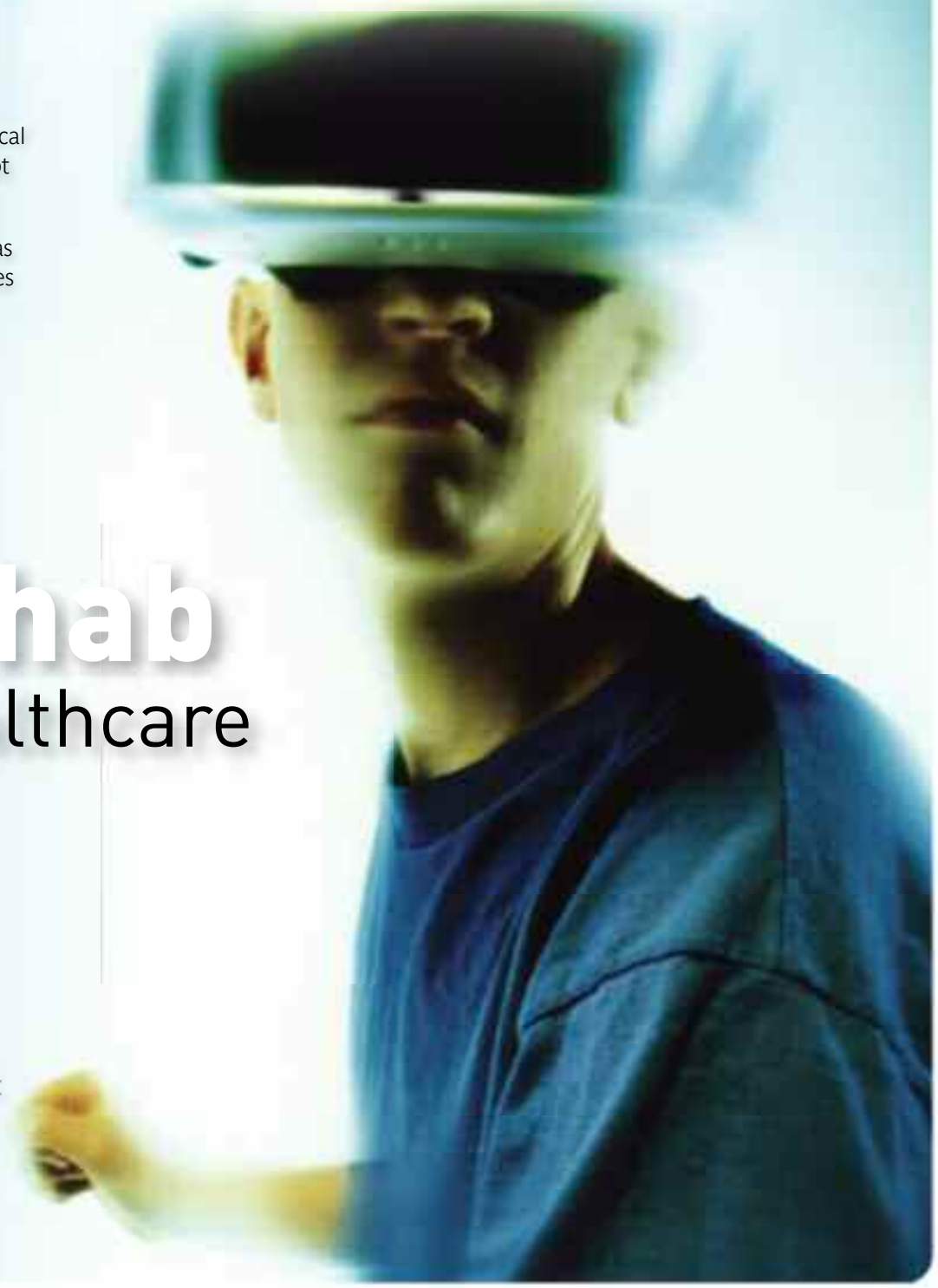
Issue 1 / 2008

CyberTherapy & Rehabilitation

The Official Voice of IACR



Letter from the Publisher

Professor Dr. Brenda K. Wiederhold

"This publication will serve as a catalyst whereby society may rapidly benefit from the remarkable technological revolution..."

Dear Reader,

Welcome to the inaugural issue of CyberTherapy & Rehabilitation Magazine (C&R), the official voice of the International Association of CyberTherapy & Rehabilitation (IACR). IACR is an international association that has been created with the goal of disseminating knowledge about exciting new findings being made to transform healthcare through the addition of cutting edge technologies.

An exciting body of research regarding the utilization of advanced technologies in the areas of training, therapy, education, prevention, and rehabilitation has emerged over the past fifteen years, revealing developments and discoveries made by over 450 clinicians and researchers. Advanced technologies—such as virtual reality (VR), robotics, non-invasive physiological monitoring, e-health, and adaptive displays—are now being applied to several areas of healthcare, including physical and cognitive rehabilitation, anxiety disorders, eating disorders and obesity, addictions, stress management, and as a distraction mechanism during painful or anxiety-provoking medical or dental procedures. These technologies are also providing for improved quality of life for populations such as the elderly and the disabled.

An increasing number of agencies are recognizing the huge potential of technology to dramatically improve 21st century healthcare. The European Commission, in its last three frameworks, has invested heavily in research support of e-health and simulation technologies applied to healthcare and e-inclusion. The European Union, as well as individual governments within Europe, has recognized the critical role that advanced technologies can play in both prevention and treatment. As well, in the United States, forward-thinking organizations such as the National Institute on Drug Abuse (NIDA), National Institutes of Health (NIH), the National Science Foundation (NSF) and the Department of Defense (DoD) continue to support simulation for training, education, and therapeutic interventions.

IACR believes there is an urgent need to develop a set of standards and a "roadmap" for future directions. Since this is a rapidly growing field with significant implications to change healthcare as we know it, it is critical that there be a unified voice which brings together thought leaders and provides a forum to speak with policymakers, decision makers, and funding agencies to voice our needs and help shape research agendas. There is also a critical necessity to provide a central repository of information for those in both the general public as well as the scientific community who are eager to learn more about how technology can enhance healthcare.

This publication will serve as a catalyst whereby society may rapidly benefit from the remarkable technological revolution that is occurring, with the ultimate aim of improving the quality of today's healthcare, helping to quickly disseminate research results, and ultimately elevating the level of care available for each citizen. Currently a considerable knowledge base exists; however, there is no unified plan for the future of best practices for adding advanced technologies to existing clinical protocols. IACR aims to be the organization that brings ideas and decision makers together.
Topics C&R intends to address include:

• Large-scale display technologies including 3-wall CAVES.

GENERAL INFORMATION

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CyberTherapy & Rehabilitation Magazine is published quarterly by the Virtual Reality Medical Institute, 28/7 Rue de la Loi, B-1040 Brussels, Belgium in collaboration with EMC Consulting Group. The magazine explores the uses of advanced technologies for therapy, training, education, prevention, and rehabilitation. Areas of interest include, but are not limited to, psychiatry, psychology, physical medicine and rehabilitation, neurology, occupational therapy, physical therapy, cognitive rehabilitation, neurorehabilitation, oncology, obesity, eating disorders, and autism, among many others.

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REPRINTS

Individual article reprints are available from corresponding authors. Please contact the publisher for rates on special orders of 100 or more.

MANUSCRIPTS

Submissions should be addressed to the JCR Managing Editor, Virtual Reality Medical Institute, 28/7 Rue de la Loi, B-1040 Brussels, Belgium, Telephone +32 2 286 8505, Fax: +32 285 8508; E-mail: office@vrphobia.eu.

Letter from the Publisher

• Low-cost videogame-based simulations including inexpensive handheld devices, portable consumer products, and other low-cost mobile, wireless, and patient-friendly interfaces.

• Next-generation immersive head-mounted displays (HMDs) which might include retinal displays.

• Low-cost, interactive haptic devices that can be used in the home for education, training, and healthcare delivery.

• Easy-to-use software that allows for real-time creation of any environment from digital photographs.

• Object-oriented software for the creation of digital avatars that can rapidly be made to perform any type of movement, action, or complex series of commands.

Other thought-provoking questions that C&R hopes to explore are:

• How can simulation tools become both doctor and patient-friendly?

• How can virtual environments and internet-based therapies be created so that they automatically respond and morph based upon a predetermined set of criteria established by the therapist?

• What type of interface needs to be created so that a continuum from the therapist's office to the patient's home and place of employment (etc.) exists?

• How can technologies be specifically focused to meet the needs of varied patient populations, their families, and caregivers?

In this first issue, we begin our process of discovery by exploring both currently available technologies as well as some of their present applications. We begin with an introduction to "VR in healthcare" in our features section. Since many of today's applications employ HMDs, you will find information on some of the currently available HMDs in our product comparison chart and surrounding pages. This issue's country focus is on Spain. Take a moment to read what cutting-edge researchers are doing throughout the country.

I hope you will enjoy reading our publication and find it informative and beneficial for you. Always striving to meet the needs of our readers, your suggestions and contributions are always welcome. Please contact me, or Daniel Stevens, Managing Editor, at office@vrphobia.eu with your comments, which we believe are vital to our continued growth.

Create your own reality!
Brenda Wiederhold

VR in Healthcare

Virtual Reality, a term used for the first time in the 1980s to describe a computer simulated environment within and with which an individual can interact, has been utilized for almost two decades to aid in therapy and rehabilitation. Amongst the latest developments are networked virtual environments and 3-D interfaces to the Internet.

The Emergence of CyberFashion

Medical experts have begun to realize the incredible opportunity provided by wearable technologies, allowing citizens to benefit from a continuum of care. Prevention, assessment, diagnosis, and treatment can all benefit, allowing citizens more available access to healthcare.

Conference Participation Report Fall/Winter 2008

PRESENCE 2008:

11th Annual International Workshop on Presence

Padova, Italy / October 16-18, 2008

As part of the PRESENCE 2008 conference, Dr. Anna Spagnolli and Dr. Luciano Gamberini of HTLab, University of Padova, Italy and Dr. Brenda K. Wiederhold of IACR co-organized the Second European Workshop of Cybertherapy, Rehabilitation and E-Mental health. ** JCR Editorial Board Member, Dr. Paul Emmelkamp, University of Amersterdam, chaired the symposium and also gave an address in the opening session. The speakers represented 6 countries and spoke on a range of topics from virtual reality and eating disorders to on-line counseling and the therapeutic value of videogames. In addition studies dealing with basic research on presence as well as clinical applications were presented during the pre-conference workshop and as part of the regular conference. The International Society for Presence Research also held its first general assembly, chaired by President Matthew Lombard.

** Drs. Spagnolli, Gamberini, and Wiederhold are all Founding Members of IACR.

For further information, please visit:
http://www.presence2008.org/uploads/file/PRESENCE_2008_Second_CfP.pdf

Presence:

Present and Future Markets, The Peach Industry Event

Turin, Italy / November 12-13, 2008

The Peach Industry Event "Presence: Present and Future Markets" was focused on assessing future market trends and opportunities for presence technologies and applications, and addressed both market actors and the research community. PEACH is an FP6 funded project. During the event, international experts discussed present and future markets, offered examples of commercial applications as well as research and development (R&D) outcomes. The event covered topics such as promising application fields, Presence technologies (e.g. virtual agents, brain-computer interface, 3D displays etc.) as well as training and education.

This year's event was organized in partnership with the VIEW Conference - Digital Transformations - an international event focusing on Computer Graphics and covering Digital Cinema, Automotive Design, Virtual Reality, 3D Animation & VFX, Architecture & Design and Games. Exhibits allowed attendees the opportunity to try many of the new technologies for themselves.

For further information, please visit:
http:// peach.tel.fer.hr/industry/peach_industry_event_home.html

The World of Health IT'08

Conference & Exhibition

Copenhagen, Denmark / November 4-6, 2008

The World of Health IT Conference & Exhibition 2008 (WoHIT 2008) has been designed for and by the healthcare ICT community in the European region including: technology end users, vendors, providers and policy makers. Addressing the perspectives of clinicians, directors and other healthcare professionals, WoHIT offered:

- Educational sessions
- Vendor exhibitions
- Best practice exchange
- IHE Interoperability Showcase
- Networking sessions
- Continuing Medical Education (CME)

Speakers included Viviane Reding, the European Commission's commissioner for Information Society and Media; Jakob Axel Nielsen, Denmark's minister for health and prevention; Former Prime Minister of Finland Esko Aho; and Nicholas Negroponte, Chairman Emeritus of the MIT Media Lab. Dr. Wiederhold, Secretary General of the IACR and Dr. Giuseppe Riva, Founding Board Member, held a symposium on Virtual Reality in Training, Therapy, & Rehabilitation. In addition, VR equipment was demonstrated for the audience, and also available in the Exhibit Hall.

In addition, the European Commission, HIMSS Europe, the Ministry of Health and Consumption of Spain, and the Government of Catalonia announced that the next WoHIT conference and exhibition will be held in conjunction with the European Union's annual High Level eHealth Ministerial Conference in Barcelona on March 15-18, 2010.

For further information, please visit: http://www.worldofhealthit.org

ICT 2008

- Setting the ICT Research Agenda for the Next Decade

Lyon, France / November 25-27, 2008

The European Commission's ICT event, held in the Centre de Congrès in Lyon, examined how and where Europe can lead the ICT agenda in the next ten years. The main themes covered topics such as:

- European Union priorities in ICT research for over €2 billion of funding available in 2009-2010;
- The major current technological trends which impact upon strategic research planning
- Public research policies to stimulate research and innovation.

The ICT event also included 180 exhibits showcasing the latest breakthroughs of European research projects as well as networking sessions for researchers and investors to find partners for potential research initiatives.

For further information, please visit:
http://ec.europa.eu/information_society/events/ict/2008/index_en.htm

CYBERFASHION FOR WELLBEING

Introducing the CyberFashion for Wellbeing Show and Wearable Technology Symposium at CT14

The 14th Annual CyberTherapy (CT14) & CyberPsychology Conference, taking place this June in Lago Maggiore, Italy, announces its call for the "Wearable Technology for Training, Healthcare, and Wellbeing Symposium," which will provide a forum for new research, innovative technologies, and studies done pertaining to health-related topics.

In addition, CT14 will incorporate the first *CyberFashion for Wellbeing Show* in its annual Cyberarium event, which will incorporate fashion and wearable health technologies in order to display innovative designs and research. Innovators in the fields of fashion industry, wearable companies, students, wireless devices for health, intelligent textiles, and sportswear are encouraged to submit their work and participate in both of these events. This event is open to the press.

JUNE 22, 2009	location: LAGO MAGGIORE, ITALY	time: 8:00PM	The CyberFashion for Wellbeing Show is part of the CyberTherapy & Cybertsychology Conference. Contact office@cpsbrain.eu or go to www.interactivemediainstitute.com for more information.

Virtual Reality in Health Care: An introduction

For many health care professionals, VR is first of all a technology. However, the analysis of the different VR applications clearly shows that the focus on technological devices is not the same in all the areas of medicine and it is related to the specific goals of the health care provider.

By Giuseppe Riva

Since 1986, when the computer scientist and author Jaron Lanier used the term for the first time, "virtual reality" (VR) has been usually described as a computer simulated environment with and within which people can interact.

The basis for the VR idea is that a computer can synthesize a three-dimensional (3D) graphical environment from numerical data. Using visual, aural or haptic devices, the human operator can experience the environment as if it were a part of the world. This computer generated world may be either a model of a real-world object, such as a house; or an abstract world that does not exist in a real sense but is understood by humans, such as a chemical molecule or a representation of a set of data; or it might be in a completely imaginary science fiction world.

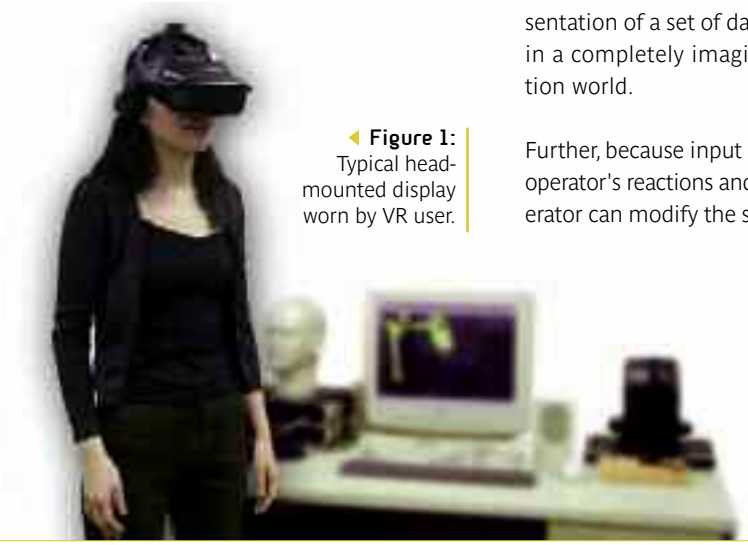

Figure 1: Typical head-mounted display worn by VR user.

Further, because input devices sense the operator's reactions and motions, the operator can modify the synthetic environment, creating the illusion of interacting with and thus being immersed within the environment. Typically, a VR system is composed by:

- the output tools (visual, aural and haptic), that immerse the user in the virtual environment;
- the input tools (trackers, gloves or a mouse) that continually reports the position and movements of the users;
- the graphic rendering system that generates, at 20-30 frames per second, the virtual environment;
- the database construction and virtual object modeling software for building and maintaining detailed and realistic models of the virtual world. In particular, the software handles the geometry, texture, intelligent behavior, and physical modeling of hardness, inertia, surface plasticity, of any object included in the virtual world.

▲ **Figure 2:** Addition of haptic device on VR user' shand to allow for "touch sensation"

The computer technology that allows the development of three-dimensional virtual environments consists of both hardware and software (see Table 1 for VR Hardware). The computer hardware used ranges from standard PCs to high-performance workstations with parallel processors for the rapid computation of world models, and high-speed computer networks for transferring information among participants in the virtual world. The implementation of the virtual world is accomplished with software for modeling (geometric, physical, and behavioral), navigation, interaction, and hypermedia integration.

The most recent development of VR has been in the area of networking and the Internet. Networked virtual environments and 3-D interfaces to the Internet are amongst the latest applications of VR in a growing telecommunications market (See Table 2 for a 5-year forecast of VR in health care).

For many health care professionals, VR is first of all a technology. However, the analysis of the different VR applications clearly shows

▲ **Figure 3 and 4:** Examples of VR environnement before and after mapping

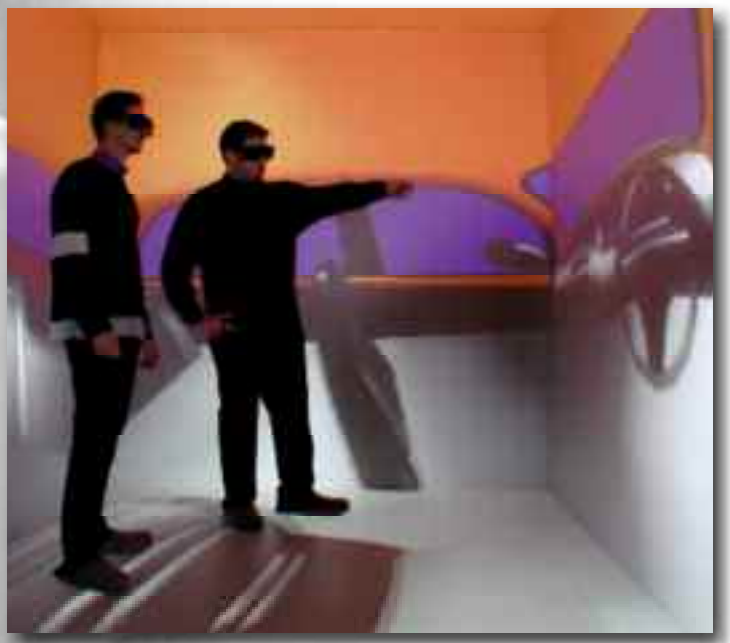

Figure 5: Users interacting with large scale VR environment

Figure 6: Example of Character Design software Interface

that the focus on technological devices is not the same in all the areas of medicine and it is related to the specific goals of the health care provider.

For instance, former Defense Advanced Research Projects Agency (DARPA) Program Manager and retired Army Colonel Dr. Richard Satava (M.D., FACS), in his recent book "Emerging Technologies in Surgery," describes VR as: "a collection of technologies that allow people to interact efficiently with 3D computerized databases in real time using their natural senses and skills". This definition lacks any reference to head mounted displays and instrumented clothing such as gloves or suits. In fact, less than 20% of VR health care applications in medicine are actually using any immersive equipment.

However, if we shift our attention to behavioral sciences and rehabilitation, where immersive devices are used by more than 50% of the applications, VR is described differently. For instance Drs. Brenda and Mark Wiederhold, in their book "Virtual Reality Therapy for Anxiety Disorders: Advances in Evaluation and Treatment" define VR as "an advanced form of human-computer interface that allows the user to interact with and become immersed in a computer-generated environment in a naturalistic fashion".

These two definitions underline two different focuses of VR in medicine: VR as simulation tool and VR as interaction tool.

For physicians and surgeons, the simulation focus of VR prevails over the interaction one: the ultimate goal of VR is the presentation of virtual objects to all of the human senses in a way identical to their natural counterpart. As noted by Satava, as more and more of the medical technologies become information-based, it will be possible to represent a patient with higher fidelity to a point that the image may become a surrogate for the patient – the medical avatar. In this sense, an effective VR system should offer real life body parts or avatars that interact with external devices such as surgical instruments as near as possible to their real models. This view also drives the Information and Communications Technologies (ICT) Work Programme strategic objective "Virtual Physiological Human" (VPH). The VPH lists as its main target outcome patient-specific computer models for personalized and predictive healthcare and tools for modeling and simulation of human physiology and disease-related processes.

For clinical psychologists and rehabilitation specialists, the interaction focus of VR prevails over the simulation one: they use VR to provide a new human-computer interaction paradigm in which users are no longer simply external observers of images on a computer screen but are active participants within a computer-generated three-dimensional virtual world. Within the VE the

▲ **Figure 6:** Second Life online world

Table 1: VR Hardware

VR Workstation
Nvidia Quadro Plex 2000 D2
Nvidia Quadro Plex 1000 Model 4

Professional graphic cards
Quadro FX 5800 2048 Mbyte PCI Express
ATI FirePro 8700 2048 Mbyte PCI Express
Quadro FX 4600 768 Mbyte PCI Express

Consumer graphic cards
Nvidia GeForce 8800 Ultra 768 Mbyte PCI Express
ATI Radeon HD 4870 X2 2048 Mbyte PCI Express

VR Gloves
CyberTouch with tactile feedback
5DT Data Glove 5 Ultra Wireless
Pinch Glove
P5 Glove

Tracking system
Polhemus Fastrak
Ascension PC Flock of Birds
Intersense Intertrax 2

3D Shutter Glasses
StereoEyes Wireless
Elsa 3D Revelator IR
VRex Cordless

Head Mounted Display
PiSight (2400x1720 resolution - 3D display)
VR 1280 (1280x1024 resolution – 3D)
Visette 45 (1280x1024 resolution – 3D)
3-Scope (800x600 resolution – 2D)
Z800 eMagin (800x600 resolution – 3D)
I Glassess PC/SVGA (800x600 resolution – 3D)
Vuzix iWear VR920 (640x480 resolution – 3D)

**Prices available upon request at office@vrphobia.eu.*

Table 2: Five Year Forecast

- Health Care VR systems for less than 5000 Euros
- Clinical/Well Being VR experiences on the web and on high-end cellular phones
- Large scale randomized controlled trials
- Integration of VR systems with biosensors: the features of the VR world are adapted according to the biological responses of the patients

patient has the possibility of learning to manage a problematic situation related to his/her disturbance. The key characteristics of virtual environments for these professionals are both the high level of control of the interaction with the tool without the constraints usually found in computer systems, and the enriched experience provided to the patient.

In the following C&R papers we discuss in more detail these two visions, describing more in detail different areas of health care in which the use of VR is actually investigated.

Both areas of VR are equally important, and equally useful, as we move towards the integration of technology into existing clinical and teaching paradigms. Technology works to assist and enhance existing clinical skills and training tools, not to replace them.

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Product Comparison Chart:
Handhelds & Mobile Health Services

Head-Mounted Displays (HMDs) are critical tools for medical therapies that incorporate virtual reality as a basis for treatment. Therapists use HMDs as tools to aid in stimulating emotions, reactions, and memories that can trigger a patient's anxiety. HMDs can also be applied for entertainment purposes, while some companies design their models for military purposes only. C&R has compiled a list of the most common HMD models and their details in order to compare the quality, affordability, weight, and other information to best suit the consumer.

MODEL	MANUFACTURER	RESOLUTION	DISPLAY TYPE	FIELD OF VIEW	DEVICE WEIGHT
i-Theatre XT	i-O Display Systems	320 x 240	LCD	32°	2.1 oz.
i-glasses VIDEO 3D PRO	i-O Display Systems	800 x 600	LCD	26°	< 8 oz.
DV920	Vuzix	640 x 480	LCD	26°	3.5 oz.
VR920	Vuzix	640 x 480	LCD	32°	3 oz.
LV920	Vuzix	640 x 480	LCD	32°	12 oz.
hi-Res800	Cybermind NL	800 X 600	LCOS	26°	21.2 oz
hi-ResSVGA+ Dual input version.	Cybermind NL	800 x 600	OLED	42°	17.6 oz
Visette45 SXGA	Cybermind NL	1280 x 1024	FLCOS	45°	24.7 oz.
i-visor FX601	Daeyang	800 x 600	OLED	42°	4.23 oz.
i-visor DH4400VP	Daeyang	800 x 600	LCOS	31°	11.3 oz.
i-visor FX605	Daeyang	800 x 600	OLED	42°	4.23 oz.
Z800 3D visor	eMagin	800 x 600	OLED	40°	< 8 oz.
i-Theater	Digital Vision	320 x 240	LCD	25°	2.10z.
nVisor ST	NVIS	1280 X 1024	LCOS	60°	45.9 oz.
nVisor SX	NVIS	1280 x 1024	LCOS	60°	35.3 oz.
piSight	Sensics	2400 x 1720	MICRO	82°-188°	< 35.3 oz.
ARvision 3D HMD	Trivisio	800 x 600	LCOS	40°	8.1 oz.
3scope HMD	Trivisio	800 x 600	LCOS	40°	4.2 oz.
M3	Trivisio	800 x 600	LCOS	32°	3.9 oz.
VR1280	Virtual Research	1280 x 1024	FLCOS	60°	28 oz.
Ruggedized i-visor	Virtual Research	800 x 600	LCD	42°	16 oz.
Cyberface	Leep VR	120 x *1	LCD	120°	18 oz.
Cyberface2	Leep VR	385 x 119	LCD	145°	2 oz.
Cyberface3	Leep VR	720 x 240	LCD	80°	3 oz.
AddVisor 150	SaabTech	1280 x 1024	FLCOS	46°	35.3 oz.
5DT HMD 800-26-3D	Inition	800 X 600	LCOS	26°	21.2 oz.
ProView XL35	Rockwell Collins	1024 x 768	XGA	35°	35.3 oz.
ProView XL40 STm	Rockwell Collins	1024 x 768	AMLCD	44°	28.2 oz.
ProView XL50	Rockwell Collins	1024 x 768	XGA	50°	35.3 oz.
Sim Eye XL100A	Rockwell Collins	1024 x 768	XGA	112°	88.2 oz.

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JCR

Facing Your Fears: Virtually

With over 200 recognized anxiety disorders affecting one-fourth of the world's population, the need for continued improvement of treatment availability is critical. With advanced technologies, psychology has the opportunity to rise to a new level, moving towards unprecedented heights to offer more affordable, more available healthcare to a larger portion of our society.

By Brenda K. Wiederhold

What if the thought of entering the enclosed space of an elevator terrified you so badly that you decided to climb the seven flights of stairs to your doctor's office? Or imagine having to send regrets to your best friend's wedding because you could not stand the idea of mingling at the reception. Though fear and anxiety are a normal part of the human experience, for some these feelings are so intense that they can severely impact everyday life. For these people, there are various treatments that can offer hope, some with traditions stretching for hundreds of years, and others newly arrived, seemingly from the realm of science fiction.

Anxiety disorders, as a group, are the most common mental illnesses in the world. According to a 2007 study by the Anxiety Disorder Resource Center, anxiety disorders affect approximately 1 in 4 people worldwide at some point in their lives. The Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision (DSM-IV-TR) lists phobias (specific phobias, social phobia, and agoraphobia), panic disorder, obsessive-compulsive disorder, posttraumatic stress disorder and generalized anxiety disorder under the broad category heading of Anxiety Disorders. This group of disorders does not distinguish between age, sex, or race, afflicting those from all walks of life. Not only adults, but also children and adolescents can develop anxiety disorders.

Most people experience feelings of anxiety before an important event such as a business presentation, big exam, or first date. Anxiety disorders, however, are illnesses that fill people's lives with overwhelming anxiety and fear that are chronic, unremitting, and can grow progressively worse. Tormented by obsessive thoughts, flashbacks of traumatic events, panic attacks, nightmares, or countless frightening physical symptoms, some people with anxiety disorders may even become housebound. Groups around the world are, however, advancing the treatment of these conditions through the use of virtual reality (VR) therapy.

VR exposure therapy immerses an individual in a computer-generated world where various stimuli related to the phobia may be "experienced" three-dimensionally. The client wears a head-mounted display with small TV monitors and stereo earphones to receive both visual and auditory cues. In careful, controlled stages, the client is exposed to experiences that elicit higher levels of anxiety. Each stage can be repeated until the client is comfortable with the experience and satisfied with the response.

Specific Phobias

Phobias are the most common psychiatric disorder, more common than alcohol abuse, alcohol dependence, or major depression. A specific phobia is defined as an intense and persistent fear that is considered excessive or unreasonable in response to a situation. Specific phobias include fear of flying, spiders, heights, thunderstorms, public speaking, blood, etc. Exposure to the phobic stimulus consistently provokes an anxious reaction,

▲ The Client wears a headmounted display with small monitors to receive both visual and auditory cues

▲ VR environment for treating aviophobia

▲ VR environment for treating posttraumatic stress disorder

which may take the form of a situationally predisposed panic attack. Adults recognize that their fear is excessive and unreasonable, but are unable to control it. Children may or may not have any insight into the fact that their fear is excessive. In both adults and children, the feared object or situation is usually avoided or anticipated with dread. The phobia is diagnosed when one's fear, or evasive actions to avoid the feared situation, interferes with daily routine, employment, or social life.

Over 200 phobias have been identified and named, falling into five different subtypes:

- Animal Type, which generally has a childhood onset and includes fear of insects or other animals.
- Natural Environment Type, which includes fear of heights, water, and storms and generally has a childhood onset.
- Blood-Injection-Injury Type, including fear of invasive medical or dental procedures such as receiving an injection, giving blood or seeing blood or an injury. This phobia subtype is often characterized by fainting.
- Situational Type, which includes fear of flying, bridges, elevators, driving, or enclosed places. The age of onset is either during childhood or in the mid-20s. This is the most frequent subtype seen in adults.
- Other Type, which includes fear of falling down when away from walls, fear of vomiting or choking, fear of contracting an illness, fear of loud sounds, and fear of costumed characters.

The most common treatment for specific phobias is exposure therapy. This exposure was typically done either in real-life *(in vivo)* or imaginally *(in vivo)* prior to VR. However, *in vivo* exposure is not always convenient, safe, or cost-effective (e.g. fear of flying, fear of driving), and *in vitro* is often difficult as only 15% of individuals are able to imagine the feared situation vividly enough to evoke the anxiety response necessary for successful treatment. That's where virtual reality (VR) steps in. *In Virtuo* exposure provides all of the stimuli needed for successful treatment while at the same time allowing therapy to take place in a secure, controlled environment. Studies around the globe have shown that VR for specific phobias has approximately a 92% success rate in just 8-12 one-hour sessions. In addition, by adding physiological monitoring and feedback to the VR protocol, relapse rate and both short and long-term treatment gains may be further improved.

Social Phobia

Social phobia, or social anxiety, is a disorder characterized by excessive self-consciousness and overwhelming anxiety in everyday social situations. People with social phobia have a persistent, intense, and chronic fear of being watched and judged by others and of being humiliated or embarrassed by their own actions. Their fear may be so severe that it interferes with work, school, and other ordinary activities. While many people with social phobia recognize their fear is excessive or unreasonable, they are unable to overcome it. They often worry for days or weeks in advance of the dreaded situation.

Social phobia may involve only one type of situation (such as a fear of speaking in formal or informal situations, or eating or drinking in front of others) or, in its most severe form, it may be so broad that a person experiences symptoms almost any time they are around other people. Social phobia can be very debilitating and can even prevent an individual from going to work or school. Many people with this illness have a hard time making and keeping friends.

Physical symptoms often accompany the intense anxiety of social phobia and may include symptoms of anxiety such as profuse sweating, trembling, blushing, difficulty talking and nausea or other stomach discomfort. These visible symptoms heighten the fear of disapproval and the symptoms themselves can become an additional focus of fear. Fear of symptoms can create a vicious cycle: as people with social phobia worry about experiencing the symptoms, the chances of developing the symptoms increase. Social phobia often runs in families and may be accompanied by co-morbid disorders such as depression or alcohol dependence.

Research has shown two main forms of effective treatment: medication and cognitive-behavioral therapy (CBT). A main component of CBT is exposure therapy, which involves helping patients gradually become more comfortable with situations that frighten them. The exposure process often involves three stages. The first is introducing the individual to the feared situation. The second level is to increase the risk for disapproval in that situation so the patient builds confidence and can handle rejection or criticism. The third stage involves teaching the patient techniques to cope with disapproval. In this stage, the individual is asked to imagine his/her worst fear and is encouraged to develop constructive responses to this fear and any perceived disapproval.

All three stages of exposure can be accomplished *in vivo*, *in vitro*, or *in virtuo* (VR). However, using VR provides certain advantages. First, therapy is carried out in the privacy of the therapist's office. Second, the therapist can more carefully control the reactions of the people with which the patient is interacting. And most importantly, treatment can progress at the user's own pace. It allows each session to be customized to the individual receiving treatment.

Panic Disorder

Panic disorder is characterized by unexpected and repeated episodes of intense fear (called panic attacks) accompanied by physical symptoms that may include shortness of breath, dizziness, chest pain, heart palpitations, or abdominal distress. These sensations often mimic symptoms of a heart attack or other life-threatening medical condition. As a result, the diagnosis of panic disorder is unfortunately often not given until extensive and costly medical procedures fail to provide an alternate diagnosis or relief.

Many people with panic disorder develop intense anxiety between episodes. It is not unusual for a person with panic disorder to develop phobias about places or situations where panic attacks have occurred, such as in supermarkets or other everyday situations. As the frequency of panic attacks increases, the person often begins to avoid situations where they fear another attack may occur or where help would not be immediately available. This avoidance may eventually develop into agoraphobia, an inability to go beyond known and safe surroundings because of intense fear and anxiety.

Appropriate treatment by an experienced professional can help reduce or prevent panic attacks in 70% to 90% of people with panic disorder. Treatment for panic disorder often includes medications and CBT. CBT teaches people how to view panic attacks differently and demonstrates ways to reduce anxiety. VR environments used to treat panic disorder involve exposing patients to feared situations (similar to those where they have experienced panic attacks) or to reproductions (interoceptive exposure) of the physical symptoms of panic attacks (e.g., shortness of breath, vertigo, and tunnel vision). These symptoms can be recreated in virtual environments with sound (pounding heart, fast breathing) or with visual effects (blurred or stretched images). Each of these exposures is accompanied by therapist-facilitated cognitive restructuring and coping skills.

Most patients show significant progress after approximately ten treatment sessions. Relapses may occur, but they can often be effectively treated with "booster sessions" or a short "refresher" course.

Obsessive-Compulsive Disorder

There are two sides to obsessive-compulsive disorder (OCD): obsessions and compulsions. Obsessions are thoughts, and compulsions are actions. The obsessions in OCD are repetitive and persistent, inappropriate and intrusive, and are impossible to suppress. These cause the sufferer significant distress and anxiety. Compulsions are repetitive behaviors or mental acts that the person applies based on rigid rules that they follow. The goal of these actions is to prevent a dreaded event or to lessen distress. They are, however, not really connected in a logical way to these events. Once the person completes a compulsive behavior, a sense of relief is felt. It is easy to imagine how these unwanted thoughts and disruptive behaviors cause disturbances and impair the sufferer from living everyday life. Not only are these rituals time consuming, but it is quite difficult to function socially while experiencing them.

OCD is most often treated with a combination of medication and exposure therapy with ritual prevention. Some medications have been found to have a significant effect on symptoms, but relapse rates upon medication cessation are extremely high if coping skills are not

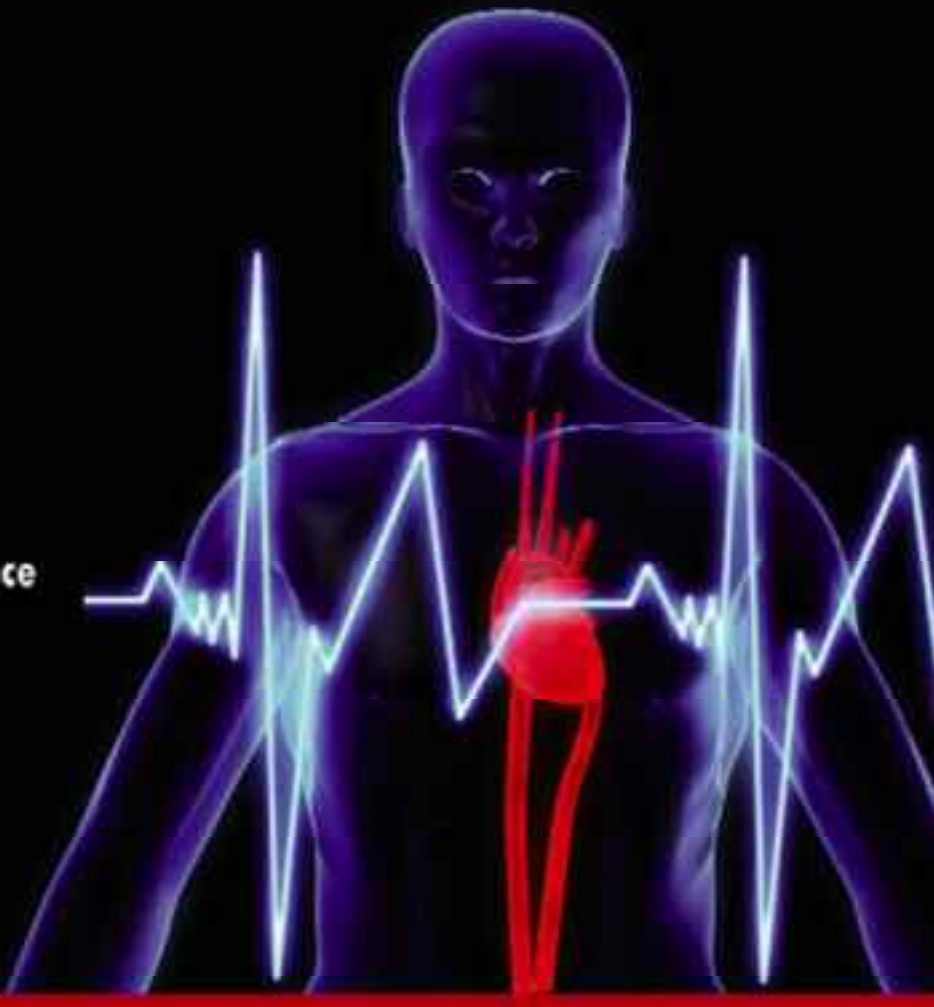
Heart Rate Variability & Virtual Reality

Applications

from asthma to autism,

from anxiety to depression,

from PTSD to peak performance



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also learned prior to discontinuing medication. Research has revealed that VR is effective at inducing the anxiety response necessary for effective treatment to take place. The benefit of conducting exposure therapy with VR is that situations that trigger obsessions and compulsions can be experienced repeatedly, a necessary element of overcoming the repetition of OCD. In addition, this treatment can take place in the privacy of a therapist's office, ensuring patient confidentiality. Though VR exposure therapy for OCD can take longer than for specific phobias, many patients experience some relief within the first few sessions.

Posttraumatic Stress Disorder

Many have heard the term "shell shock" in the context of soldiers returning from war. The condition's technical name is Posttraumatic Stress Disorder (PTSD). PTSD can affect anyone who has experienced a traumatic event such as a motor vehicle accident, an assault, or anything that threatens a person's life or physical integrity. Symptoms may range from increased anxiety or arousal to dissociation and flashbacks of the event, though the disorder may manifest differently in each individual.

Because PTSD has such varied symptoms, a combination of treatments is often necessary. Anxiety-reducing medications, antidepressants, support from friends and family, and CBT involving exposure can help with recovery. A recent Institute of Medicine study maintains that exposure is an important component to be included in treatment regimens. One type of exposure therapy that has often been used is imaginal exposure therapy, in which patients are asked to repeatedly imagine and retell their traumatic experience to their therapist. However, because one of the hallmarks of PTSD is an avoidance of reminders of the trauma, this is often difficult for some patients. Those who are unable to engage with their memories do not evoke an anxiety response during exposure, and these patients fail to improve. It is generally thought that this is due to lack of activation of the brain's fear structure, where the trauma memories are stored. Since the structure is not activated, it is thought that the information stored is therefore not available to receiving "disconfirming" information (e.g., "there is no longer danger here").

Virtual reality (VR) can solve the problem of avoidance and lack of good imagery abilities that plague some patients and prohibits successful alleviation of symptoms. By providing the patient with stimuli that engage multiple senses (audio, visual, tactile, and olfactory), the therapist does not have to rely on the imagination and willingness of the patient to create anxiety, but rather can provide stimuli directly to the patient at the touch of a button. In addition, because the virtual environment allows the therapist and patient complete control over the pace and duration of treatment sessions, the danger of overwhelming the patient with anxiety can be avoided, alleviating the patient's anxiety at beginning treatment. In addition, many clinicians combine physiological monitoring and feedback with VR exposure. This has the added advantage of providing continuous monitoring of the patient's heart rate, breathing rate and other physiological signals, allowing for an objective, real-time measurement of the patient's condition to occur. This also can be used to teach the patient to visually understand when relaxation has been achieved. With this addition, the therapy can be further individualized to progress according to each individual patient's needs.

VR exposure treatment has been performed for survivors of earthquakes, motor vehicle accidents, terror attacks and other various traumatic events. One of the most recent developments has been to use this treatment for those returning from Iraq and Afghanistan who are diagnosed with PTSD (www.vrphobia.com). The Virtual Reality Medical Center and Interactive Media Institute, have both received funding from various military and government organizations to develop virtual reality software and clinical protocols, and to provide treatment to both U.S.-based active duty and veteran populations as well as NATO coalition troops and continuing clinical education and training to psychologists and psychiatrists. Currently in use at over thirty installations in the U.S., systems are also now available in both Warsaw, Poland and Zagreb, Croatia. Psychologists and psychiatrists trained on the clinical protocols are now able to provide this innovative treatment to patients.

The VR programs recently established in Croatia and Poland will not only help patients, but will allow for the clinical investigation of determining the system's cross-cultural relevance. Some parts of the system may be shown to be transferable across cultures whereas other portions may need to be re-configured to allow for cultural differences.

Conclusion

Virtual reality has made a significant impact on the way anxiety disorders are able to be treated. With increasing advancements in technology, and with the availability now to port many VR experiences over the Internet, the potential for improved psychological treatment of mental disorders is seemingly endless. With over 200 recognized anxiety disorders affecting one-fourth of the world's population, the need for continued improvement of treatment availability is critical. With advanced technologies, psychology has the opportunity to rise to a new level, moving towards unprecedented heights to offer more affordable, more available healthcare to a larger portion of our society.

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My Heart's " Neurological Rehabilitation " Concept:

Technologies for Post-Stroke Treatment

MyHeart's Neurological Rehabilitation (NR) Concept is especially devoted to supporting post-stroke treatment. This paper describes how the concept is structured and how technologies are leveraged to support both motor rehabilitation and speech/cognitive training. The architecture permits assisted training both at the clinic and at home, after discharge from the in-tensive care unit. Both promising results and issues, collected during the first evaluation phase, will be discussed.

By Toni Giorgino et al.

Recovery from a stroke begins in the acute unit and it is articulated into a series of intensive and extensive rehabilitation protocols. Despite the protocols variability, there is nowadays a common trend, in clinical medicine, to shorten hospitalization and foster homecare. The reason is both to cut costs and improve quality of life. The aim of My Heart's Product Concept NR is to support patients in the performance of speech and motor therapy, both when they are still hospitalized, and after discharge, at home. Patients eligible for the service must be in stable clinical condition and show mild motor impairment and/or aphasia with no other cognitive impairment that could impact on the system's use.

Liability constraints of Italian hospitals impose that IT-based rehabilitation does not replace conventional therapy. Therefore, at the hospital, exercise performed with the system is added to the conventional one, resulting in a more intensive, hopefully more effective, program. This could lead to an earlier discharge. After discharge, patients could bring the rehabilitation device to a long stay ward or at home, and continue exercises with the help of their caregivers.

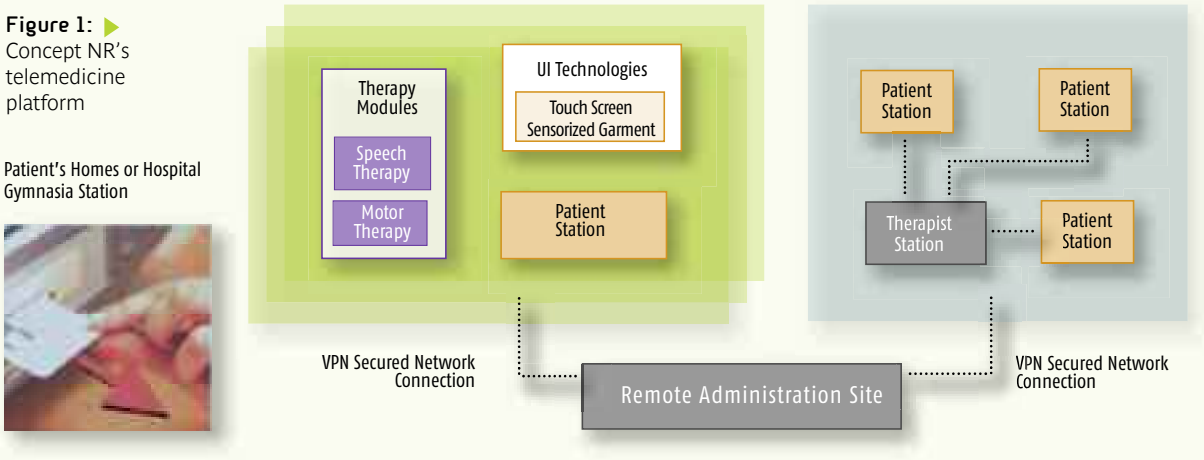
In this paper, the service built within Concept NR will be described, in terms of its architecture, technology used and first experimental results.

The system architecture

Figure 1 shows a simplified view of the system technical architecture.

The infrastructure is based on EvoCare, a solution developed by Dr Hein GmbH. The main components are one server, and a number of users' workstations, connected by a secure network.

Figure 1: Concept NR's telemedicine platform



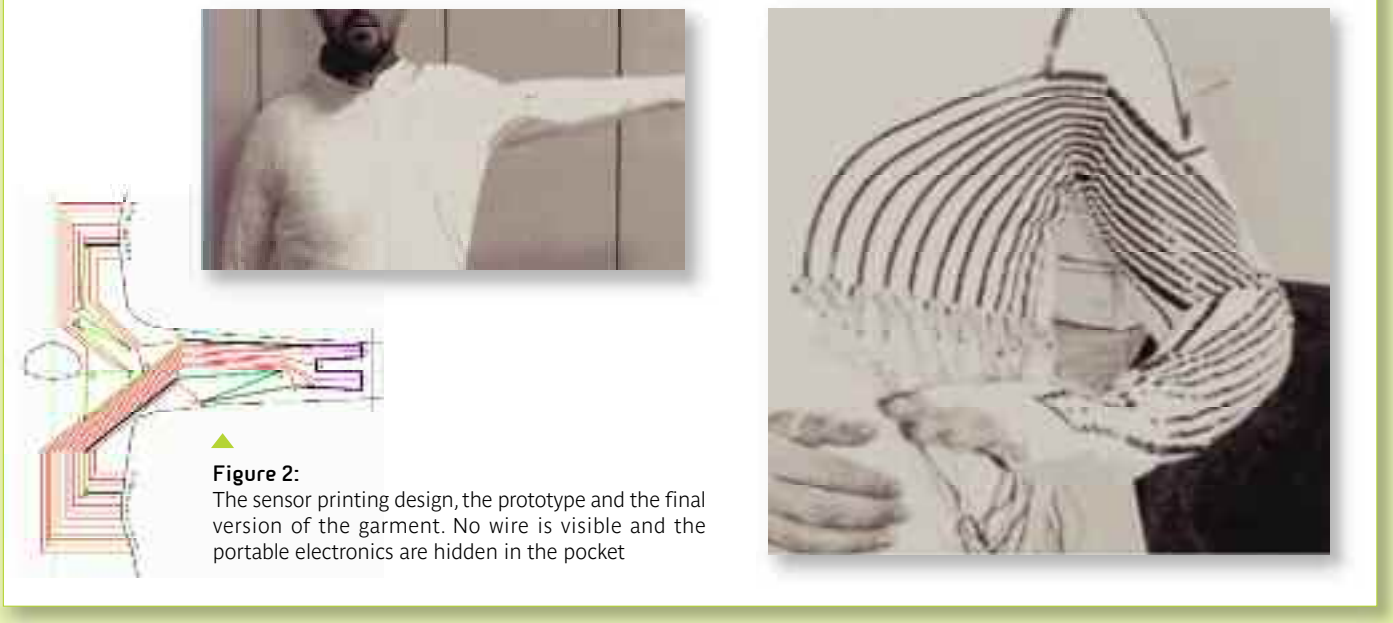


Figure 2:
The sensor printing design, the prototype and the final version of the garment. No wire is visible and the portable electronics are hidden in the pocket

Medical personnel use the therapists' stations to administer their assigned patients, prescribe exercises, and review their performance.

Patients use the patients' stations which support the rehabilitation exercises. Patients' identities are recognized via per-sonal "check-in cards." Once inserted, the exercise protocol (prepared by physicians) and messages are downloaded automatically at the patient's site.

The server acts as the repository for exercise prescriptions, results, and messages.

Specific exercises, including speech therapy and motor therapy, are realized by a "plug-in" mechanism. Each plug-in implements all activities required by the specific type of exercise: it is responsible for providing configuration screens, supports the execution of the actual exercise, provides appropriate feedback to the patient, and stores the results. It also supports browsing and summarization of the results for the therapist to review.

The technology

Speech therapy is based on the EvoLing software developed by Dr. Hein GmbH. It includes an extensive set of exercises, each promoting one ability: to recognize words, phonemes, graphemes, and pictures. Semantic and orthographic information is considered in order to build exercises with an adapting degree of difficulty.

Motor therapy is an innovative component of the system. When sitting at their station, patients wear a special sensorized garment, plugged into a portable electronics box (fig. 2). After a brief calibration phase, the motion recognition software is started; it provides real-time feedback on the progress and accuracy of exercises by means of clear symbols such as colored bars and a smiling/frowning face. The movements have to be repeated until the assigned number of repetitions are performed, or a timeout expires. A traffic light icon shows when to start a new repetition (fig. 3, left).

Motion recognition is based on strain sensor technology, directly printed on garments. Conductive elastomers are polymer-based materials which exhibit electrical conductivity. Sensing stripes are thin and can be printed by cheap industrial processes; they do not alter the mechanical properties of the fabric (Lycra in our case) and they are stable and non-toxic. The same material can be used to realize connection wires between sensors and the readout electronics (fig. 2).

Movement recognition

When signals from body movement are acquired, they are processed in order to verify the correct execution of the rehabilitation exercise. Since there is no direct correspondence between the fabric stretch values at various points of the garment and biomechanical parameters or like angles between limb segments, posture classification was tackled via machine-learning based algorithms. Therefore, every repetition is classified evaluating the similarity with a known "correct" or reference path. Some reference paths correspond to well-known, deficit-related exercises, like adduction, abduction, rotation, extension, etc. But other exercises may be tailored to the specific patients, in particular functional movements like combing, eating, brushing, etc. A short "calibration session" allows the system to learn such movements and store the corresponding reference paths.

The machine learning approach to move-

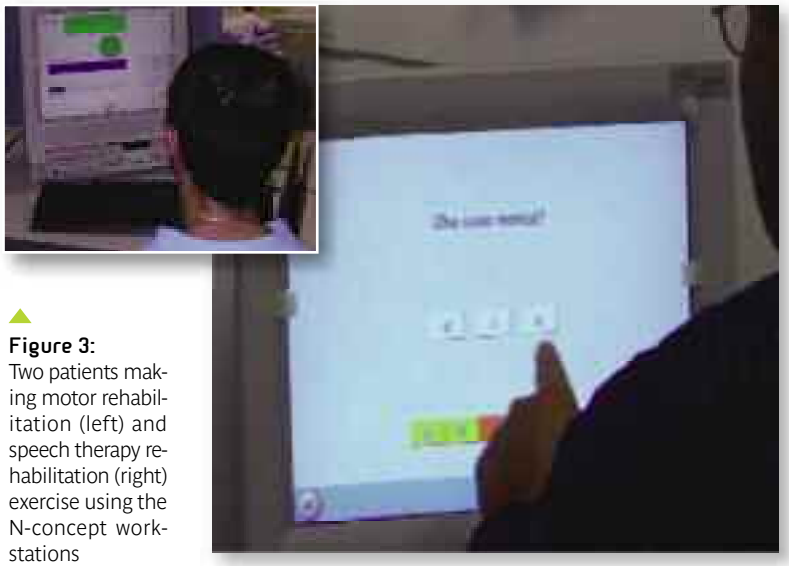


Figure 3:
Two patients making motor rehabilitation (left) and speech therapy rehabilitation (right) exercise using the N-concept workstations

ment recognition is an important research topic by itself, because strain sensors are affected by various sources of uncertainty, which make the recovery of limb positions from sensor readings less than straightforward. The accuracy of classification is affected by the dynamic nature of the task. Smeared sensors produce velocity-dependent artifacts; therefore, the recognition accuracy is impaired when limbs are moving. In addi-tion, patients wear the garment each time in a different way, and also within the same session the garment may slightly move. Also, one is interested in the closeness of a movement path to a reference, not just to detect a limited set of basic positions.

Results

The NR system is currently undergoing a small-scale study to assess user satisfaction and gather initial measures and feedback. It includes, in its last phase, 10 months of experience in the field, with real healthcare operators and at least 20 patients exploiting the different system functionalities. Results of the study will deal with the usability of the system (user-friendliness, lack of technical problems, comfort e.g. possible problems with the garment) and the users' satisfaction (perceived usefulness from the patients' and therapists' point of view).

Preliminary qualitative and quantitative results for speech therapy were obtained from the first ten patients enrolled. Most of the enrolled patients enjoy using the system, and use it about three times a day, in addition to their traditional face-to-face encounter with the speech therapist.

Motor therapy support, while representing a very promising technology, is a more challenging task. The preliminary laboratory evaluation with voluntary subjects showed an overall efficiency on movement recognition of 91%. However, we can not report at the moment quantitative results on patients, since the first months of the evaluation phase have been spent in gathering feedback from patients (six subjects) and therapists in order to improve the system usability. The garment design has been improved adding a zip to facilitate wearing and markers to facilitate wearing the garment always in the same way. Also the interfaces have been made more and more simple and immediate, leaving out all the pictures, icons and words that could make the patient confused.

Conclusion

The integrated nature of the NR system is intended to support a multidisciplinary, telemedicine-based approach to rehabilitation. The benefits of this (and similar) IT-based aids are supported by current beliefs on rehabilitation, e.g. those expressed in the SPREAD guidelines (www.spread.it). First of all, long term rehabilitation programmes are considered beneficial for the recovery process, but cost is very high. IT technologies are a promising solution for pro-viding long-term rehabilitation at lower costs. At the same time, early discharge is recommended for patients with less severe disability. The system allows for early discharge while still being monitored remotely.

Finally, the concept addresses a frequently-reported issue, i.e. lack of quantitative measures on the progress of rehabilitation. The diffusion of computerized monitored rehabilitation aids may increase the objectivity of practice and allow for quantitative progress evaluation and therapy comparisons.

Acknowledgments

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Using Mobile Phones as Behavioral Technologies

Opportunities and Challenges

Technology should be easy to weave into the fabric of our everyday life; recent research in Human-Computer Interaction shows that this integration is made easier if the technology supports situated use, exploiting user actions and the environment as a resource- rather than requiring explicit commands or data entry by users.

Giulio Jacucci

Behavioral technology should ideally be always with users, should not burden them with additional devices or force them to learn new interfaces, and should be flexibly applicable to different tasks and activities. In short, the technology should be easy to weave into the fabric of our everyday life. Recent research in Human-Computer Interaction shows that this integration is made easier if the technology supports situated use, exploiting user actions and the environment as a resource rather than requiring explicit commands or data entry by users. There is a candidate platform that can accommodate these requirements, and that is "what used to be called the mobile phone."

Mobile phones have evolved to the extent that manufacturers do not call them phones anymore. Features include cameras with ever increasing resolution for picture and video capture, internet connectivity (based on operators network or WLAN), near field communication as RFID (Radio Frequency Identification), a variety of sensors like accelerators, and GPS (Global Positioning System). Through the bluetooth interface virtually any sensor can be used in applications and the bluetooth itself can be a sensor that is able to scan and sense the presence of other devices. More importantly, the mobile phone contains rich and diverse information about the user and his or her actions that can be used by applications: calendar, communication logs, profile of the phone in silent, usage data of the phone or its applications.
All these features are even more powerful when used in concert rather than separately and initial naturalistic studies show that such novel mobile applications can have a great impact on activities and experiences of users in particular leveraging social interaction. Let's review some examples starting with studies of collective story creation using mobiles, then studies of mobile awareness cues and their integration, and finally sensing and augmented reality and their potential for novel applications.

Collective Creation and Sense Making of Mobile Media

With Comeks on the phone, users create comic strips by augmenting and annotating their own mobile pictures with speech bubbles and other comic-related accessories. Messages are put in a sequence creating stories that can be sent to friends. In a longitudinal field study messages featured performative acts where members play-acted together or turned objects into characters. Collage was frequent, re-using, for example, pictures from the members of the group or other printed material (Salovaara 2007). The study shows how a mobile phone that supports producing and sending comic strips out of mobile pictures (figure 1, left) can impact group communication and experience by creating novel expression practices in a group of subjects.
In a series of studies on spectators at large-scale events we have shown how mobile pictures can affect group experience and action. In a first study by just utilizing simple camera phones with just the built in applications, we witnessed rich forms of multimedia-mediated expression such as staging, competition, storytelling, joking, communicating presence, and portraying others. These expressions were always connected to group practices and were motivated by how they featured in socially engaging, processual, and shared nature of experiences. The analysis pointed to how mobile media was not only important to mediate or document experiences but in how it participated in the very construction of experience by providing opportunities for action.

In a subsequent study, we equipped groups of spectators with an application that implemented mobile media messaging in collective stories (group messaging spaces) that became archived group media albums. We have used the term "collective" to refer to the experiential component in joint media creation and sense-making. Collective use appears to be rewarding because it not only provides new forms of interpersonal and inter-group communication, but also ways to re-enact and re-use group's conventions and shared memories in novel inspiring ways. In

these collective albums awareness and social presence are actively constructed achievements. Our work points to how users can actively engage in constructing the cues by contributing to build up the medium for presence.

Awareness Cues and Their Integration

Another example is how mobile awareness cues on other's context impact coordination and communication. ContextCues augments the contact list of the mobile phone by juxtaposing to each name and number context information on that person. These cues can include: the location, nearby members, time elapsed since phone used, and other activity cues. Longitudinal intervention studies showed impact to coordination whereby cues were used to infer information, align, and optimise mobility and communication. More importantly, cues were used in the pursuit of connectedness, companionship, and a sense of belonging with peers and significant others.

In further experiments we have also combined awareness cues and collective media stories as shown in Figure 2. Our system combined a group media space with event information and integrated awareness cues throughout. In two field trials we found that the system supported what we call active spectatorship facilitating onsite reporting to offsite members, coordination of group action, keeping up to date with others, spectating remotely, and joking. In these activities, media, awareness cues, and event information were often used in concert, albeit assuming differing roles.

Sensing and Augmented Reality

Also sensor information, for example a heart rate sensor, can be used in mobile applications as the one in Kurvinen et al. 2007 that was experimented with sharing real-time performance information of football teenage players to their parents and coaches during training and competition. This exemplifies how easy it is to integrate sensorial information even at a physiological level and also how the sensed information can be used not just for the individual user but in a social application.

Technologically there are some solutions on mobile phones that start to be interesting as ways to tag the environment like RFID tags, and optical markers. The mobile phone increasingly can interface with a variety of sensors. We have developed at our institute a platform for this called ContextPhone. Also 3D graphics are developing quickly, enabling complex visualization that could be useful in rehabilitation scenarios.

Recent developments make Augmented Reality visualizations possible to be played on mobile phones which means enabling the ability to register 3D virtual objects in a real scene using computer vision tracking optical markers (Figure 1, right). This creates engaging and rich mediation to the physical environment and has been shown to activate users in navigating and using space in a different way for example in educational games in museums.

A Call for Balance and Artful Integration

The mobile phone is therefore a surprisingly powerful tool compared to desktop applications for its ability to provide continuous and ubiquitous use, meaning also interaction with the environment, which can be useful in physically activating subjects. More importantly, it can function as a powerful tool for expression and social interaction, deeply affecting action and experience in a variety of activities. Our examples show that to make best use of the rich features provided by mobile phones, an artful integration is required to create applications that can truly be woven in users' everyday practices.

There are several issues and open questions connected to the mobile phone as a behavioral technology. On a technical level, developing applications for phones is difficult given the portability problems, as there are several programming languages and operating systems on phones. Finally, although phone screens are getting bigger and their interface easier (see iPhone), a phone application can be perceived to be difficult and complex to use. More importantly, in some of the studies mentioned before, the use was so intensive, it raised concerns of negative effects in the longer term. Some users even reported having felt social uneasiness in public spaces when other people noticed them staring so long at their mobile phone. Therefore as with any technology, the design should aim for achieving a balanced impact.

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Figure 1. pictures from two different comic stories created by subjects with a mobile phone using Comeks Salovaara (2007).

Figure 2: awareness cues about other members

Figure 3. recent developments allow Augmented Reality visualizations (by Schamlstieg and Wagner 2007)

The Emergence of CyberFashion

There is no doubt that wearable technology is on the rise. The future cannot be foreseen, but the possibilities are bright; cyberfashion will most undoubtedly change the way we wear our clothes…

By Daniel Stevens

When most think of fashion, we tend to think of chic models, latest trends, beautiful garments, and innovative designs. The clothing industry has generated billions in revenue by creating enticing designs for the general population. Fashion designers are always searching for the next fashion trend for innovative products. I would like to declare that I have discovered that new trend; that new, exciting, and innovative fad that will change the fashion world forever: the new trend is here, it is "now," it is….technology.

Recently, technology has begun to emerge onto the fashion scene, creating unique additions incorporated within fashion designs. Products such as mobile phone technology, kinetic energy, and sunlight reactors have begun to intertwine with well-known fashion designers, introducing technology to runways worldwide. However, interestingly enough, technology companies have begun to "dip their toes" in the pool of fashion as well. Companies such as Philips, known throughout the world for their technologies and electronics, have begun producing technology that can be fused with textiles to give your clothing that "extra something," the new wave of the future.

Wearable Technologies

Medical technology has begun to realize the incredible market for wearable technology. Wearable health companies have surfaced in North America, Europe, and Asia as innovators to the new "trends" in healthcare. Intelligent textile companies use their textiles for the wearer's wellbeing, using temperature-changing materials to change color in reaction to body heat, fabrics that have their own cooling system in reaction to the wearer's environment, and even clothing that has its own personal heating system.

With materials and technology like these, the future is electrifying. Imagine being able to control your own body heat at all times, never too cold and never too hot. Envision the possibilities if a material can determine if an infant has a fever or is too cold when it cannot speak to its parents.

Futuristic Fusion

Mobile phones and telehealth have made headway in the medical field, bringing wireless communication for better health and wellbeing to the user. Companies have even created clothing that actually acts as a mobile phone, catching much media attention worldwide. CNN.com has recently described this phenomenon, stating, "Futuristic fusion of fashion and technology is becoming more common as [clothing] designers are increasingly incorporating electronics into their garments." The article featured fashion companies that have added creative technology in their garments. Products featured include swimwear that changes colors in reaction to sunlight, a dress that measures air qual-

Bruce Damer models his iDoublet designs. Photo courtesy of CyberWearz. www.cyberwearz.com

Mamagoose technology for SIDS detection. Photos courtesy VERHAERT

ity, garments that show moving video images and a self-heating vest, among others. CyberFashion has progressed into the entertainment industry, with products such as the "air guitar t-shirt," a shirt that allows the user to play an objectless musical instrument by Dr. Richard Helmer of the Commonwealth Scientific and Industrial Research Organisation (CSIRO), and CuteCircuit's "Hug Shirt," which enables mobile phones to give someone a "virtual hug."

But why are these companies moving towards technology instead of using, should we call them, "unintelligent" textiles? Is this a passing fad or has this sparked the new wave of modern clothing? There is no doubt that wearable technology is on the rise. The future cannot be foreseen, but the possibilities are so bright; this will most undoubtedly change the way we wear our clothes. Once these products become affordable and commercialized, the trend will take off and continue to prosper. Even the "simplest" things, the ability to change the color of a garment at will or trendy mobile phone accessories, are sure to become more than a passing craze. Investigating these new garments is difficult, as most are not currently commercializing their products for the mainstream market. Philips, who has created the LumaLive technology, a material that can change colors, shapes, and designs controlled by the user, rents out their technology for shows, but are still in the "customizing phase," working to make their product more flexible. Other designers such as Hussein Chalayan and Vega Zaishi Wang use technology to create visual effects on a runway, but do not necessarily infuse the effects in the commercialized version.

Bruce Damer of CyberWearz has created the iDoublet, in which he designs clothing that incorporates an Apple iPod directly into the garment. The iDoublet was debuted at MacWorld. In addition, Damer has presented his research at many prestigious conferences and shows including the Second Skin Show in San Francisco, the 11th Annual Presence Conference in Padova, and at the Virtual Worlds Summit in London. "I see a merger between the two fields with textiles becoming high tech and manufacturing of garments becoming driven by CAD/CAM (Computer Aided Design/Manufacturing)," Damer states, "The apparel business is one of the last holdouts of old fashioned 18th Century hand construction." A pioneer in early virtual worlds and avatars now turned designer, Bruce foresees fashion moving towards the medical realm. "Medical health monitoring [and] cyber-garments will bring real breakthroughs such as heart monitoring, galvanic skin response, and communication of health status."

Other pioneering developments in clothing have made headway in this field. The Mamagoose pajamas, created by the European Space Agency, embody built-in sensors and electronic monitoring to detect Sudden Infant Death Syndrome (SIDS), more commonly called "cot death." When symptoms or characteristics of SIDS arise, an alarm sounds to prevent death. The World Health Organization (WHO) has conducted many studies on using wearable monitoring systems for the prevention of the relapse of depression, monitoring and correlating responses to antidepressant drugs, detecting drug mis-

use, and to warn or obtain feedback in order to prevent self-injury and suicide. The most incredible benefit for using intelligent textiles is the ability for the user to live a "normal life," while wearing a medical disorder preventative aid. Such anticipatory garments can be worn underneath other clothing which still appear to be "unintelligent" textiles, giving the user the feeling of normalcy. Even "wearable computing," a wearable computer that monitors behavior and health, can appear to be a common wristwatch.

Downsides

On the other hand, as critics may suggest, there are a few downsides to technology in clothing:

Practicality. Clothes become dirty and therefore must be washed. Modern technology must be made waterproof to be completely integrated into clothing.

Affordability. Incorporating expensive technology into new designs will be pricey. Most consumers are not willing to part with hundreds to thousands of dollars for an article of clothing.

Paranoia. For those conspiracy theorists, one could make the argument that incorporating technology into clothing is one more way for an individual to be monitored, given the possibility that electronics capable of tracking devices could be attached to the garment. However, mobile phones already have such tracking capabilities; a concerned parent would not have to worry about their child losing a phone if the monitoring chip was built into the child's clothing.

Longevity. Clothing featuring battery-powered electronics must either be charged or will most likely have a short life span. If such an expensive garment were purchased, the consumer would not look too kindly on its inability to last.

Reliability. Micro-technology and electronics have the tendency to break or go "haywire." Mobile phone companies, small electronic producers, and handheld music device companies have support staff, reliable store outlets for repair, and can easily exchange the item for one similar. With these added hassles, mainstream clothing companies may avoid selling such materials, despite their ability to appeal to the consumer.

Positive Attributes

Despite the above complications, cyberfashion has many positive attributes while the complications previously mentioned have the ability to be fixed. Looking at medical purposes alone, the positives outweigh the negatives. Many companies have solved the waterproofing issue; affordability will come with time, while longevity and reliability can be perfected in the coming future.

CyberFashion for Wellbeing

CyberFashion has initially emerged at technology conventions and conferences. The upcoming CyberTherapy & CyberPsychology (CT14) conference will celebrate cyberfashion this June near Milan, Italy. The annual Cyberarium, which provides a forum for new and emerging technology, research, and wearable products, will incorporate advanced technology with high fashion at the first CyberFashion for Wellbeing Show.

Fashion students have already begun to construct designs focusing on medical wellbeing for the show. Conference organizers are engaging with fashion designers and wearable companies to participate in this innovative fashion show. Taking place in Lago Maggiore, Italy, the venue is beautifully set on the gorgeous Italian lake, near Milan, the fashion capital of the world.

New and emerging technologies will intertwine with the clothing, textile, and fashion industry. Women's apparel seems to be the "up and coming" sector of fashion to first feature technology. Look for the latest trends to materialize in accessories such as purses, bags, and shoes before evolving to garments. There is no doubt in my mind that cyberfashion will become the new craze and even revolutionize the clothing industry. It just goes to show that within the exciting and innovative field of technology, there is always something fresh and captivating, delighting the user in a multitude of capacities.

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Designs made of a jogging suit that lights up from kinetic energy during evening runs for safety and visibility by fashion students at the University College Ghent for the CyberFashion for Wellbeing Show. Designs created by 1. Julie Migneau, 2. Lieve Martens, 3. Saskia Dobbelaere, 4. Bertien Boon. Jean Luc Dejaeghere is also involved in the design team.

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Cybermind, creation of tools for Cybertherapy.

About Cybermind:

Cybermind Interactive Nederland is a young and dynamic company, founded in April 1997, and has grown to become the leading European distributor/manufacturer of Head Mounted Displays (HMDs). Using HMDs (Goggles, wearable monitors, personal displays) has a lot of advantages and creates an experience that cannot be realized with any other form of presenting images, data, or other information to the participant. Cybermind Interactive Nederland is a technology-based company that seeks to excel in producing affordable, high- end, HMDs that are durable, comfortable, and versatile. These tools are produced for professionals, can be customized according to the requirements of the application, and enable effective treatments.

The use of HMDs, and understanding their effectiveness, is widely accepted compared to instance monitors, projection surfaces, and Cave-like projection environments. Scientific research over the last few years confirms the usage and the increased effectiveness and efficiency of procedures and treatments.

Virtual Reality (VR) and Augmented Reality (AR) technology within Cybertherapy in 2008:

The unique design features of HMDs include the following: complete immersive design, lightweight, comfortable, functional, and flexible (seamless integration of microphones, cameras, sensors etc). The immersive design is also highly effective in combination with AR applications. The treatments of various phobias, including the fear of heights, claustrophobia, and the fear of flying, have proven successful. In addition, other medical applications, such as pain relief during treatment of burn wounds, are done with "traditional" VR equipment as well.

Cybermind has created their own technology and optics in order to offer high-end equipment at an affordable price to make VR and AR accessible for a wider audience. Not only can the equipment be used with many different sources (PC, cameras, DVD players etc.), but the unique technology also supports content with various resolutions and is compatible with older VGA animations combined with video segments and SXGA animated content. This is all made possible with the HMD Visette series.

The Visette 45, a top range model, complemented with Optical See-through, or combined with one of the headsets containing a camera, can open the world of AR to any user. Adding virtual objects (like spiders or fire) to real life scenery has great potential. AR can, for a variety of treatments, be more effective than the complete virtual environments that are utilized by VR.

Future expectations:

With the steps taken by Cybermind to create a technology platform and its optical system, future developments will follow at a faster pace. The last three years have been focused on the creation of a versatile platform and a transparent optical system. Creating larger Field of Views will be the most important achievement for the standard Visette range, but the possibilities for creating mobile set-ups, and lighter and more attractive designs etc. are plentiful. The focus on Field of View is important, although, using motion capture (tracking the person/object within the virtual environment) creates the experience of 360° Field of View. In certain cases, mainly in the clinical area, having sight in the periphery of the eyesight is important.

Cybermind will proceed with creating non-invasive designs with specifications (Field of View, resolutions comfort etc.) that create near-life experiences, which will increase the already impressive effectiveness of HMDs.

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Across North America...

Over the past two decades, researchers have been busy designing, developing, testing, and implementing advanced technologies to successfully help those with disorders, spanning from anxiety to addiction to phantom limb pain. Scientists throughout the world are realizing the potential for technology to enhance the medical "continuum of care" beginning with prevention, training, and education and continuing through treatment and rehabilitation. In this issue, we highlight some of the advances being made in North America.

Canada

Universities across Canada are currently conducting exciting research projects using virtual reality (VR) to assess, understand, and treat mental disorders, including anxiety disorders and eating disorders. These studies have resulted in the production of effective clinical protocols, enabling affected individuals within Canada to undergo enhanced treatment methods. The principal investigators of these various projects use a variety of technologies, such as high quality Head-Mounted Displays (HMDs), eye-tracking systems, physiological measures, and precision motion tracking.

The CyberPsychology Lab of the Universite du Quebec en Outaouais, headed by Stéphane Bouchard, recently unveiled its addition of a CAVE system; one of the few in use in the world. The University's CAVE, a 6-wall immersive room, is referred to as "Psyche" and devoted to research on VR, presence and mental disorders. Other researchers study eye-gaze patterns to assess sexual preferences among pedophiles, use a virtual bicycle to increase obese children's motivation to exercise, and validate the VR environment to test executive functioning.

United States

Across the United States, small companies and university research labs are incorporating Virtual Reality (VR) and Mixed Reality (MR) technology into more traditional medicine and therapy protocols. The combination of VR, MR, and in some cases haptics, provides for the assessment and treatment of a variety of disorders ranging from anxiety to traumatic brain injury to pain distraction. Protocols may include physiological monitoring and feedback for further training of patients or participants and objectification of results. American psychologists have developed successful protocols for the treatment of specific phobias (flying, driving, public speaking, claustrophobia, heights, and spiders), panic disorder, agoraphobia, posttraumatic stress disorder due to motor vehicle accidents, and social phobia through conducting controlled studies with VR-CBT. Telehealth is also being explored for treatment through use of avatars and Internet-based worlds.

In addition to therapy and rehabilitation, the area of stress inoculation training (SIT) for first responders and military personnel is being augmented by VR simulations and more realistic wound creation through scientific advancements. One small company, Virtual Reality Medical Center, headed by Dr. Mark Wiederhold, is working with areas as diverse as posttraumatic stress disorder, chronic and acute pain, cognitive and physical rehabilitation, and SIT. The technology is proving to be an important adjunct to established methods.

Mexico

In Mexico City, five public health hospitals have participated in VR research by using VR to reduce the distress and pain associated with invasive procedures. Led by forward-thinking physician Jose L. Mosso-Vázquez, clinicians are using a Head Mounted Display (HMD) system in order to display VR scenarios to their patients during procedures. To date, almost 500 patients have participated in the studies, with the conclusions showing that positive results are being received, through both reduced patient discomfort and reduced cost of certain procedures, since the need for pain medication and anesthesia is greatly reduced.

VR has been shown by many groups to successfully reduce pain or discomfort in a variety of less invasive procedures, such as dentistry, wound care and physical therapy. The use of VR during these procedures has led to the exploration of the potential for VR to be used during procedures of higher complexity. This is the first study to document the use of VR for complex and invasive medical procedures.

In the upcoming issues of C&R Magazine, we will continue to showcase the advances being made in other parts of the world. In the next issue, cybertherapy and advanced technologies in mental health will be examined in Asian countries.

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> **COUNTRY** FOCUS

C&R in Spain

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Many Spanish universities and clinics have begun using cybertherapy to treat mental disorders, joining an international community of researchers and clinicians. Specifically, over the past few years, the connections between Spain and the rest of the world have improved dramatically.

With the national motto of "Plus Ultra," meaning "Further Beyond," it only seems fitting that cybertherapy found its way into the Mediterranean-based country of Spain. With over 40 million inhabitants, Spain shares the highest prevalence for mental disorders in Europe with the United Kingdom. Thus, a heightened need for increasingly effective treatment for mental disorders has become evident in the Reino de España. Many laboratories and clinics in Spanish universities have developed virtual reality and advanced technology-based therapy treatments in order to better treat the increasingly large population of individuals who suffer from mental disorders.

History of Mental Health in Spain

The Proclamation of the Health Reform Law in 1985, which introduced modernity into the Spanish health care system, came with a humanitarian concern for large amounts of prevalent mental disorders in the population, ideally bringing the general care for the mentally ill to the same level of their industrialized European neighbors. Since then, mental health care has significantly improved, including the birth of advanced technologies to aid in the treatment of mental disorders.

Many agree that cybertherapy was first formally introduced to the world in 1992 at the first Medicine Meets Virtual Reality Conference; however, the use of virtual reality for the treatment of mental disorders has been distinct in Spain for just over 10 years. The Spanish Ministry of Education and Science, the Government of Catalonia, along with other regional and national agencies currently fund projects for research teams towards the application of new ICTs in clinical psychology and rehabilitation. Many award-winning projects and innovative research have risen out of Spanish laboratories and universities, placing Spain in an impressive position in the world of cybertherapy.

International Collaborations

Many Spanish universities and clinics have begun using cybertherapy to treat mental disorders, joining an international community of researchers and clinicians. Specifically, over the past few years, the connections between Spain and the rest of the world has improved dramatically. Nonetheless, Spain lacks the same budget for research and development to comparatively remain at the same level as its surrounding countries. Many researchers use international journals to disseminate their findings in an effort to globalize their studies.

The European Framework Programmes have decisively contributed to the connection of the research groups in Spain with the rest of Europe. Currently, Spanish teams are participating in some of the most important European projects in mental health, allowing Spanish laboratories to connect and collaborate with other European institutions. Select labs have ongoing collaborations with universities and research centers in Italy, the United States, the United Kingdom, Germany, The Netherlands, Portugal, Sweden, Ireland, Canada, Mexico, Colombia, Argentina, and South Africa, among others. It is not uncom-

Population (Million)	40,5	2008
Percentage of Urban Population	0,77	2006
Unemployment Rate	8,30%	2007
Life Expectancy (years)	79,9	2008
Psychiatrists (per 100,000 Inhabitants)	6	2008
Number of Universities Offering Psychology Programs	35	2008
Population Median Age (years)	39	2001
Population Self-Assessing	61.72 - 77%	2002
Health as Good Suicide Rate (per 100,000)	3,2	2005
Psychiatric Hospital Beds (per 100,000)	45.77 - 46%	2005
Fertility Rate	1.22 - 1.34%	2004
Extrapolated Prevalence to Eating Disorders (total)	740.455	2004
Extrapolated Prevalence to Schizophrenia (total)	325.800	2004
Extrapolated Prevalence to Anxiety Disorders (total)	592.364	2004

mon for Spanish clinics and universities to solicit foreign researchers as well as visit laboratories in other countries.

Research Facilities in Spain

The ability to raise funds for research has grown dramatically in Spain in recent years. Both the central government and many of the regional administrations are now aware that the investment in research and development is vital to ensure the welfare of the population. Private companies of a certain size, as well, are investing in basic and applied research. Spain is in a relatively good position in Europe, with the possibility of FEDER funds, which have been a notable help towards the development and update in many domains, including research. National agencies normally fund equipment and personnel for furthering research. Nonetheless, constant funds are needed due to the high-speed evolution of the cutting edge systems and platforms as well as other essential equipment such as HMDs, projectors, sound systems, informatics, head position trackers, and eye tracking displays.

Universities work hand-in-hand with clinicians, realizing the support needed for ICT projects. Cooperation and mutual enrichment make Spanish laboratories' research improve and become more enjoyable. In general there is a very good relationship between the universities and the research labs that operate within them. Collaboration between well-connected Spanish colleagues has also been beneficial for most Spanish universities with projects such as CONSOLIDER, which includes seven participating universities as well as CENIT, which links Spanish universities and enterprises.

EU Funded Projects

EU funded projects and funding is one of the best ways to obtain adequate resources that will enable Spain to reach levels of scientific output of high quality. The possibility of collaborating with first line researchers and to participate in the joint effort of developing scientific knowledge is key for Spanish laboratories. Extending and disseminating knowledge and research is of the highest priority. However, some groups hesitate to take advantage of EU funded projects because of the complexity and time needed to set up a consortium, a proposal, and finally manage the administrative tasks associated with the projects, preparation of reports, etc.

Research Areas

Many distinguished studies are being explored in Spain, promising future exemplified results. Areas of current study include:

- **Theoretical and methodological topics including:**
  - Reality judgment and sense of presence in virtual environments
  - Learning in virtual environments and learning transfer
  - Design and development of psychological assessment tools based on ICT
  - Development of mood induction and mood change experimental procedures
  - Experimental procedures for subliminal perception in virtual environments.

- **Advances in the utility of technological developments in clinical psychology including:**
  - Environmental Intelligence
  - Augmented reality without traces
  - Autonomous agents
  - D systems in real time on ICT mobiles
  - RFID sensors
- **Psychological disorders and other psychological problems including:**
  - Development and consolidation of technological applications for the assessment and treatment of anxiety, eating disorders, child mental disorders, adjustment disorders and grief, and problems related to violence and aggressiveness
- **Physical and health problems including:**
  - Development consolidations of technological applications for the assessment and treatment of pain management
  - Palliative treatment for restricted mobility people
  - Palliative treatment of cancer
  - Cognitive rehabilitation in cognitive disorders
- **Quality of life and wellbeing in the elderly enhancing e-inclusion solutions**
- **Advances in psychopathology and psychological treatment of several mental disorders including:**
  - Anxiety disorders
  - Mood disorders
  - Somatoform disorders
  - Adjustment disorders
  - Substance-related disorders
  - Impulse control disorders
- **Kansei engineering and product evaluation**
- **Basic perceptual processes**

Spanish Projects in the Spotlight

Some significant projects to come out from Spain are: "Development and Application of Technologically Advanced Methods Based on Virtual Reality for Attention-Diversion, Visualization and Body Image Modification, and Adjunct Analgesic Techniques Against Chronic Pain", and the EU funded EMMA Project (Engaging Media for Mental Health Applications).

The first project consists of 19 researchers, deriving from the University of Barcelona, the University Jaume I, the Hospital Provincial de Castellón, the University of Valencia, the Polytechnical University of Catalonia, and the University Miguel Hernández of Alicante for a three-year collaboration. The gathering of these groups to carry out this project has given birth to one of the most efficient teams in the field of virtual reality applied to health disorders and disease.

The latter of the two projects, EMMA, developed a mood induction procedure that effectively changes the users' mood and has been proven to be useful in basic and clinical research. An adaptive display was developed during this project for the delivery of psychological treatments in complex mental disorders. This display has been effective in the treatment of post-traumatic stress disorder, complicated grief, and adjustment disorders.

The Future of ICT Research in Spain

It is agreed that the future is limitless in Spain due to its efficiency and future collaboration possibilities. Physical and mental health, health in the workplace, leisure, and general wellbeing are among several possibilities for the future. CyberTherapy in Spain has left its mark on the world and the world looks back with interest as future research emerges. With future collaborations with European and international partners, advances in cybertherapy will continue to flourish in la España soleada.

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