object in a virtual environment.On the wobble board (right) besides balance skills additional muscle strength is required. And in subjects with low-back pain or balance disorders also an assistance of a physiotherapist is mandatory..

Cikajlo, I, and Bajuk, S (2014), Differences in effects when using virtual reality balance trainer or wobble board in terms of postural responses, *Proc. 10th Intl Conf. on Disability, Virtual Reality and Assoc. Technologies*, PM Sharkey, L Pareto, J Broeren, M Rydmark (Eds), pp. 241−247, Gothenburg, Sweden, 2−4 Sept. 2014.

Spatial working memory performance in real museum environment versus computer simulation: a comparison between healthy elderly and young adults

M Korman, R Kizony, M Hochhauser, T Kuflik, A J Wecker, P L Weiss

University of Haifa, ISRAEL

Sheba Medical Center, Tel Hashomer, ISRAEL

ABSTRACT

In recognition of the limited ecological validity of testing in a laboratory setting, we compared spatial memory performance of healthy young and older adults in a real museum setting and on a computer simulation. In the museum, participants physically moved between display stations to locate hidden tokens; an ongoing representation of previous searches had to be remembered. A comparable task was implemented via mouse actions on a computer simulation. Nine older (60-80 years) and 20 younger (20-45 years) adults performed both tasks. The younger group was superior to the older group in terms of success and time, and all participants were more efficient within the simulated task. The feasibility of using realistic tasks in a physical location to study spatial memory is discussed.

On-site (museum) setting. Left, Experimental area in the museum, Right, Participant's hand selecting a target while searching for a token.

Korman, M, Kizony, R, Hochhauser, M, Kuflik, T, Wecker, AJ, and Weiss, PL (2014), Spatial working memory performance in real museum environment versus computer simulation: a comparison between healthy elderly and young adults, *Proc. 10th Intl Conf. on Disability, Virtual Reality and Assoc. Technologies*, PM Sharkey, L Pareto, J Broeren, M Rydmark (Eds), pp. 249–255, Gothenburg, Sweden, 2–4 Sept. 2014.

Web accessibility by Morse Code modulated haptics for deaf-blind

L Norberg, T Westin, P Mozelius, M Wiklund

Stockholm University, SWEDEN

ABSTRACT

Providing information using a modality that is both non-visual and non-auditory such as haptic feedback, may be a viable approach regarding web accessibility for deaf-blind. Haptic navigation systems have been shown to be easy to learn (Venesvirta, 2008), and modulating navigation related information as patterns of vibrations has been shown to be perceived as natural and non-intrusive (Szymzcak, Magnusson and Rassmus-Gröhn, 2012). To minimise the bandwidth needed, a varying length encoding scheme such as Morse code may be considered. A prototype Morse code vibration modulated system for web page navigation was developed, using a standard game controller as a means of output. Results show that simulated deaf-blind test subjects using the system were able to navigate a web site successfully in three cases out of four, and that in some situations a version of the system with a higher degree of manual interaction performed better.

Test setup showing use of laptop touch pad for input and Xbox360 controller for output. Test subjects were blindfolded and wore ear protection.

Norberg, L, Westin, T, Mozelius, P, and Wiklund, M (2014), Web accessibility by Morse Code modulated haptics for deaf-blind, *Proc. 10th Intl Conf. on Disability, Virtual Reality and Assoc. Technologies*, PM Sharkey, L Pareto, J Broeren, M Rydmark (Eds), pp. 257−264, Gothenburg, Sweden, 2−4 Sept. 2014.

Intensive language-action therapy in virtual reality for a rehabilitation gaming system

K Grechuta, B Rubio, A Duff, E Duarte Oller, P Verschure

Pompeu Fabra University, Barcelona, SPAIN

Hospital del Mar i l'Esperanza, Barcelona, SPAIN

Institució Catalana de Recerca i Estudis Avançats, Barcelona, SPAIN

ABSTRACT

One third of stroke patients suffer from language disorders. These disorders severely impair individuals' communication abilities, which impacts on their quality of life. Recently, the Intensive Language Action Therapy (ILAT) emerged as a novel paradigm for aphasia rehabilitation. ILAT is grounded in three main principles: intense practice, overcoming the learned non-use, and an individualized training. In the present study we designed and developed a VR based language rehabilitation tool by integrating ILAT's object request LAG in RGS, a novel paradigm for the rehabilitation of motor deficits after lesions to the central nervous system. RGS is a gaming environment that provides a multimodal, task specific training in virtual reality scenarios. Its special design consists of an intelligent motion detection system that monitors the users' movements. This allows for an active interaction as well as continuous evaluation of the affected limbs. We addressed the question whether aphasia rehabilitation designed within the VR environment of RGS can be an effective tool. The principal purpose of the initial pilot study was to validate the system and to learn whether a virtual adaptation of the ILAT into RGS can trigger positive changes in the linguistic behavior of Broca's aphasia patients. We report the results of a double-case initial pilot study where one acute and one chronic aphasic patient followed five RGS-ILAT therapy sessions. Before and after the treatment we evaluated their language skills using the Communication Activity Log (CAL) and Western Aphasia Battery (WAB) scales. Results show that the patients learnt how to interact within the VR system. The CAL performance suggests that both patients and their therapist perceived improvements in the communication skills after the therapy. Additionally, the approval and acceptance of the system were high. Based on this initial outcome we will further provide the present RGS-ILAT with substantive technological advancements and evaluate the system to reliably replicate the original ILAT, in order to better understand the potential of the virtual reality based language rehabilitation therapies.

The virtual scenario of Intensive Language Action Therapy

Grechuta, K, Rubio, B, Duff, A, Duarte Oller, E, and Verschure, P (2014), Intensive language-action therapy in virtual reality for a rehabilitation gaming system, *Proc. 10th Intl Conf. on Disability, Virtual Reality and Assoc. Technologies*, PM Sharkey, L Pareto, J Broeren, M Rydmark (Eds), pp. 265–273, Gothenburg, Sweden, 2–4 Sept. 2014.

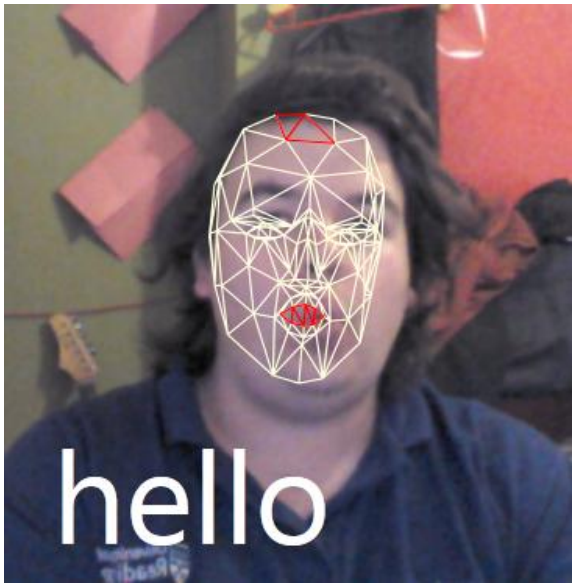
Speech development and therapy using the Kinect

S Frost, R J McCrindle

University of Reading, UK

ABSTRACT

The use of computers and technology to treat patients with developmental problems or rehabilitation needs is an emerging field. Implementation of such treatment methods however has not traditionally been easy, requiring expensive equipment, significant programming experience and the time of trained medical professionals. The release of gaming systems with natural user interfaces has opened up new possibilities for creating home based therapy and rehabilitation systems that are more engaging, affordable and customisable to individual needs. This project leverages the high quality voice and facial recognition capabilities of the Microsoft Kinect natural user interface, and affordable hardware, to provide an interactive speech therapy application that can be used by patients in their own homes, whilst also collecting metric data for remote monitoring by medical professionals to ensure that engagement with, and appropriate progression of, treatment is occurring.



Facial Recognition Map.

Frost, S, and McCrindle, RJ (2014), Speech development and therapy using the Kinect, *Proc. 10th Intl Conf. on Disability, Virtual Reality and Assoc. Technologies*, PM Sharkey, L Pareto, J Broeren, M Rydmark (Eds), pp. 275–284, Gothenburg, Sweden, 2–4 Sept. 2014.

Design and usability evaluation of an audio-based college entrance exam for students with visual disabilities

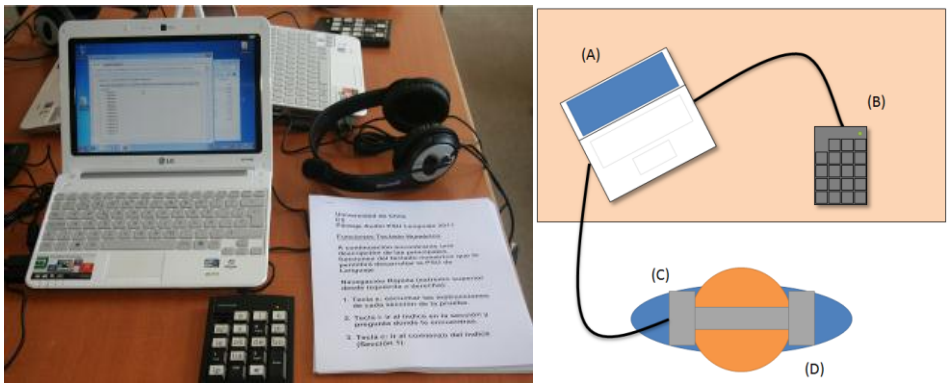
J Sánchez, M Espinoza, M de Borba Campos

University of Chile, Santiago, CHILE

Pontifical Catholic University of Rio Grande do Sul, BRAZIL

ABSTRACT

The purpose of this research was to design, implement and evaluate the usability of a digital pilot system that adapts the Language and Communication subject section of the PSU (Chilean college entry exam), allowing for equal and autonomous participation by learners with visual disabilities in the college selection process. The study was carried out in two stages during the years 2010 and 2012. The pilot project was carried out in December of 2010 in three different regions of Chile, at the same time as the regular process for taking the PSU. Based on the initial results from 2010, the system was redesigned, implemented and evaluated in order to create the final version. The results for the final version of the tool designed demonstrate a high level of usability. This work provides a detailed analysis and discussion of the results obtained in 2012, as well as future directions regarding the issue at hand.



Work station for the AudioPSU user, (A) Netbook, (B) Braille Numpad, (C) Stereo Headphones, (D) User Who is Blind.

Sánchez, J, Espinoza, M, and de Borba Campos, M (2014), Design and usability evaluation of an audio-based college entrance exam for students with visual disabilities, *Proc. 10th Intl Conf. on Disability, Virtual Reality and Assoc. Technologies*, PM Sharkey, L Pareto, J Broeren, M Rydmark (Eds), pp. 285–292, Gothenburg, Sweden, 2–4 Sept. 2014.

Short Papers ~ Abstracts

A participatory design framework for the gamification of rehabilitation systems, **D Charles**, **S McDonough**, University of Ulster, NORTHERN IRELAND

In recent years games and game technology have been used quite widely to investigate if they can help make rehabilitation more engaging for users. The underlying hypothesis is that the motivating qualities of games may be harnessed and embedded into a game-based rehabilitation system to improve the quality of user participation. In this paper we present the PACT framework which has been created to guide the design of gamified rehabilitation systems; placing emphasis on people, aesthetics, context, and technology from the beginning of a design and development process. We discuss the evolution of PACT from our previous GAMER framework, which was used to develop a range of games for upper arm stroke rehabilitation with natural user interfaces. GAMER was established to guide the design of rehabilitation games from the viewpoint of a designer, whereas with PACT greater emphasis has been placed on an inclusive design process. We provide a detailed work flow illustration for the use of PACT in the development of rehabilitation systems and provide examples of practical design and analysis tools that improve the quality of workflow in PACT.

Charles, D, and McDonough, S (2014), A participatory design framework for the gamification of rehabilitation systems, *Proc. 10th Intl Conf. on Disability, Virtual Reality and Assoc. Technologies*, PM Sharkey, L Pareto, J Broeren, M Rydmark (Eds), pp. 293–296, Gothenburg, Sweden, 2–4 Sept. 2014.

Smart cane outdoor navigation system for visually impaired and blind persons, **B Chaudary**, **P Pulli**, University of Oulu, FINLAND

This paper presents prototype of an outdoor navigation system designed to assist visually impaired (VI) and blind persons in outdoor navigation. It assists VI persons in moving independently on sidewalks in urban areas using an augmented guidance cane and informs them about points of interests (POI) through serialized braille encoded vibrational guidance messages. Augmented guidance cane, magnet points' trail, metallic trail, and pulsing magnet apparatus for transmission of serialized braille encoded guidance messages in the form of vibration are the features of the proposed navigation system. Magnet points' trail, metallic trail, and pulsing magnet apparatuses will be installed on the special sidewalks for the visually impaired persons in city centers. VI persons will be able to sense magnet points' trail or metallic trail through augmented guidance cane. It will assist them to walk independently being oriented on the sidewalks. Pulsing magnet apparatuses will be installed at the verge of the POIs on the sidewalks. VI persons will be able to sense the serialized braille vibrational messages through augmented guidance cane and become aware of the POI. Numbers of usability experiments are designed to evaluate the usability of the proposed system in qualitative interviews sessions. It is expected that the results of the qualitative interviews and the test sessions will provide valuable information to make this prototype a full-fledged system ready to be deployed.

Chaudary, B, and Pulli, P (2014), Smart cane outdoor navigation system for visually impaired and blind persons, *Proc. 10th Intl Conf. on Disability, Virtual Reality and Assoc. Technologies*, PM Sharkey, L Pareto, J Broeren, M Rydmark (Eds), pp. 297–300, Gothenburg, Sweden, 2–4 Sept. 2014.

Video-based quantification of patient's compliance, during post-stroke virtual reality rehabilitation, **M Divjak**, **S Zelič**, **A Holobar**, University of Maribor, SLOVENIA

We present a video-based monitoring system for quantification of patient's attention to visual feedback during robot assisted gait rehabilitation. Patient's face and facial features are detected online and used to estimate the approximate gaze direction. This gaze information is then used to calculate various metrics of patient's attention. Results demonstrate that such unobtrusive video-based gaze tracking is feasible and that it can be used to support assessment of patient's compliance with the rehabilitation therapy.

Divjak, M, Zelič, S, and Holobar, A (2014), Video-based quantification of patient's compliance, during post-stroke virtual reality rehabilitation, *Proc. 10th Intl Conf. on Disability, Virtual Reality and Assoc. Technologies*, PM Sharkey, L Pareto, J Broeren, M Rydmark (Eds), pp. 301–304, Gothenburg, Sweden, 2–4 Sept. 2014.

Virtual spatial navigation tests based on animal research – spatial cognition deficit in first episodes of schizophrenia, **I Fajnerová**, **K Vlček**, **C Brom**, **K Dvorská** , **D Levčík**, **L Konrádová**, **P Mikoláš**, **M Ungrmanová**, **M Bída**, **K Blahna**, **F Španiel**, **A Stuchlík**, **J Horáček**, **M Rodriguez**, Prague Psychiatric Center/Institute of Physiology, Academy of Sciences of the Czech Republic/Charles University, CZECH REPUBLIC

The impairment of cognitive functions represents a characteristic manifestation in schizophrenia. Animal models of schizophrenia demonstrated behavioural changes in several spatial tasks. In order to assess spatial abilities in schizophrenia using methods applicable in comparative research, we designed two virtual tasks inspired by animal research: the Morris water maze and the Carousel maze. The tested subject is required to navigate toward several hidden goal positions placed on the floor of an enclosed stable arena or a rotating arena. Data obtained in a group of schizophrenia patients show cognitive impairment in both newly-developed virtual tasks comparing to matched healthy volunteers.

Fajnerová, I, Vlček, K, Brom, C, Dvorská, K, Levčík, D, Konrádová, L, Mikoláš, P, Ungrmanová, M, Bída, M, Blahna, K, Španiel, F, Stuchlík, A, Horáček, J, and Rodriguez, M (2014), Virtual spatial navigation tests based on animal research – spatial cognition deficit in first episodes of schizophrenia, *Proc. 10th Intl Conf. on Disability, Virtual Reality and Assoc. Technologies*, PM Sharkey, L Pareto, J Broeren, M Rydmark (Eds), pp. 305–308, Gothenburg, Sweden, 2–4 Sept. 2014.

Exploring haptic feedback for robot to human communication, **A Ghosh**, **J Penders**, **P Jones**, **H Reed**, **A Sorranzo**, Sheffield Hallam University, Sheffield, UNITED KINGDOM

Search and rescue operations are often undertaken in low-visibility smoky environments in which rescue teams must rely on haptic feedback for navigation and exploration. The overall aim of our research is to enable a human being to explore such environments using a robot. In this paper we focus on creating feedback from a robot to a human. We describe our first designs and trials with vibration motors. The focus is on determining the potential use of vibration motors for message transfer and our trials reflect whether different messages can be discriminated. We describe the testing procedure and the results of our first tests. Based on these results, we conclude that close spatial arrangement of the motors blurs individual signals.

Ghosh, A, Penders, J, Jones, P, Reed, H, and Sorranzo, A (2014), Exploring haptic feedback for robot to human communication, *Proc. 10th Intl Conf. on Disability, Virtual Reality and Assoc. Technologies*, PM Sharkey, L Pareto, J Broeren, M Rydmark (Eds), pp. 309–312, Gothenburg, Sweden, 2–4 Sept. 2014.

Kinecting the moves: the kinematic potential of rehabilitation-specific gaming to inform treatment for hemiplegia, **S M N Glegg**, **C T Hung**, **B A Valdés**, **B D G Kim**, **H F M Van der Loos**, Sunny Hill Health Centre for Children, Vancouver/University of British Columbia, CANADA

Two therapy applications for hemiplegic arm rehabilitation were developed and tested, along with a motion tracking application that used two interfaces (PlayStation® Move and Microsoft® Kinect™) for videogame play through a social media application developed on Facebook©. To promote affected arm use, users are required to employ bimanual symmetrical hand motions. Preliminary kinematic data analysis of two subjects obtained during user testing is presented. Clinically relevant information, such as range of motion, trunk compensation, and total distance of hand movement was extracted from kinematic data. Results showed the system is capable of accommodating users with large variation in arm function.

Glegg, SMN, Hung, CT, Valdés, BA, Kim, BDG, and Van der Loos, HFM (2014), Kinecting the moves: the kinematic potential of rehabilitation-specific gaming to inform treatment for hemiplegia, *Proc. 10th Intl Conf. on Disability, Virtual Reality and Assoc. Technologies*, PM Sharkey, L Pareto, J Broeren, M Rydmark (Eds), pp. 313−316, Gothenburg, Sweden, 2−4 Sept. 2014.

Integrating motor learning and virtual reality into practice: a knowledge translation challenge, **S M N Glegg**, **D E Levac**, **H Sveistrup**, **H Colquhoun**, **H Finestone**, **V DePaul**, **P Miller**, **L Wishart**, **J Harris**, **M Brien**, Sunny Hill Health Centre for Children, Vancouver/University of Ottawa/ Ottawa Hospital Research Institute/Bruyere Continuing Care, Ottawa/ McMaster University/Ottawa Children's Treatment Centre, CANADA

Virtual reality (VR) systems are promising treatment options in stroke rehabilitation because they can incorporate motor learning strategies (MLS) supporting task-oriented practice. A pre-post design was used to evaluate a knowledge translation (KT) strategy supporting therapists in acquiring proficiency with VR while integrating MLS. Following e-learning modules and experiential learning, outcome measures evaluated changes in VR knowledge, attitudes, behaviours and MLS use. Improvements in therapists' behavioural control, self-efficacy, and VR knowledge were observed, though therapists used few MLS, with no improvement over time. Future KT strategies should target proficiency in VR use prior to integration of a theoretical treatment approach.

Glegg, SMN, Levac, DE, Sveistrup, H, Colquhoun, H, Finestone, H, DePaul, V, Miller, P, Wishart, L, Harris, J, and Brien, M (2014), Integrating motor learning and virtual reality into practice: a knowledge translation challenge, *Proc. 10th Intl Conf. on Disability, Virtual Reality and Assoc. Technologies*, PM Sharkey, L Pareto, J Broeren, M Rydmark (Eds), pp. 317−320, Gothenburg, Sweden, 2−4 Sept. 2014.

Assessment of motor function in hemiplegic patients using virtual cycling wheelchair, **R Ishikawa**, **N Sugita**, **M Abe**, **M Yoshizawa**, **K Seki**, **Y Handa**, Tohoku University/Sendai School of Health and Welfare, JAPAN

A cycling wheelchair (CWC) is a rehabilitation tool for hemiplegic patients. In previous studies, our group developed a virtual reality system that allows patients to practice driving a CWC. This study proposes a new method to estimate the torque of each leg extension of a hemiplegic patient while driving the virtual CWC. Experimental results from four healthy subjects and four hemiplegic patients showed the usefulness of the proposed method in evaluating the motor function of the patients.

Ishikawa, R, Sugita, N, Abe, M, Yoshizawa, M, Seki, K, and Handa, Y (2014), Assessment of motor function in hemiplegic patients using virtual cycling wheelchair, *Proc. 10th Intl Conf. on Disability, Virtual Reality and Assoc. Technologies*, PM Sharkey, L Pareto, J Broeren, M Rydmark (Eds), pp. 321−324, Gothenburg, Sweden, 2−4 Sept. 2014.

A comparison of upper limb movement profiles when reaching to virtual and real targets using the Oculus Rift: implications for virtual-reality enhanced stroke rehabilitation, **M A Just**, **P J Stapley**, **M Ros**, **F Naghdy**, **D Stirling**, University of Wollongong, AUSTRALIA

Recent innovations in the field of virtual reality, such as the Oculus Rift head mounted display, provide an unparalleled level of immersion in the virtual world at a cost which is rapidly approaching mainstream availability. Utilising virtual reality has been shown to improve many facets of the rehabilitation process, including patient motivation and participation. These systems, however, do not enable the user to receive feedback when interacting with virtual objects, which may influence the movement profile of a patient. Therefore, to investigate how a virtual environment influences movements during stance, participants were required to reach to a real and a virtual target. Their movements were quantified using a motion capture suit, and the virtual target was generated using the Oculus Rift. The motions to both targets were compared using a number of measures calculated to characterize the velocity profiles.

Just, MA, Stapley, PJ, Ros, M, Naghdy, F, and Stirling, D (2014), A comparison of upper limb movement profiles when reaching to virtual and real targets using the Oculus Rift: implications for virtual-reality enhanced stroke rehabilitation, *Proc. 10th Intl Conf. on Disability, Virtual Reality and Assoc. Technologies*, PM Sharkey, L Pareto, J Broeren, M Rydmark (Eds), pp. 325−328, Gothenburg, Sweden, 2−4 Sept. 2014.

Conducting focus groups in Second Life® on health-related topics, **A Krueger**, **P Colletti**, **H Bogner**, **F Barg**, **M Stineman**, Virtual Ability®, Inc., Aurora, CO/University of Pennsylvania, USA

The "Mrs. A and Mr. B" research project uses focus groups conducted in the virtual world Second Life® to collect qualitative data on healthcare equitability as experienced by persons with and without disabilities. Novel methodological adaptations to traditional focus group methods include avatar consent, text discussion, participant advance preparation and disability accommodation. In this project, focus group findings are used to enrich and clarify results obtained from the analysis of a quantitative administrative dataset derived from Medicare data. In this article, advantages and challenges of using virtual world focus groups are highlighted.

Krueger, A, Colletti, P, Bogner, H, Barg, F, and Stineman, M (2014), Conducting focus groups in Second Life® on health-related topics, *Proc. 10th Intl Conf. on Disability, Virtual Reality and Assoc. Technologies*, PM Sharkey, L Pareto, J Broeren, M Rydmark (Eds), pp. 329−332, Gothenburg, Sweden, 2−4 Sept. 2014.

Physically accurate velocity distribution profiles for use in virtual reality training for prosthetic limbs, **P Kyberd**, **R Bongers**, **S Hamza**, University of New Brunswick, CANADA/University of Groningen, THE NETHERLANDS

Virtual reality has been used in many areas of application, from training to simulation. There is an increasing interest in using VR for training persons for prosthetic limb control. In a prosthesis, a myoelectric signal map to the velocity or position of a prosthetic joint. There is little evidence on what is the appropriate mapping between the myoelectric input and the prosthetic joint output. There is a possibility that a poor mapping will hinder the training. This study is the first stage in the process to understand this mapping, by studying the distribution of velocities in the intact arm in a conventional Fitts law test. What is observed is a wide range of velocities, decreasing in frequency as the velocity increases. This implies that for VR training to be effective a wide range of velocities need to be used in that training.

Kyberd, P, Bongers, R, and Hamza, S (2014), Physically accurate velocity distribution profiles for use in virtual reality training for prosthetic limbs, *Proc. 10th Intl Conf. on Disability, Virtual Reality and Assoc. Technologies*, PM Sharkey, L Pareto, J Broeren, M Rydmark (Eds), pp. 333−336, Gothenburg, Sweden, 2−4 Sept. 2014.

Perception of multi-varied sound patterns of sonified representations of complex systems by people who are blind, **O Lahav**, **J Kittany**, **S T Levy**, **M Furst**, Tel Aviv University/University of Haifa, ISRAEL

Listening to Complexity is a long-term research project, which addresses a central need among people who are blind: providing equal access to the science classroom, by allowing them to explore computer models, independently collect data, adapt and control their learning process. The innovative and low-cost learning system that is used in this project is based on the principle of perceptual compensation via technologies, by harnessing the auditory mode to transmit dynamic and spatial complex information, due to its unique affordances with respect to vision. Sonification of variables and events in an agent-based NetLogo computer model is used to convey information regarding both individual gas particles and system-wide phenomena, using alerts, object and status indicators, data representation and spatial audio displays. The paper describes two experiments: (1) Auditory perception of varying types of auditory representations, spatial trajectories of a modeled object's motion, relative intensity, and frequency; and (2) Auditory perception of complex sound patterns – exploring detection and recognition of multiple sound channels at different complexity levels of sound patterns. The research would serve to improve our understanding of the auditory processes by which perception of sound patterns takes place and transforms into a conceptual model. The long-term practical benefits of this research are likely to have an impact on science, technology, engineering and mathematics education for students who are blind.

Lahav, O, Kittany, J, Levy, ST, and Furst, M (2014), Perception of multi-varied sound patterns of sonified representations of complex systems by people who are blind, *Proc. 10th Intl Conf. on Disability, Virtual Reality and Assoc. Technologies*, PM Sharkey, L Pareto, J Broeren, M Rydmark (Eds), pp. 337−340, Gothenburg, Sweden, 2−4 Sept. 2014.

Adaptation of postural symmetry to an altered visual representation of body position, **M Lemay**, **L-N Veilleux**, **M Marois**, **L Ballaz**, **D M Shiller**, Université du Québec à Montréal/Centre de réadaptation Marie Enfant (CHU Sainte-Justine), Montréal/Université de Montréal, CANADA

The goal of the present study was to determine whether postural symmetry can be altered through sensorimotor adaptation. A gradual change in postural symmetry was induced in participants by biasing visual feedback of their body's center of pressure toward the left or the right. Results showed that this procedure induced a significant shift in participants' stance, which resulted in postural asymmetry and altered postural control that persisted beyond the period of altered visual feedback. We discuss the implications of such visuo-motor procedures for the rehabilitation of patients with postural asymmetry.

Lemay, M, Veilleux, L-N, Marois, M, Ballaz, L, and Shiller, DM (2014), Adaptation of postural symmetry to an altered visual representation of body position, *Proc. 10th Intl Conf. on Disability, Virtual Reality and Assoc. Technologies*, PM Sharkey, L Pareto, J Broeren, M Rydmark (Eds), pp. 341−344, Gothenburg, Sweden, 2−4 Sept. 2014.

Virtual anatomical interactivity: developing a future rehabilitation aid for survivors of Acquired Brain Injury, **V Macri**, **P Zilber**, **V J Macri**, 3D PreMotorSkills Technology, Durham, New Hampshire, USA

Anatomically realistic virtual upper extremities with analogous true range of motion were developed and made available in a platform of video game-like exercises and tasks to pilot test re-learning to plan and execute purposeful motor control and related executive function in survivors of acquired brain injury. The platform game-play is designed for survivors disabled from using physical extremities due to brain injury and for other conditions of brain-motor malfunction. Survivors control virtual upper extremities (before being able to control physical extremities), in order to simulate on-screen physical exercises and task completions, i.e. they stimulate brain processes for pre-action planning and training. This paper describes several imagery (visualization) methods of virtual reality rehabilitation, reports on use of a virtual anatomical interactivity ("VAI") platform by twelve participant/survivors of acquired brain injury and suggests opportunities for expanded collaborative research.

Macri, V, Zilber, P, and Macri, VJ (2014), Virtual anatomical interactivity: developing a future rehabilitation aid for survivors of Acquired Brain Injury, *Proc. 10th Intl Conf. on Disability, Virtual Reality and Assoc. Technologies*, PM Sharkey, L Pareto, J Broeren, M Rydmark (Eds), pp. 345–348, Gothenburg, Sweden, 2–4 Sept. 2014.

Enhancing brain activity by controlling virtual objects with the eye, **C Modroño**, **J Plata**, **E Hernández**, **I Galván**, **S García**, **F Zelaya**, **F Marcano**, **O Casanova**, **G Navarrete**, **M Mas**, **J L González-Mora**, University of La Laguna/Hospital Universitario de Canarias, Tenerife, SPAIN/King's College London, UK/Diego Portales University, CHILE

Stimulation of the damaged neural networks is a key factor for the reorganization of neural functions in the treatment of motor deficits. This work explores, using functional MRI, a system to activate motor regions that does not require voluntary limb movements. Healthy participants, in a virtual environment, controlled a virtual paddle using only their eye movements, which was related with an increase of the activity in frontoparietal motor regions. This may be a promising way to enhance motor activity without resorting to limb movements that are not always possible in patients with motor deficits.

Modroño, C, Plata, J, Hernández, E, Galván, I, García, S, Zelaya, F, Marcano, F, Casanova, O, Navarrete, G, Mas, M, and González-Mora, JL (2014), Enhancing brain activity by controlling virtual objects with the eye, *Proc. 10th Intl Conf. on Disability, Virtual Reality and Assoc. Technologies*, PM Sharkey, L Pareto, J Broeren, M Rydmark (Eds), pp. 349–352, Gothenburg, Sweden, 2–4 Sept. 2014.

Minimally invasive, maximally effective: multisensory meditation environments promote wellbeing, **H J Moller**, **L Saynor**, **H Bal**, **K Sudan**, University of Toronto/University of Waterloo/OCAD University/Praxis Holistic Health, Toronto, CANADA

Increasing evidence is pointing towards the health benefits of leisure: freely chosen, intrinsically motivated and self-directed "flow states", often environment-directed and quite probably with the potential to enact potent changes of consciousness. Optimal leisure experiences are thought to result in enhanced mental wellbeing, positive affect and transformational learning states that carry over into effectively coping with daily routines, stresses and roles. Our group has developed and researched the medically supervised administration of standardized simulated leisure-state meditation experiences in the context of pleasant, hedonic sensory input incorporating multiple sensory channels (visual, auditory, haptic) to promote broad-spectrum wellbeing in mental health care. In this brief report, we report on clinical outcomes for a case series of patients undertaking a therapeutic protocol of TEMM- a technology-enhanced multimodal meditation stress-reduction program with a broad-spectrum mental health benefit, analogous to conventional Mindfulness Based Stress Reduction (MBSR) programs, and a therapeutic risk-benefit margin possibly superior and often preferred by patients to medication therapy attending a holistic health centre. We touch upon seamless diagnostic evaluation and clinical utility of Wellpad, our Electronic Medical Record (EMR) system developed using an iterative Inclusive Design approach. We place our multisensory meditation therapy within the scope of Virtual Environment Therapy (VET) and suggest the mechanism of action as an induced leisure or flow state to potentiate relaxation, stress-reduction, resilience and personal transformation. The relevance of leisure states to wellbeing and specifically positive experiential learning through inspirational/motivational shifts in consciousness delivered via multimodal immersive environments are described as an important health promotion avenue to pursue and the VET research community to consider.

Moller, HJ, Saynor, L, Bal, H, and Sudan, K (2014), Minimally invasive, maximally effective: multisensory meditation environments promote wellbeing, *Proc. 10th Intl Conf. on Disability, Virtual Reality and Assoc. Technologies*, PM Sharkey, L Pareto, J Broeren, M Rydmark (Eds), pp. 353–356, Gothenburg, Sweden, 2–4 Sept. 2014.

Raised-dot slippage perception on fingerpad using active wheel device, **Y Nomura**, **H Kato**, Mie University, JAPAN

To improve the slippage perceptual characteristics with the fingertip cutaneous sensation, we have introduced raised dots on the surface of a wheel rotating on an index fingerpad. Examining the perceptual characteristics of the raised-dot slippages by psychophysical experiments, we obtained factor effects on the perception. As a result of ANOVA, it was confirmed there was a significant difference among the three surfaces: the 3.2 mm period of raised dots, the 12.8 mm periods of raised dots, and the without-raised-dots smooth surface.

Nomura, Y, and Kato, H (2014), Raised-dot slippage perception on fingerpad using active wheel device, *Proc. 10th Intl Conf. on Disability, Virtual Reality and Assoc. Technologies*, PM Sharkey, L Pareto, J Broeren, M Rydmark (Eds), pp. 357–360, Gothenburg, Sweden, 2–4 Sept. 2014.

Low-cost active video game console development for dynamic postural control training, **A Pouliot-Laforte**, **E Auvinet**, **M Lemay**, **L Ballaz**, Université du Québec à Montréal/UHC Sainte-Justine Research Center, Montreal/École Polytechnique de Montréal/Quebec Rehabilitation Research Network, Montreal, CANADA

Weight shifting is a key ability to train and monitor in rehabilitation processes. In the last decade, active video game console (AVGC) has been viewed as a promising and appealing way to solicitate weight shifting ability. However, to date, no commercially available AVGC was specifically developed for balance and postural control throughout rehabilitation processes. The present study aims to establish a proof of concept about the possibility to integrate, in a unique AVGC, a board, monitoring the player centre of pressure and a Kinect, which take into account the postural movement and the player motor function capacity.

Pouliot-Laforte, A, Auvinet, E, Lemay, M, and Ballaz, L (2014), Low-cost active video game console development for dynamic postural control training, *Proc. 10th Intl Conf. on Disability, Virtual Reality and Assoc. Technologies*, PM Sharkey, L Pareto, J Broeren, M Rydmark (Eds), pp. 361−364, Gothenburg, Sweden, 2−4 Sept. 2014.

Evidence-based facial design of an interactive virtual advocate, **W A Powell**, **T A Garner**, **D Tonks**, **T Lee**, University of Portsmouth/University of Kent, UK

RITA (Responsive InTeractive Advocate) is the vision for a computer software-based advocacy and companion service to support older adults and provide an alternative to institutional care. The RITA service will offer a preventative care approach, creating a digital champion who will learn an individual's needs and preferences over time, and be a friendly interface between users, family and professionals. This will involve the integration of a variety of technical components: (1) The Face - a realistic and emotionally expressive avatar, encouraging communication and interaction; (2) The Mind - a repository to store, organise and interpret personal and memory-related information representing the "essence" of a person, with user-defined access controls; (3) The Heart - an empathetic sensory interface which is able to understand and respond to the physical, emotional and psychological needs of the user. Each of these aspects presents a series of technical challenges, which will be addressed by combining existing state-of-the art techniques from a variety of disciplines, together with innovative processes and algorithms, to improve and extend functionality. RITA is being designed in consultation with user groups and service providers, and drawing extensively on existing research to inform the design and functionality of the system. In this short paper we introduce the design and development of the face of RITA.

Powell, WA, Garner, TA, Tonks, D, and Lee, T (2014), Evidence-based facial design of an interactive virtual advocate, *Proc. 10th Intl Conf. on Disability, Virtual Reality and Assoc. Technologies*, PM Sharkey, L Pareto, J Broeren, M Rydmark (Eds), pp. 365−368, Gothenburg, Sweden, 2−4 Sept. 2014.

Study of geometric dispatching of four-kinect tracking module inside a Cave, **S Salous**, **T Ridene**, **J Newton**, **S Chendeb**, Paris 8 University, FRANCE

In a virtual reality application that requires the user to interact with his environment and in the context of an application inside a virtual reality room (CAVE) there is an ever increasing need to optimize the interaction cycle in all its steps, especially in the tracking step. Many existent tracking systems are used inside CAVEs, in this paper we propose a study of geometric dispatching of four-kinects inside a CAVE to be used as a tracking module for virtual reality applications.

Salous, S, Ridene, T, Newton, J, and Chendeb, S (2014), Study of geometric dispatching of four-kinect tracking module inside a Cave, *Proc. 10th Intl Conf. on Disability, Virtual Reality and Assoc. Technologies*, PM Sharkey, L Pareto, J Broeren, M Rydmark (Eds), pp. 369−372, Gothenburg, Sweden, 2−4 Sept. 2014.

Harnessing the experience of presence for virtual motor rehabilitation: towards a guideline for the development of virtual reality environments, **T Schüler**, **L Ferreira dos Santos**, **S Hoermann**, University of Osnabrück/Technische Universität Berlin, GERMANY/University of Otago, NEW ZEALAND

The experience of presence has been shown to be important for virtual motor rehabilitation. Despite its importance, current research and therapy systems often make only limited use of it. This article introduces a conceptualization of presence that provides a guideline for the implementation of virtual rehabilitation environments. Three types of visual feedback in virtual rehabilitation systems are linked to three dimensions of presence. In particular it is shown how movement visualization, performance feedback and context information correspond to the presence dimensions: spatial presence, involvement and realness. In addition, practical implications are discussed to support the development of future virtual rehabilitation systems and to allow better use of the experience of presence for virtual motor rehabilitation after stroke.

Schüler, T, Ferreira dos Santos, L, and Hoermann, S (2014), Harnessing the experience of presence for virtual motor rehabilitation: towards a guideline for the development of virtual reality environments, *Proc. 10th Intl Conf. on Disability, Virtual Reality and Assoc. Technologies*, PM Sharkey, L Pareto, J Broeren, M Rydmark (Eds), pp. 373–376, Gothenburg, Sweden, 2–4 Sept. 2014.

The potentiality of virtual reality for the evaluation of spatial abilities: the mental spatial reference frame test, **S Serino**, **F Morganti**, **P Cipresso**, **E E R Magni**, **G Riva**, IRCCS Istituto Auxologico Italiano, Milan/University of Bergamo/Università Cattolica del Sacro Cuore, ITALY

In recent decades, the use of Virtual Reality (VR) in the context of cognitive evaluation of dementia has considerably increased. The main objective of this preliminary study is to assess the feasibility of a VR-based tool for detecting deficits in using different spatial reference frames by comparing the performances of patients with probable Alzheimer's Disease (AD) with cognitively healthy controls. Although preliminary, our results showed the potentiality of using this VR-based tool to evaluate the ability in encoding and using different spatial reference frames.

Serino, S, Morganti, F, Cipresso, P, Magni, EER, and Riva, G (2014), The potentiality of virtual reality for the evaluation of spatial abilities: the mental spatial reference frame test, *Proc. 10th Intl Conf. on Disability, Virtual Reality and Assoc. Technologies*, PM Sharkey, L Pareto, J Broeren, M Rydmark (Eds), pp. 377–380, Gothenburg, Sweden, 2–4 Sept. 2014.

Improved mobility and reduced fall risk in older adults after five weeks of virtual reality training, **S R Shema**, **P Bezalel**, **Z Sberlo**, **O Wachsler Yannai**, **N Giladi**, **J M Hausdorff**, **A Mirelman**, Tel Aviv Sourasky Medical Center/Tel-Aviv University, ISRAEL/Harvard Medical School, Boston, USA

The aim of this analysis was to assess whether 5 weeks of training with virtual reality (VR) in a clinical setting can reduce the risk of falls in a variety of older adults. Thirty-four participants attending the VR clinic were studied. Participants underwent 15 training sessions consisting of walking on a treadmill with a VR simulation. Significant improvements were observed in gait speed, the Four Square Step Test and the Timed Up and Go. Treadmill training with VR appears to be an effective and practical clinical tool to improve mobility and reduce fall risk in older adults.

Shema, SR, Bezalel, P, Sberlo, Z, Wachsler Yannai, O, Giladi, N, Hausdorff, JM, and Mirelman, A (2014), Improved mobility and reduced fall risk in older adults after five weeks of virtual reality training, *Proc. 10th Intl Conf. on Disability, Virtual Reality and Assoc. Technologies*, PM Sharkey, L Pareto, J Broeren, M Rydmark (Eds), pp. 381–384, Gothenburg, Sweden, 2–4 Sept. 2014.

Realistic and adaptive cognitive training using virtual characters, **D Sjölie**, University of Gothenburg, SWEDEN

Computer-aided cognitive training has the potential to be an important tool in the fight against dementia and cognitive decline but many challenges remain. This paper presents an example of how realistic and adaptive training may address these challenges. Virtual characters were used as stimuli in a dual n-back working memory task in a realistic 3d-environment. Support for continuous adaptation was a priority, including adaption based on affective states such as arousal.

Sjölie, D (2014), Realistic and adaptive cognitive training using virtual characters, *Proc. 10th Intl Conf. on Disability, Virtual Reality and Assoc. Technologies*, PM Sharkey, L Pareto, J Broeren, M Rydmark (Eds), pp. 385−388, Gothenburg, Sweden, 2−4 Sept. 2014.

Performance analysis of adults with Acquired Brain Injury making errands in a virtual supermarket, **E Sorita**, **P A Joseph**, **B N'Kaoua**, **J Ruiz**, **A Simion**, **J M Mazaux**, **E Klinger**, Université de Bordeaux/CHU Bordeaux/ESIEA, Laval, FRANCE

Virtual Environments (VE) offer the opportunity to analyze the performance of people with Acquired Brain Injury (ABI) in Instrumental Activities of Daily Living (IADL). A number of studies have been carried out with the Virtual Action Planning Supermarket (VAP-S) among adult populations with cognitive disorders. Dysexecutive components such as planning have been identified from VAP-S outcome measures. The aim of this study is to explore the links between patients' performance, daily life integration and data from neuropsychological tests.50 adults with ABI in chronic stage (mean delay post onset = 54 ± 53 months) were recruited from a social and work integration program. A Principal Component Analysis (PCA) including a neuropsychological battery, the community integration questionnaire (CIQ) and performance in the VAP-S.The PCA raises four factors that explain 70% of the total variance. These factors show that the performance in the VAP-S cannot be only explained by executive functioning but dynamically mix high and low cognitive processes. Interesting questions also raise to know if performance in the VAP-S would only reflect cognitive disorders or conversely an adaptation level from preserved capacities. Functional performance in VAP-S virtual environment offers promising information on the impact of neuropsychological diseases in daily life. Executive functions impairment is showed. However other cognitive components are involved in VAP-S performance.

Sorita, E, Joseph, PA, N'Kaoua, B, Ruiz, J, Simion, A, Mazaux, JM, and Klinger, E (2014), Performance analysis of adults with Acquired Brain Injury making errands in a virtual supermarket, *Proc. 10th Intl Conf. on Disability, Virtual Reality and Assoc. Technologies*, PM Sharkey, L Pareto, J Broeren, M Rydmark (Eds), pp. 389−392, Gothenburg, Sweden, 2−4 Sept. 2014.

Color-check in stroke rehabilitation games, **V Szücs**, **C Sik Lanyi**, **F Szabo**, **P Csuti**, University of Pannonia, HUNGARY

The article presents the colorimetric testing of rehabilitation games designed for the StrokeBack project. In this testing the main subject of the investigation was how the people with different colour-blindness types can percept the games. Many of the programmers and game designers do not pay attention to the aspect that the games should be accessible. This accessibility implies that the colour-blind users should be able to use the games the same way as the people with no vision problems.

Szücs, V, Sik Lanyi, C, Szabo, F, and Csuti, P (2014), Color-check in stroke rehabilitation games, *Proc. 10th Intl Conf. on Disability, Virtual Reality and Assoc. Technologies*, PM Sharkey, L Pareto, J Broeren, M Rydmark (Eds), pp. 393−396, Gothenburg, Sweden, 2−4 Sept. 2014.

Challenges in developing new technologies for special needs education: a force-field analysis, **P L Weiss**, **S V G Cobb**, **M Zancanaro**, University of Haifa, ISRAEL/ University of Nottingham, UK/3FBK – Fondazione Bruno Kessler, ITALY

Introduction of new technologies for use in special needs education requires careful design to ensure that their use is suitable for the intended users in the context of use and that learners benefit from the experience. This paper discusses issues that influence implementation of collaborative technologies designed to support learning of social communication skills in young people with autism. Taking a reflective view of lessons learned during the COSPATIAL project, a force-field analysis was applied to identify positive factors contributing to successful application development and negative factors that disrupted progress and implementation of the software. On the basis of our experience in the COSPATIAL project, recommendations for future projects are made.

Weiss, PL, Cobb, SVG, and Zancanaro, M (2014), Challenges in developing new technologies for special needs education: a force-field analysis, *Proc. 10th Intl Conf. on Disability, Virtual Reality and Assoc. Technologies*, PM Sharkey, L Pareto, J Broeren, M Rydmark (Eds), pp. 397–400, Gothenburg, Sweden, 2–4 Sept. 2014.

Self-management intervention for amputees in a virtual world environment, **S L Winkler**, **R Cooper**, **K Kraiger**, **A Ludwig**, **A Krueger**, **I Gaunaurd**, **A Fisher**, **J Kairalla**, **S Elliott**, **S Wilson**, **A Esquenazi**, Nova Southeastern University/Miami Department of Veterans Affairs Medical Center/Nova Southeastern University/Colorado State University/Virtual Ability, Inc. Aurora, CO/US Army Telemedicine & Advanced Technology Research Center (TATRC), Fort Detrick, MD/University of Florida/Elliott e-learning Solutions, Chicago/MossRehab Einstein Healthcare Network, Philadelphia, USA

An e-learning self-management intervention for amputees was created then beta-tested for usability using focus groups and qualitative analyses. The next phase of the study compares change in outcomes when the intervention is presented in e-learning and virtual world conditions. Focus group results identified the self-directed structure and video presentation aspects of the intervention as strengths and were less enthusiastic about use of text. Research team experiences, beta test results, and available technology suggest the need to rethink traditional learning theory in order to meet the needs of the modern learner and create more modern learning environments.

Winkler, SL, Cooper, R, Kraiger, K, Ludwig, A, Krueger, A, Gaunaurd, I, Fisher, A, Kairalla, J, Elliott, S, Wilson, S, and Esquenazi, A (2014), Self-management intervention for amputees in a virtual world environment, *Proc. 10th Intl Conf. on Disability, Virtual Reality and Assoc. Technologies*, PM Sharkey, L Pareto, J Broeren, M Rydmark (Eds), pp. 401–404, Gothenburg, Sweden, 2–4 Sept. 2014.

Grid-pattern indicating interface for ambient assisted living, **G Yamamoto**, **Z Asghar**, **Y Uranishi**, **T Taketomi**, **C Sandor**, **T Kuroda**, **P Pulli**, **H Kato**, Nara Institute of Science Technology/University Hospital, Kyoto University, JAPAN/University of Oulu, FINLAND

We propose a grid-pattern indicating interface to provide instructions remotely from remote site to support independent daily life of senior citizens. Our aim is to realize smooth and easy telecommunication between supported senior citizens at local site and supporting caregivers who are in remote site. Although we have used a monitoring method with video streaming where the remote caregivers indicate work steps as a conventional way, occlusion and depth perception problem was occurred. Our method that provides grid-pattern interface to remote caregivers could be a solution for the problems by indicating the spatial instruction easily on 2D input interface. Our prototype has been implemented with a colour camera, a range image sensor, and projector.

Yamamoto, G, Asghar, Z, Uranishi, Y, Taketomi, T, Sandor, C, Kuroda, T, Pulli, P, and Kato, H (2014), Grid-pattern indicating interface for ambient assisted living, *Proc. 10th Intl Conf. on Disability, Virtual Reality and Assoc. Technologies*, PM Sharkey, L Pareto, J Broeren, M Rydmark (Eds), pp. 405–408, Gothenburg, Sweden, 2–4 Sept. 2014.

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