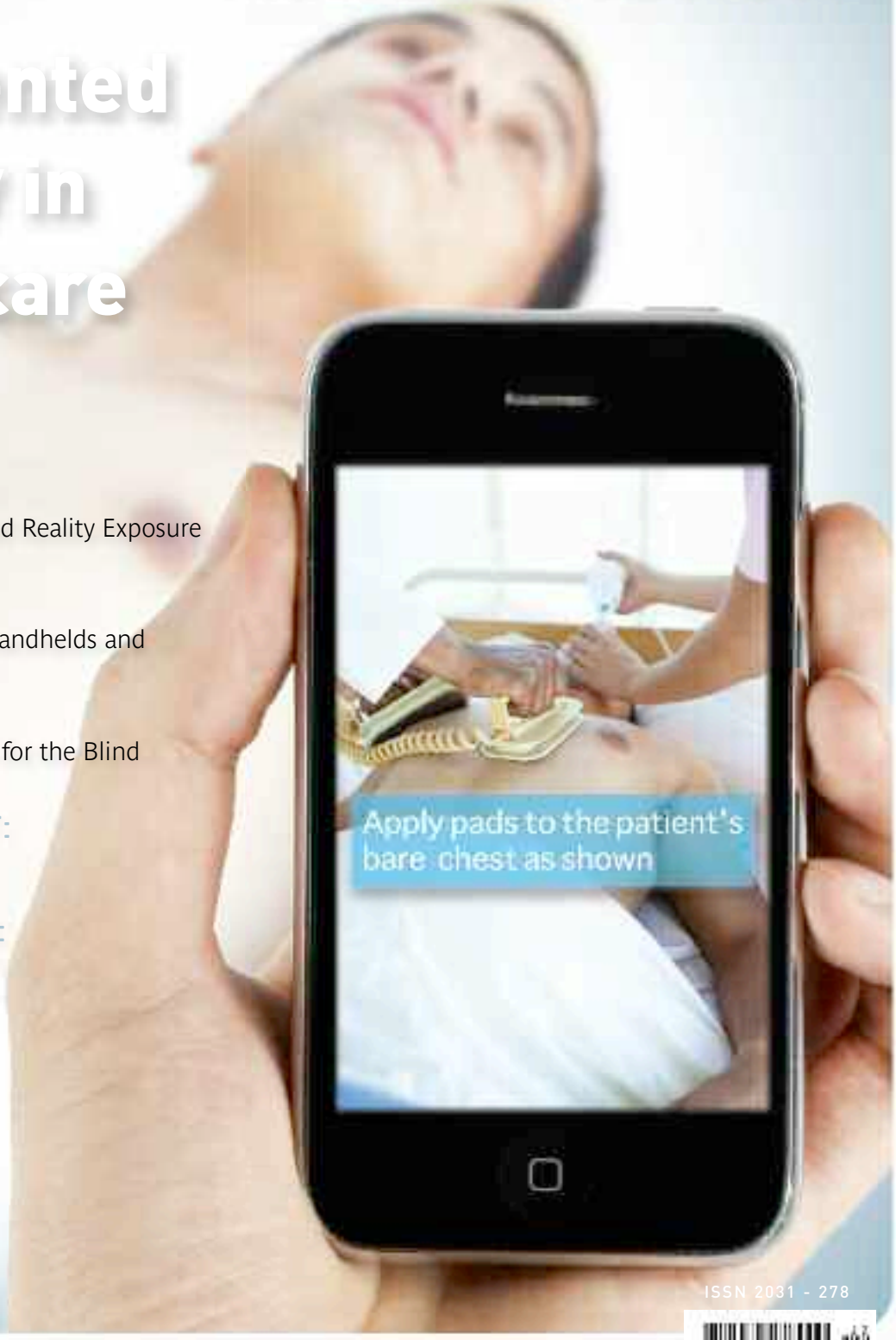
CyberTherapy & Rehabilitation

Issue 1 / 2012

The Official Voice of iACToR

COVER STORY:

Augmented Reality in Healthcare



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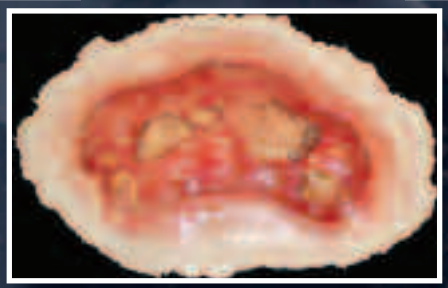

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Letter from the Secretary General and Editor-in-Chief

Professor Dr. Brenda K. Wiederhold

"While AR applications were developed as early as the 1960s, the cost of systems and the expertise needed to use them has limited their adoption in the past. Now, thanks to the ubiquitous smartphone, developers have a low cost of entry for this type of AR."

Dear Reader,

Augmented reality (AR) allows interactivity of both Virtual Reality and real-world elements. Some users wear special glasses that allow them to see the world as it is, as well as computer-generated objects that appear as display supplements to the real-world elements, as in the augmented optics or endoscopes in AR-assisted surgery. Other users may be in a specially designed room featuring image projections on objects, as in a factory in which assembly instructions are superimposed on component parts. Still others may use GPS-tracked smartphones with cameras as the input device, such as to take virtual tours of buildings, with information about office space for rent in them available in real time as the person arrives at that location.

But with so much information coming at us these days, what is the real benefit of AR? If texting while driving is such a distraction that it is banned in many U.S. states, will drivers using AR systems designed to improve safety experience distractions that will cause the accidents they are designed to prevent? Or is AR better used for entertainment, as shoppers use a smartphone app of a virtual pop-up store in different locations to "try on" different outfits and post them to Facebook?

While AR applications were developed as early as the 1960s, the cost of systems and the expertise needed to use them has limited their adoption in the past. Now, thanks to the ubiquitous smartphone, developers have a low cost of entry for this type of AR. Thanks to social networking, crowd-sourced content posted to "the cloud" creates large databases that developers can call upon to populate the fields in their applications. And thanks to the pervasiveness of computing in modern life, smartphone users have come to expect the ability to move about in the real world and simultaneously view an information overlay that seamlessly integrates data from a number of sources.

Among the first applications to show benefit were those in medicine. A recent review concluded that, "After two decades of research on medical AR the basic concepts seem to be well understood and the enabling technologies are now enough advanced to meet the basic requirements for a number of medical applications … A perfect medical AR user interface would be integrated in such a way that the user would not feel its existence, while taking full advantage of additional in situ information it provides … The AR window and video-see-through HMD systems still need hardware and software improvement in order to satisfy the requirements of operating physicians … medical AR will be one of its first killer applications, saving lives of many future patients."

"While medical uses of AR may set the highest bar for development, related uses are coming online. For example, for medical training, for which VR has long been used, the advantage of AR over VR systems is that they offer realistic haptic feedback while providing objective assessment of skill."

While medical uses of AR may set the highest bar for development, related uses are coming online. For example, for medical training, for which VR has long been used, the advantage of AR over VR sys-

Letter from the Secretary General
(continued from page 1)

tems is that they offer realistic haptic feedback while providing objective assessment of skill.

In addition to helping adult learners such as physicians, AR may also be used to help children to learn. A recent study used AR in combination with three types of physical exercise to enhance non-memorized learning, and showed that physical exercise did not detract from ability to complete cognitive tasks. In addition, the authors of a review of AR-assisted learning concluded, "The students we work with are already using their cell phones seamlessly to communicate and share information with their peers throughout the day. The findings from this study emphasize how engaged students become simply by using similar tools to learn."

"A recent review concluded that, "… A perfect medical AR user interface would be integrated in such a way that the user would not feel its existence, while taking full advantage of additional in situ information it provides … medical AR will be one of its first killer applications, saving lives of many future patients."

AR may also be used for different types of therapy. "TheraMem is a novel system which combines Augmented Reality, a simple computer game, and spatial-visual decoupling of the user's hands for use in post-stroke rehabilitation. The system is considered to be mature and usable in the early stages of stroke recovery." Another system still in development uses AR to help patients conquer fear of spiders and cockroaches, using a camera to put the patient in a real location and realistic sounds such as a spray can of insecticide or a squishing sound when a pest is killed.

Tracking an individual's whereabouts opens the door for many uses of AR. For example, a museum education system uses a markerless pose estimation algorithm to guide a tourist to superimpose a displayed AR painting, with information that enhances the tourist's understanding of the creative process, on the corresponding real-world painting. In the homes of people who have set up a home computer network, a program for the Android platform could track the WiFi signal of an individual's smartphone to determine her location in the home. Outdoor tracking is more of a challenge, since GPS does not have the precision and refresh rate required, but researchers are working on methods such as multi-sensor fusion that integrates inertial and vision tracking to meet those requirements. A combination of both indoor and outdoor AR tracking with coordinated alerts could help return wandering Alzheimer's patients safely to their homes.

So it seems that while entertainment is one possible use, AR is certainly not limited to that domain, but can help us stay healthy and improve outcomes when we need surgery. And what about that question about distraction while driving? Even that is being addressed: New tracking algorithms that help car systems estimate the head pose of a driver will enable systems to infer the driver's focus of attention, triggering alerts and saving lives.

Create your own reality!
Brenda Wiederhold

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iACToR is the official voice and resource for the international community using advanced technologies in therapy, training, education, prevention, and rehabilitation.

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Our mission is to bring together top researchers, policy makers, funders, decision makers and clinicians, pooling collective knowledge to improve the quality, affordability, and availability of existing healthcare.

Ultimately, through international collaboration with the most eminent experts in the field, we are working to overcome obstacles and increase access to top-quality healthcare for all citizens. By enhancing public awareness of the possibilities that technology offers, we move toward changing and improving healthcare as it currently exists.

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INTERSTRESS

Interreality in the Management and Treatment of Stress-Related Disorders

INTERSTRESS is a European-funded project

The INTERSTRESS project aims to design, develop and test an advanced ICT-based solution for the assessment and treatment of psychological stress.

Objectives:

- Quantitative and objective assessment of symptoms using biosensors and behavioral analysis
- Decision support for treatment planning through data fusion and detection algorithms
- Provision of warnings and motivating feedback to improve compliance and long-term outcome

To reach these goals, INTERSTRESS will use a new e-Health concept: Interreality. What is Interreality? It is the integration of assessment and treatment within a hybrid, closed-loop empowering experience, bridging physical and virtual worlds into one seamless reality.

- Behavior in the physical world will influence the virtual world experience
- Behavior in the virtual world will influence the real world experience

These goals will be achieved through:

- 3D Shared Virtual World role-playing experiences in which users interact with one another
  - Immersive in the healthcare centre
  - Non-immersive in the home setting
- Bio and Activity Sensors (from the Real to the Virtual World)
  - Tracking of emotional/health/activity status of the user and influencing the individual's experience in the virtual world (aspect, activity, and access)
- Mobile Internet Appliances (from the Virtual to the Real world)
  - Social and individual user activity in the virtual world has a direct link with user's life through a mobile phone/PDA

Clinical use of Interreality is based on a closed-loop concept that involves the use of technology for assessing, adjusting and/or modulating the emotional regulation of the patient, his/her coping skills and appraisal of the environment based upon a comparison of the individual patient's behavioural and physiological responses with a training or performance criterion. The project will provide a proof of concept of the proposed system with clinical validation.

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Augmented Reality for Exposure Therapy

By overlaying virtual content on the real world, Augmented Reality has great potential for exposure treatment. By interacting with a representation of a specific stimulus, such as spiders, the therapist is easily able to control the level of exposure experienced by the patient, leading to reduced levels of anxiety. The virtual stimulus not only appears to be moving in the real world, but also reacts and adapts to the a client's presence and actions, making therapy even more effective.

Manipulative Augmented Virtuality

Mixed reality display and tracking technologies have begun to spread into the mass market and have a great potential to be applied to various healthcare applications. Research has shown promising leads in the potential of applying manipulative augmented virtuality for individuals who have trouble walking . These developments could lead to enormous potential for rehabilitation, diagnosis and treatment of various disorders.

Conference Participation Report

Medicine Meets Virtual Reality (MMVR) 19

Newport Beach, California
February 9-11, 2012

At the 19th Annual Medicine Meets Virtual Reality Conference (MMVR19) held on February 9-11, 2012 in Newport Beach, California more than 300 participants from 20 countries presented and assessed groundbreaking developments in simulation, modeling, imaging, robotics and other emerging tools for patient care and medical education. Conference organizer Aligned Management Associates, Inc. (AMA) have organized the 3-day conference since 1992 to focus on improved precision, efficiency, and outcomes in patient care, practitioner training, and public health. This year, AMA invited physicians, surgeons and other medical professionals interested in emerging tools for diagnosis and therapy to attend and present their research.

In addition, included in MMVR19's scientific program was an opportunity for attendees to discuss their Virtual Reality (VR) modalities in medicine, mental health, rehabilitation, robotics, engineering, biomedicine and education. Many mental health providers met to share their efforts using VR and advanced technological approaches in clinical and research settings.

Members of INTERSTRESS (Interreality in the Management and Treatment of Stress-Related Disorders) and the International Association of CyberPsychology, Training & Rehabilitation (iACToR), as well as board members from C&R and the Journal of CyberTherapy & Rehabilitation, were in attendance during conference proceedings, and enriched the meeting with their contributions and presentations on their current lines of research.

A notable presentation was given during the Physical & Mental Health Application symposium which included a presentation from iACToR's President Giuseppe Riva on "The Effects of a Mobile Stress Management Protocol on Nurses Working with Cancer Patients: A Controlled Study." Regarding his presentation, Riva said, "Oncology nurses face extraordinary stresses that may lead to emotional exhaustion, a feeling of emotional distance from patient and burnout. This presentation ... [demonstrates] a significant improvement in affective change in terms of anxiety trait reduction and coping skills acquisition at the end of the protocol."

Figures: Attendees at the conference were able to interact with a wide range of exhibits.

A spokesperson from AMA, Inc. remarked at the conclusion of the conference, "Our thanks to everyone who participated in MMVR19/NextMed! The conference was definitely a success. We received numerous compliments on the program, its relevance, focus, and engaging diversity. We extend particular gratitude to all who shared their research to make the program valuable."

For more information on Allied Management Associates, Inc. or on future Medicine Meets Virtual Reality Conferences please visit http://www.amainc.com/

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Augmented Reality:

What is it and *How is it Enhancing Healthcare Today?*

Augmented Reality, in some ways seemingly bigger-than-life, combines digital information with a view of the real world in a way that best suits the user to augment the view of their surroundings. Used by pilots in the military and investigated by researchers since the 1990s, it is now becoming more widely used and explored in the medical arena.

By Mark D. Wiederhold & Brenda K. Wiederhold

While Virtual Reality (VR) has been a more established field of research for some time, Augmented Reality (AR) is a slightly newer field of research whose popularity, rate of use, and applicability to various uses has literally exploded with the increased usage of smartphones around the world. While readers are likely familiar with the term "apps" – applications downloaded to enhance the usability of a smartphone – the interpretation of AR may not be so clear cut. Questions include: What is AR? What does it encompass? And what are its applications?

What is Augmented Reality?

While VR aims to immerse the user in a purely virtual world, AR attempts to bring virtual elements to the real world. It is best described as an "AR Continuum" in which the real and virtual environments are placed at opposite ends with AR and augmented virtuality (AV) towards the middle.

AR can be defined as "the art of superimposing of computer generated content over a live view of the world" according to Dan Sung, a Pocket Lint blogger who writes on the subject. The viewer's real-time view of either the real, surrounding environment or streaming video is fused with digital information. The paramount advantage of AR over VR is that it creates an altered or augmented reality without losing the benefits of the physical setting – touch, smell, hearing, taste, and visual contact with other people.

How does it Work?

Combining real and digital elements can be done in one of three ways: using a Head-Mounted Display (HMD), placing the visual information close in front of the user's point of view; using handheld devices, most commonly smartphones and tablets; and computer-generated overlay that is placed directly on real objects using projects or devices known as Spatial Displays. Each method has distinct advantages and disadvantages.

While HMDs have been thoroughly researched and developed, leave the user's hands free and the entire visual field is augmented, the hardware can be distracting, bulky, and expensive. Handhelds are

"Although enhanced visualization is most commonly brought to mind when discussing AR, it is important to remember AR can hypothetically be used to enhance any of the senses, for example, with haptics feedback to alter the sense of touch. Still, the field of augmented vision is currently experiencing the most growth and potential for applications in various fields."

convenient, cheap and commonly carried by the majority of users, yet require the user to give up the use of a hand and the field of view is limited and framed. Viewing Spatial Displays means more than one user is exposed to the same picture and participants don't need to hold or wear anything, but the projections only work with specifically designed environments and again, set-up costs and specialized hardware can be costly and daunting.

Although enhanced visualization is most commonly brought to mind when discussing AR, it is important to remember AR can hypothetically be used to enhance any of the senses, for example, with haptics feedback to alter the sense of touch. Still, the field of augmented vision is currently experiencing the most growth and potential for applications in various fields.

"A concern voiced by medical experts is that this focus on technology may draw attention away from important cues that are present in the natural environment, leading to an over reliance on enhanced visualization and actually increasing the numbers of errors occurring during surgical planning and treatment."

Augmented Reality In Medicine

Austrian mathematician Steinhaus first described an augmented system to visualize a piece of metal embedded within tissue in 1938 when medical practitioners began envisioning ways in which real-time x-ray vision would make it possible to visualize patient data within the same space as the patient. In 1968 Ivan Sutherland described the first HMD and in the '90s research into medical applications of AR began in earnest.

Essentially, the clinical applications of AR in medicine are made up of two types of systems. As Dr. Andreas Pusch states, "On the one hand, there are systems in which synthetic multimodal head-up information is overlaid on tracked real objects (e.g., patient history and rehabilitation progress data, or specific information attached to certain body parts) while on the other hand, others permit direct guidance and training of surgeons and therapists by means of interactive co-located real-time simulations (e.g., visuo-haptic remote navigation of inspection or surgery equipment, annotations of regions to operate on, 2-D/3-D visualizations of hidden organs and structures)." For an in-depth look at Pusch's full article, see page 20.

Graphics can be overlaid on patients' bodies to identify organ placement, internal tissues, veins and arteries, and aid in the placement of stents and catheters, for example. The widespread use of smartphones has made the devices an informal tool in the clinic; practitioners can now position an iPhone over an ankle joint to readily view internal angles of bones and ligaments using a specialized app.

Not all applications of AR in medicine are aimed at care providers; the growth in apps has made smartphone users able to easily and cheaply educate themselves on medical topics and terminology.

Early in its development, researchers saw the potential for this technology to supplement healthcare. In order to be a widely used tool, however, it needs to be "scalable," that is, deliverable within the constraints that exist outside the lab. This is where smart phones are quickly bridging the gap. Quick Response (QR) codes and Near Field Communication (NFC) are two similar ways of allowing smart phones to interact with the real world. Like bar codes but able to contain much more information, QR codes are made up of black modules in a square pattern on a white background which can be printed on posters, newspaper advertisements, tickets, etc.

Pointing a camera phone enabled with a scanning app at a QR code can bring up many different kinds of data including coupons, videos, and Websites that open in the phone's browser. NFC, on the other hand, lets smart phones and similar devices establish radio communication with each other by touching them together or merely bringing them close to each other. Communication can also be designated between an NFC device and an unpowered NFC chip, called a "tag." Contactless payment systems ("virtual wallets") have attracted the most interest in the area of NFC. However, most smart phones are not yet NFC enabled.

Limitations

While it is doubtless that AR enhances the world of medical research and treatment, there is still room for vast improvements. Ideally, AR will be seamlessly integrated into the real world – free of distractions and almost imperceptible to the user.

Still, a concern voiced by medical experts is that this focus on technology may draw attention away from important cues that are present in the natural environment, leading to an over reliance on enhanced visualization and actually increasing the numbers of errors occurring during surgical planning and treatment.

Advantages and Future Research

While the growth of VR in the medical arena has been stunted due to the high costs of equipment, as well as clunky, cumbersome HMDs, one of the appeals of AR, particularly when coupled with a smartphone, is the ease-of-use, low cost and immediate accessibility to the needed software. These advantages will further speed its inception into everyday clinical practices.

Before VR and AR see widespread use for healthcare management, though, certain

legal and regulatory issues will need to be addressed. Privacy of medical information is probably the biggest concern of potential end users. Telemedicine raises questions about how to regulate medical treatment across state boundaries, including licensure and malpractice issues.

Despite these issues, the benefits of VR and AR for healthcare management have enormous potential, including improved training, better access to services, and increased cost-effectiveness and accuracy in performing certain procedures. Healthcare organizations and providers will require proof of these improvements before adopting these technologies. But, ultimately, the continual improvement of VR and AR technology will pave the way for its permanent integration into surgery, healthcare delivery, and medical education.

AR technology is still a young field with limitless room to grow and incorporate enhancements. As it improves and becomes more widely adopted, the clinical applications will continue to multiply.

While AR has not yet broken through to be used in everyday technology, the newly released Google Glasses are paving the way for mass adoption and implementation of AR. The product is creating waves in the scientific community and public consumer base alike. Looking to the future of AR, one thing is sure: the world of medicine will never be the same.

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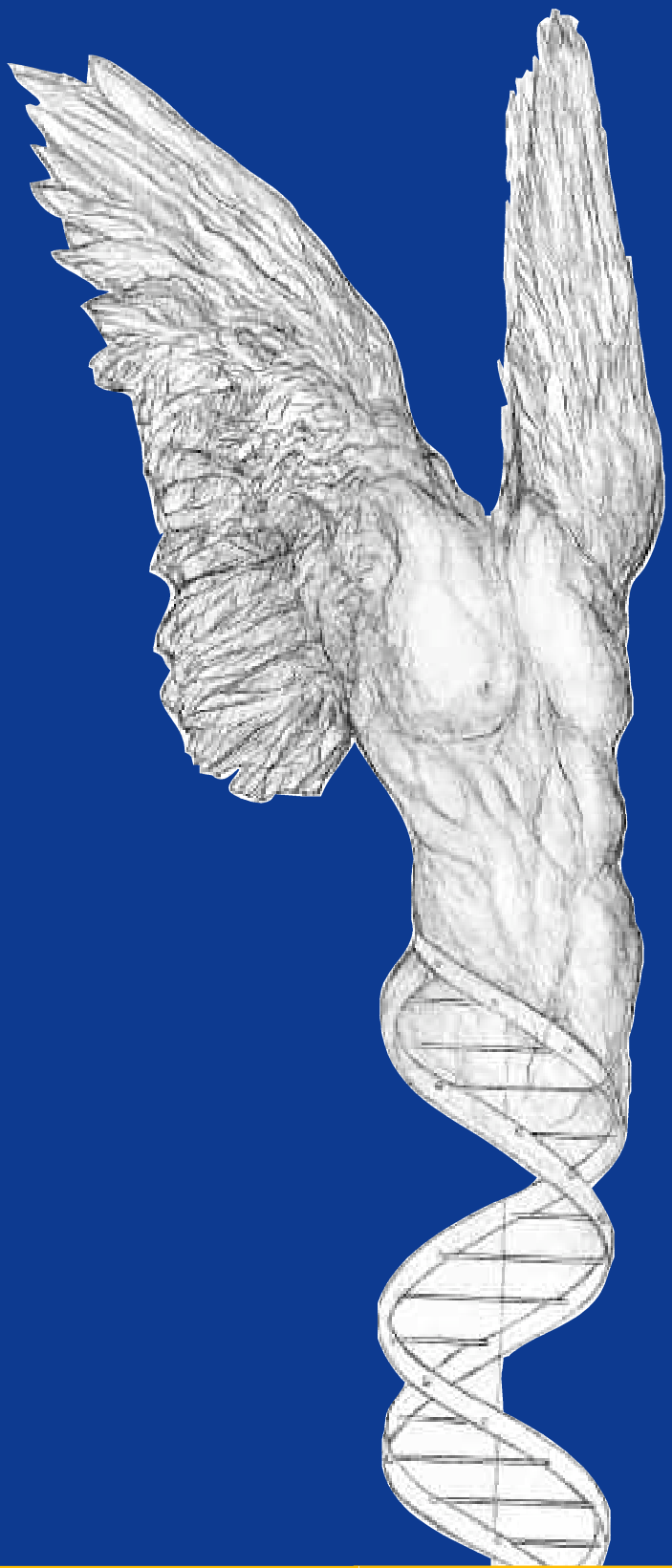

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Since 1992, NextMed / MMVR has promoted novel, interdisciplinary, data-enabled solutions to healthcare challenges. The conference fosters collaboration among scientists, engineers, physicians, therapists, educators, and students. Its outcome is tangible progress in clinical care, provider training, and patient-enabling technologies.

Next February's conference will feature a special half-day symposium, "VR for Therapy & Rehabilitation: Two Decades' Accomplishments and Future Directions," organized by Professors Brenda Wiederhold, Mark Wiederhold, and Giuseppe Riva.

The Call for Presentations is open through July 15, 2012. Researchers are invited to participate in NextMed / MMVR20 with papers, posters, and independent activities. Details at:

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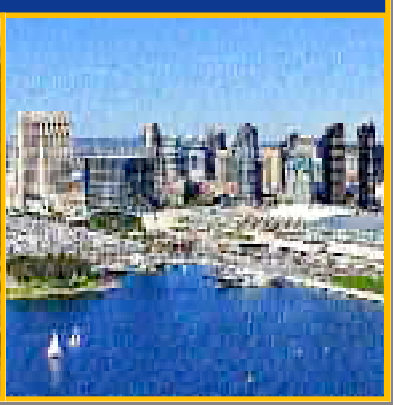

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Interactive Augmented Reality Exposure Treatment

"We are creating a new type of highly interactive augmented reality-based exposure therapy system to treat specific phobias. Extending on previous work, we focus on creating a visually naturalistic therapy context. We aim at developing a very life-like system that allows patients to interact with virtual stimuli."

By Andreas Dünser

Augmented Reality (AR), a technology that overlays virtual content on the real world, has great potential for exposure treatment and in some cases may be more efficient and cost effective than Virtual Reality (VR). An environment that combines real and virtual elements seems to be especially suitable for such treatment because it enables displaying virtual fear stimuli in the real world.

Another benefit of using an AR system in exposure treatment is that it allows patients to use their own body to interact with the stimuli. However, this type of interactivity has so far not been fully implemented in AR-based exposure therapy systems. Still, studies have found that these systems are capable of inducing high levels of anxiety which is a necessary prerequisite for such a system to be effective. Considering that a virtual stimulus could not just move in the real word but also react and adapt to the client's presence or actions (e.g., gestures) might make it even more effective for therapy.

We are developing an advanced interactive AR exposure therapy system that provides a high quality experimental test-bed and allows us to study the potential of using non-disruptive and interactive AR as a tool for exposure therapy. The novelty of our system lies in better integrating the real environment and the user into the system, using user actions/behavior as a control input to the system and creating a naturalistic environment. Our development is guided by the following aspects:

• Stable low cost hardware setup with off the shelf components

• Natural environment: Creation of a less disruptive and more "life-like" environment with using advanced tracking technology

• Environment recognition: Having virtual stimuli interact with the real environment and the client's actions to further enhance interactivity and realism

Our first system integrated most of these aspects. This system allowed users to see and interact with virtual stimuli in a naturalistic environment. Using planar Natural Feature Tracking allowed us to display virtual stimuli on any sufficiently textured surface of the environment without the need for additional visual markers or tags. Interaction was supported through hand interaction above this surface, using a vision-based hand tracking algorithm and a basic gesture recognition technique.

However, the vision-based approach for tracking the user's hand had some limitations. Therefore, we integrated the Microsoft Kinect into our AR system. The

"Using this information, we can make the virtual stimuli 'react' to the real environment and therefore create an even more realistic therapy environment. A virtual spider now can walk up, around, or behind real objects, and better react to user actions."

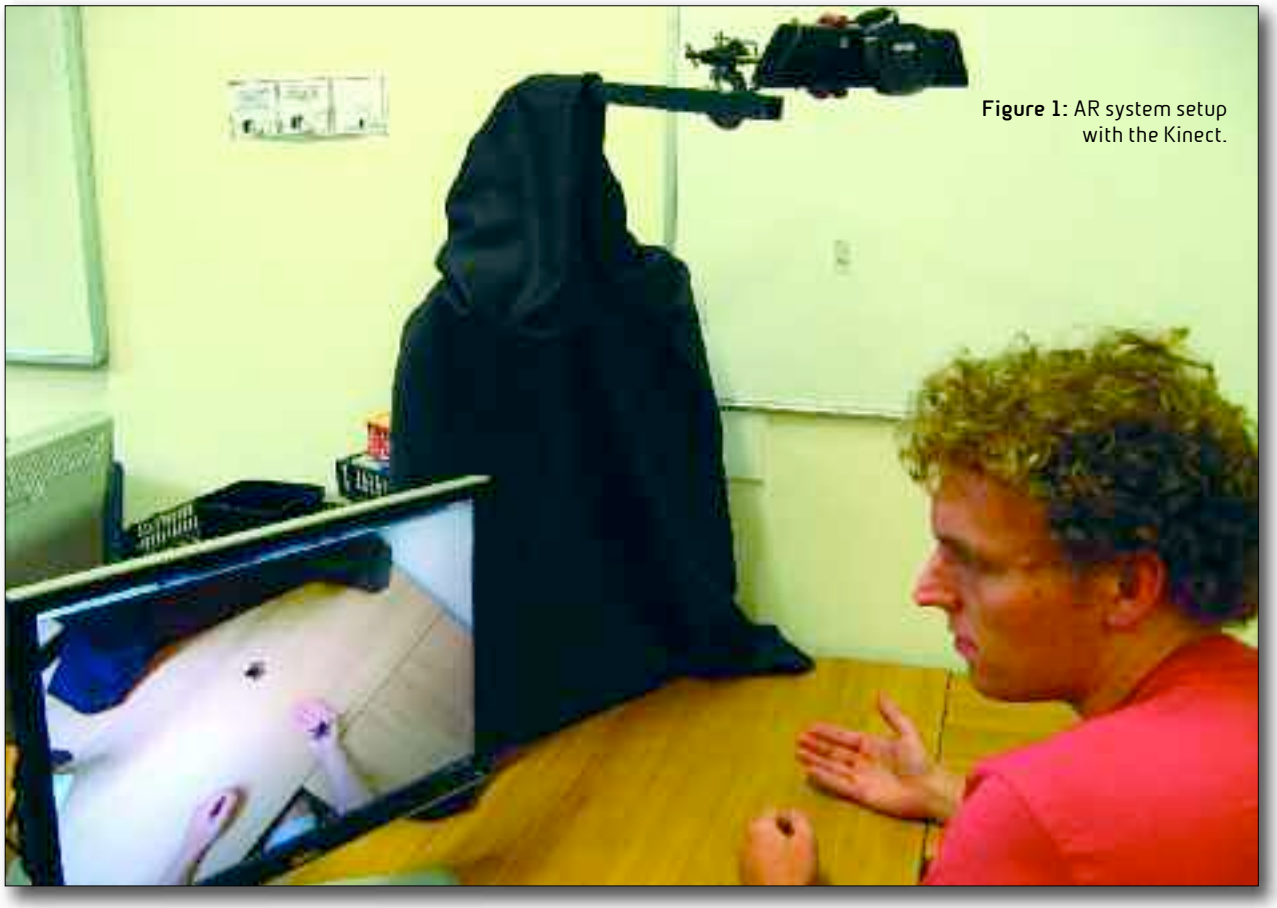
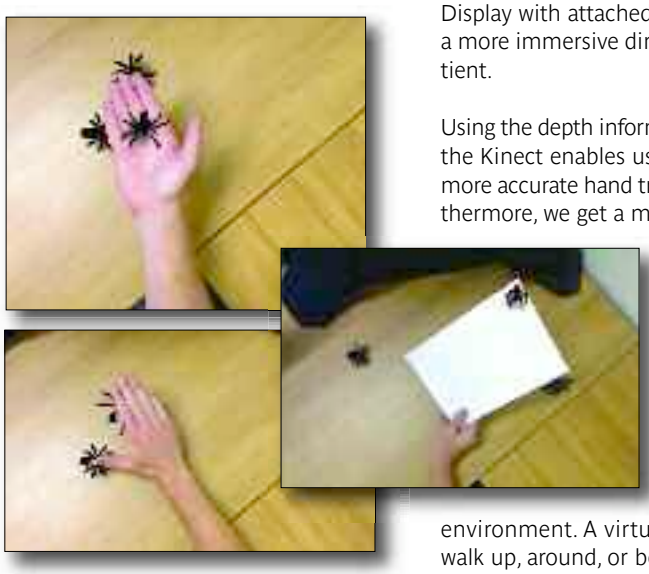


Figure 1: AR system setup with the Kinect.

Figure 2: Different ways of interacting with virtual spiders.



setup in Figure 1 shows a basic setup using the Kinect's camera image for tracking. However, the system can also be setup using an additional Head Mounted Display with attached camera providing a more immersive direct view to the patient.

Using the depth information provided by the Kinect enables us to get better and more accurate hand tracking results. Furthermore, we get a more accurate model of the user's environment. Using this information we can make the virtual stimuli "react" to the real environment and therefore create an even more realistic therapy environment. A virtual spider can now walk up, around, or behind real objects, and better react to user actions. For example (depending on the therapy stage and goals), a virtual fear stimulus can show approaching behavior to a patient's hand, avoidance behavior, react to movements, be (partially) occluded by the patient, or even sit on the patient's hands and follow their movements (see Figure 2). These elements create a more immersive and believable experience for the patient.

Future evaluation studies will focus on investigating the benefits of creating a more realistic AR-based exposure treatment environment and the effectiveness of such advanced interactivity.

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Manipulative Augmented Virtuality for Modulating Human Perception and Action

"Recently, Mixed Reality display and tracking technologies have begun to spread into the mass market and now enable a variety of promising healthcare applications ... Our research focuses on static and dynamic manipulations of a user's perception and action during body and limb movement, locomotion, as well as during interaction with multimodal virtual and augmented real environments."

By Andreas Pusch & Frank Steinicke

Mixed Reality (MR) display and tracking technologies, as well as associated interaction techniques, evolved rapidly. Recently, they have begun to spread into the mass market and now enable a variety of promising healthcare applications, some of which are already being applied in medical practice.

The current streams in healthcare can be summarized as follows:

On the one hand, there are systems in which synthetic multimodal head-up information is overlaid on tracked real objects (e.g., patient history and rehabilitation progress data, or specific information attached to certain body parts) while others permit direct guidance and training of surgeons and therapists by means of interactive co-located real-time simulations (e.g., visuo-haptic remote navigation of inspection or surgery equipment, annotations of regions to operate on, 2-D/3-D visualizations of hidden organs and structures). In the context of mental and motor disorder treatment, patients are presented with highly controllable MR stimuli (e.g., protocols for cognitive and sensorimotor function assessment, [self-]perceptual illusions, and phobic or otherwise mentally or emotionally stressing situations) whose re-

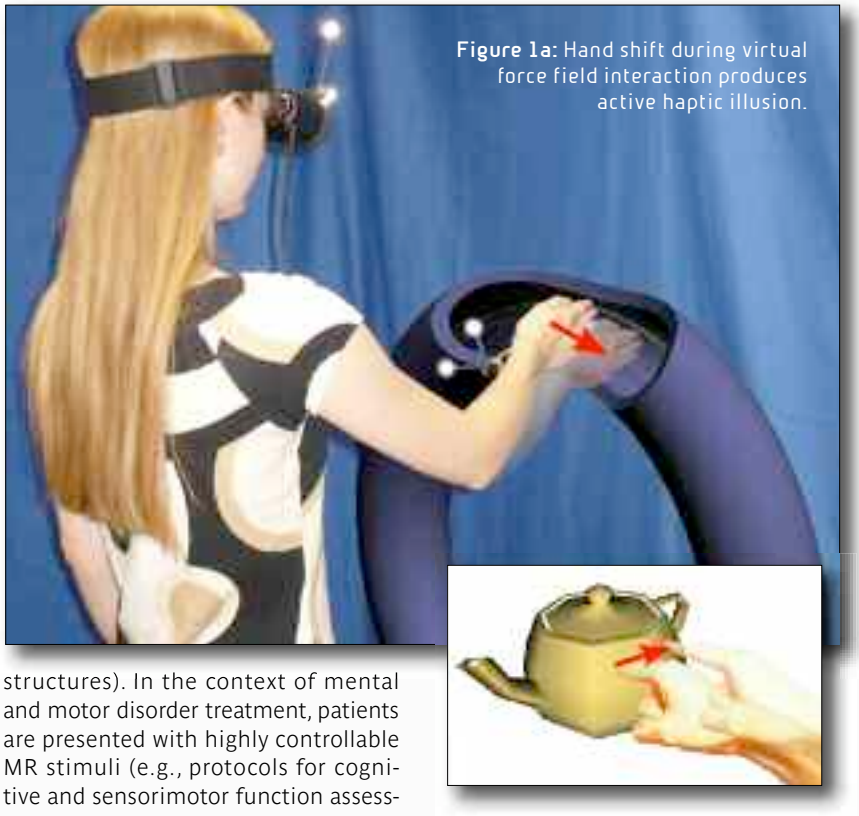

Figure 1a: Hand shift during virtual force field interaction produces active haptic illusion.

Figure 1b: Visual object penetration prevention conveying realistic virtual shape cues.

sponses are monitored and evaluated.

Our research focuses on static and dynamic manipulations of a user's perception and action during body and limb movement, locomotion, as well as during interaction with multimodal virtual and augmented real environments. Within Milgram's reality-virtuality continuum, it is "Augmented Virtuality" (AV) that fits our methodology best, because we bring the real to the virtual rather than the other way around (the latter being called Augmented Reality, AR). That is, we seek to transfer the user's body to the virtual world – and there gain full control over its multimodal manifestation.

"There are systems in which synthetic multimodal head-up information is overlaid on tracked real objects, while others permit direct guidance and training of surgeons and therapists by means of interactive co-located real-time simulations."

In 2011, we have presented a system that is capable of introducing visuoproprioceptive conflicts at the hand and lower arm levels in a very flexible way. Video of a user's limbs is first captured using stereo cameras built into a head-mounted display (HMD) and then embedded into a purely virtual world.

This self-representation can be shifted in 3-D and, though not reported so far, be scaled in place and shaded differently while interacting with virtual objects or avatars. As shown in Figures 1, the system proved useful for self-perception studies and the evocation of haptic illusions. But it can do more: Unconscious hand movement guidance and error correction in people with limited manual abilities, enable studies on static and dynamic multisensory conflict processing in healthy and neurologically impaired subjects; offer a framework for the investigation and treatment of phobic behavior involving a subject's own hands (e.g., Chiraptophobia, Ablutomania and -phobia); simulate dynamic prism glasses; and develop better accessible or assistive user interfaces (UI). A more sophisticated system offering full control over all parameters of the perceived "self" is what we are now about to conceive.

Figure 2: Fully immersive pit environment for conducting phobia experiments (left); Realistic self-representation brought to the pit environment (right).

Manipulative AV approaches can also be applied during locomotion. In healthy people, while walking in the real world, sensory information from the vestibular, proprioceptive and visual systems, as well as efferent copy signals, produce consistent multisensory cues. But various impairments ranging from lower level perceptual to cognitive, can make it very difficult to maintain orientation and explore the world by walking naturally . It has been demonstrated that users tend to unwittingly compensate for small perceptual inconsistencies. For instance, manipulations applied to the view in an AV environment cause users to unknowingly compensate by repositioning and/or reorienting themselves. Since 2008, we have performed a series of experiments in which we analyzed how much users can be guided on a different path in the real world in comparison to the perceived path covered in the AV environment. In this context (see Figure 2) we found that an AV self-representation of the user, that is, a visual high-fidelity video-based blending, further improves the sense of presence during walking. Hence, Redirected Walking techniques provide an enormous potential for the diagnosis and treatment/rehabilitation of disorders affecting, for instance, the acquisition and maintenance of spatial maps, the production of locomotor commands, actual walking, and a broad diversity of related everyday cognitive activities.

In conclusion, we believe that the principles of MR have the potential to sustainably stimulate fruitful multidisciplinary research and to contribute to an even faster growth of innovative, future-oriented healthcare applications. We look forward to being a part of this endeavor.

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2. Download and install the Junaio application.
3. Run Junaio, either search for "CityViewAR", or hit the Scan button, scan the Junaio QR Code to the right.
4. If you scanned the Junaio QR code, hit "Open" when the scan succeeds.

junaio

Augmented Reality

Handhelds and Mobile Devices

"Many healthcare companies seek to provide their services to patients and healthcare professionals alike by means of creating smartphone applications that are both user- and wallet-friendly. The young mobile health market raked in $718 million in 2011 solely from profit on smartphone apps, over a sevenfold increase from the $100 million profit in 2010."

By Allison Ines

As of July 2011, 35% of mobile users own smartphones and it is widely accepted that all mobile users will own smartphones by the end of this decade. Many healthcare companies seek to provide their services to patients and healthcare professionals alike by means of creating smartphone applications (apps) that are both user- and wallet-friendly. The young mobile health (mHealth) market raked in $718 million in 2011 solely from profit on smartphone apps, over a sevenfold increase from the $100 million profit in 2010.

Many sophisticated apps are penetrating the mHealth market as companies begin to incorporate Augmented Reality (AR) technology into their services. AR implements technology to analyze our sensory perceptions and is considered a "mixed" or "mediated" reality because the technology adds virtual overlays in real time. AR is comprised of three basic elements – a computer processor, camera and display – and it is for this reason that smartphones serve as an ideal candidate for the distribution of handheld, AR medical services.

Prior to the addition of smartphone medical apps, quick response (QR) codes served as the backbone of the mHealth market. QR codes are a type of data matrix barcode that can be read with a cell phone camera to access information about the object it is affixed to. Among other uses, QR codes may be placed on medication labels to provide pharmacy and physician contact information and identify specific drug reactions; on food and drink packages to present interactive calorie counters; and on medical devices/monitors to offer how-to information in text, audio and video form.

"Another important concern is the ***potential over-reliance on the AR system itself****: important cues from the environment might be missed, proving to be hazardous to the user. Preventative measures must be made, such as guidelines in the development and use of AR handheld apps."*

To incorporate AR technology into this premise, the software developers at Gravity Jack have invented quick augmented reality (QAR). QAR allows virtual information to directly overlay a data matrix barcode through the use of browsAR, Gravity Jack's unique QAR-code reader app, instead of having to view the information through a Web browser. Although current uses are limited to personalized QAR codes displaying Facebook and business profiles, there is great promise for their technology to penetrate the mHealth market to promote patient education.

Many medical AR smartphone apps designed by healthcare professionals have been marketed to assist fellow colleagues by providing supplemental tools specific to their line of work. WG Healthcare developed the Hallux Angles iPhone app to aid in the pre-operative radiographic planning process used by foot surgeons.

By aligning the iPhone with forefoot bones pictured on an x-ray film (using the camera and on-screen guides), the built-in goniometer and accelerometers can measure specific angles – the Distal Metatarsal Articular Angle, Inter-Phalangeal Angle and Hallux Valgus Angle – and record measurements for patients directly on their phone for future reference.

A similar program is the CobbMeter app developed by Dr. Fredric P. Jacquot for spinal care professionals. The CobbMeter is designed to measure the Cobb angle, kyphosis angle and the sacral slope on vertical spine radiographs using integrated position sensors, and claims to accurately measure within one-tenth of a degree, making it more precise than the tools used in everyday practice.

A number of healthcare AR smartphone apps are geared specifically towards patients. The AED4.EU app, created by the Radboud University Nijmegen Medical Centre and only available in the Netherlands, allows patients to locate the nearest automated external defibrillator (AED) registered in their independent database using Layar, an AR browser for smartphones that overlays information on maps using built-in GPS. By turning on the camera, lifting the phone and facing a street, icons pointing to the nearest AED will pop up on the device in real time. There are currently more than 20,000 AEDs registered and the general public is encouraged to register their AEDs online (www.aed4.eu) in order to potentially save lives of those who suffer from cardiac arrest. MediaspreeLLC's iBlemish app for iPhones uses advanced "complexion matrix" image effects and high-resolution camera optics to scan and reveal skin damage on the face, from blemishes and blackheads to sun damage and abscesses, which could potentially lead to early detection of precancerous cells.

The incorporation of AR into mobile phones is still relatively new and has its limitations. Current GPS technology on smartphones is only accurate within nine meters and doesn't work well indoors. Developments in the technology are also addressing issues such as system temporal delays and inaccurate depth perception. Another important concern is the potential overreliance on the AR system itself: important cues from the environment might be missed, proving to be hazardous to the user. Preventative measures must be made, such as guidelines in the development and use of AR handheld apps.

The mHealth market already contains countless smartphone apps that are beneficial to and easily accessible for both the patient and the professional. With continued research on the dynamics of AR on handhelds and the production of new and upgraded smartphones, companies will be able to present new portable and innovative medical services that can potentially make the smartphone-acclimated public more proactive and responsible with their health.

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Visual Augmentation for the Blind

▸ By Patrick Degenaar

Human beings have six dominant senses – vision, hearing, touch, taste, smell, and vestibular balance. Of these, vision is perhaps our most important. The loss of vision can be devastating, but not entirely disabling, especially in the young. The brain is sufficiently adaptable to re-route other functions, such that visual loss coincides with significantly improved hearing, touch and associated memory. Therefore, the visually impaired can augment their reality via sensory substitu-

"Perhaps the most exciting work in the field is with the new optogenetic method. Instead of implanting electrodes, it is now possible to genetically re-engineer the remaining cells of the eye to be light sensitive. Specially adapted Virtual Reality headsets can then transmit high intensity pulses of light to return vision."

tion. In rare cases, individuals (blind from birth) are even able to develop an auditory visual system through echolocation – making small clicking noises and detecting their 3-D environment by timing how long it takes for the echo to return.

Techniques to enhance sensory substitution, through for example walking sticks, have been around for some time. Now in the 21st century, blind computer users regularly use a screenreader program called JAWS, which converts the screen information to sound. Such users can navigate using auditory information streams which are unintelligible to the normally sighted. Day to day mobility can now be enhanced via an echolocating walking stick – the ultracane, which gives vibrating feedback about objects three to five meters away. There are even attempts to use a camera and processing engine to convert the visual world into auditory or gustational signals. And yet, the overwhelming desire of the majority of the visually impaired is to return to at least some visual function rather than sensory substitution.

Electrical stimulation of the visual system has been attempted for almost a century. The first experiments on live humans date to 1929, but subsequent progress has been slow. The most impressive results to date have been by a German company, Retina AG, whose low resolution implant has allowed individuals to be able to read large, high contrast characters.

Perhaps the most exciting work in the field is with the new optogenetic method. Instead of implanting electrodes, it is now possible to genetically re-engineer the remaining cells of the eye to be light sensitive. Specially adapted Virtual Reality headsets can then transmit high intensity pulses of light to return vision. This is the basis of the European OptoNeuro project. What is particularly exciting is that resolution is no longer limited by the curvature of the eye and degradation of implanted electrodes. Additionally, without the need for expensive surgery the cost of such systems can be reduced significantly from hundreds of thousands to thousands.

Figures 1: Human vision is limited to between wavelengths of 400 and 700nm. If we return vision to the blind, scenes will be interpreted through the medium of silicon technology. The user may then find it more useful to augment his/her information stream by viewing the world as a cartoon, or in ultraviolet or infrared.

We must, however, accept that in the early phases, perfect vision will not be returned. As such, the prosthesis needs to interpret the world and send only the most useful information. By cartoonizing the scene, less important textures are suppressed to give better contrast to the more important features (e.g., body shapes). A particularly intriguing question is whether the users of such visual systems will want to limit themselves entirely to the visual range. In *Song of the Machine*, my team at Newcastle in conjunction with Superflux conceptually explore the possibilities of the future – where users can view the world in the infrared and ultraviolet as well as the visible. This can be combined with assistive technologies such as navigation and face recognition, so that the total package – mixing augmented visual return with supplemented sensory substitution – will allow the blind to lead normal lives.

" ... the total package, mixing augmented visual return with supplemented sensory substitution, will allow the blind to lead normal lives."

Full human trials of such optogenetic retinal prosthesis are a few years away pending safety trials and will in the first instance only help those suffering from the *Retinitis Pigmentosa* disease. Trials for those blinded by other conditions will be further down the line. Assistive technologies are however already here. The touchscreen smartphones are now becoming surprisingly popular amongst the visually impaired because previous keypads are being replaced with vibrating and auditory feedback. As such, GPS based navigational apps are already changing lives.

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Product Comparison Chart: Augmented Reality

RESEARCHERS:

Rasheda Farid & Allison Ines
Editorial Department, C&R Magazine

www.vrphobia.eu, editorial@vrphobia.eu

PRODUCT	DESCRIPTION	MANUFACTURER
Hallux Angles	radiographic measurement aid utilizing Augmented Reality for assisting in the pre-operational radiographic planning process with an intention to supplement conventional techniques for those practicing forefoot surgeries; also able to record measurements for either foot which are individually stored along with the patient ID, date and time	App Store
iBlemish	used with a handheld device or smartphone, utilizes high resolution camera optics and an advanced "complexion matrix" imaging system to detect skin damage including age spots, wrinkles and sun damage which could potentially lead to earlier detection of precancerous cells not yet visible to the naked eye	App Store
CobbMeter	medical tool application designed for spinal care professionals to be used with smartphone; measures Cobb angle, kyphoses angle and sacral slope on vertical spine radiographs to effectively monitor degenerative and deformitic conditions as well as spinal fractures	ALTAVI sarl
www.aed4.eu	mobile smartphone app allows patients to locate the nearest automated external defibrillator (AED) registered in their independent database using Layar, an AR browser for smartphones that overlays information on maps using built-in GPS	Radboud University Nijmegen Medical Centre
The Computer Assisted Medical Diagnosis and Surgery System	prototype consisting of an ultrasound and HMD, visual cues are displayed in the HMD and projected over the patient's body while voice controls guide the user through procedures; designed to allow astronauts in orbit the ability to diagnose and treat medical complications without depending on ground personnel	European Space Agency
Dankam	app applies filters to assist color blind users in determining colors, or differences in colors, that would otherwise be invisible; currently optimized system for the most common form of color vision deficiency	Dan Kaminsky Holdings, LLC
Virtual Retinal Display	prototype creates images viewed directly on the retina by scanning low power lasers into the eye in a raster pattern; ideal for improving the human-computer interface during surgery where doctors traditionally rely on screens for AR guidance	Human Interface Technology Lab
myGames	VR games created for patients with upper limb motor disorders that combine both real and virtual objects to promote movement necessary for regaining motor abilities and improve activities of daily living; can be played at home for convenience, and level of difficulty can be modified to best suit an individual's abilities and progress	Myomo and the University of Ulster
Essential Reality P5 Data Glove	Input device designed to capture data on finger-bend and relative hand-position to enable intuitive interaction with 3-D environments, includes tactile feedback; potential applications in rehabilitation using haptic feedback	Essential Reality

Wounds of War IV: Pain Syndromes: From Recruitment to Returning Troops

EDITED BY:
Professor Dr. Brenda K. Wiederhold, Ph.D., MBA, BCIA

WOUNDS OF WAR IV: PAIN SYNDROMES – FROM RECRUITMENT TO RETURNING TROOPS

On September 30-October 2, 2011 the NATO Advanced Research "Wounds of War IV: Pain Syndromes – From Recruitment to Returning Troops" drew over 25 eminent experts from 11 countries to discuss the topic of increased pain syndromes in our service men and women.

Held in Südkärnten, Austria at the Hotel Amerika-Holzer, discussion topics included increased pain syndromes as a result of missions, as well as how pain syndromes may be prevented. Research has shown that those who have served in both combat missions and peacekeeping operations are at an increased risk for pain syndromes. The ultimate aim of the workshop will be critical assessment of existing knowledge and identification of directions for future actions. The co-organizers of the workshop alongside Professor Brenda K. Wiederhold included Professor Kresimir Cosic, Professor Mark D. Wiederhold and Colonel Carl Castro.

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The post-conference book will reflect the key topics discussed in the four sections at the workshop:

First Session
Vulnerability to Pain Syndromes
Second Session
Diagnosis and Assessment of Pain Syndromes
Third Session
Treatment of Pain Syndromes
Fourth Session
Clinical Updates on Pain Syndromes

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Clinical Skills Learning with Touch Technology

"The hapTEL project [was designed] to develop, evaluate and integrate the use of haptics in Dental Education and investigate its impact on teaching and learning ... The research showed that an advantage of the hapTEL system is the instant analysis, review and repetition."

By Margaret J. Cox, Jonathan P. San Diego & Barry Quinn

Previous studies have shown that a range of manipulative clinical skills can be practiced through the use of haptics (sense of touch), such as tooth drilling, needle insertion, bone surgery, and instrumentation for gum diseases. Presently there is little evidence of what actual impact haptic devices might have on students' learning, on the curriculum and on institutions' adoption and integration of such technologies.

The hapTEL project, based at King's College London Dental Institute, was set up in July 2007, and is funded by the UK's Economic and Social Research Council and the Engineering and Physical Sciences Research Council, to develop, evaluate and integrate the use of haptics in dental education and investigate its impact on teaching and learning. The hapTEL team, which has won many awards for dental education and technological innovation, includes dentists, e-learning professionals and educational researchers at King's College London, cyberneticists from Reading University and engineers from Birmingham City University.

The Development of the System

The technical development involved creating a realistic virtual mouth using MRI/CT scans of the human jaw combined with clinical expert feedback. The touch input device is based on that used in the gaming industry. A real dental drill connected to the device enables students to operate on the virtual mouth, feeling the difference between drilling hard healthy and softer decayed tooth tissues. Operated by a foot pedal, as in a regular dental chair, the students learn how much pressure needs to be applied in preparing a cavity. In order to see the virtual mouth in 3-D, shutter glasses are worn and students' head movements are tracked by a camera to give them a real world experience of examining the mouth from different angles. The screen display shows the learning activities from selecting the patient case, to choosing the correct instruments and assessing clinical performance.

Fourteen identical workstations were produced and located in the clinical skills lab (CSL) at King's College London. Figure 1 shows the hapTEL workstation being used by a student.

Identifying the Curriculum Use and Measuring the Curriculum Impact

In order to know if the system could be integrated successfully in the curriculum, the team firstly reviewed the traditional course to identify where haptics might most appropriately be used. Students worked in pairs, one as the "dentist" and the other as the "nurse." The hapTEL system recorded computer logs of the interactions and the procedures performed. During traditional simulation students first learn to prepare small carious cavities advancing to more complex preparations.

Measuring the Impact on Students' Learning

Previous studies on haptics have only reported limited measurements of the impact on students' learning. The project therefore conducted two years of large-scale student trials with one-third of the 144 Year 1 students using the hapTEL devices and the other two-thirds learning in the traditional laboratory. Figure 2 shows

Figure 1: hapTEL Dental Workstation.

the trials' arrangements.

Feedback from the first year trials enabled the system to be improved for the second year. For each year cohort a series of pre- and post-tests were developed and used to measure the students' psychomotor skills, what they had learned, and their attitudes towards using the system and whether there were any differences between the groups' learning outcomes.

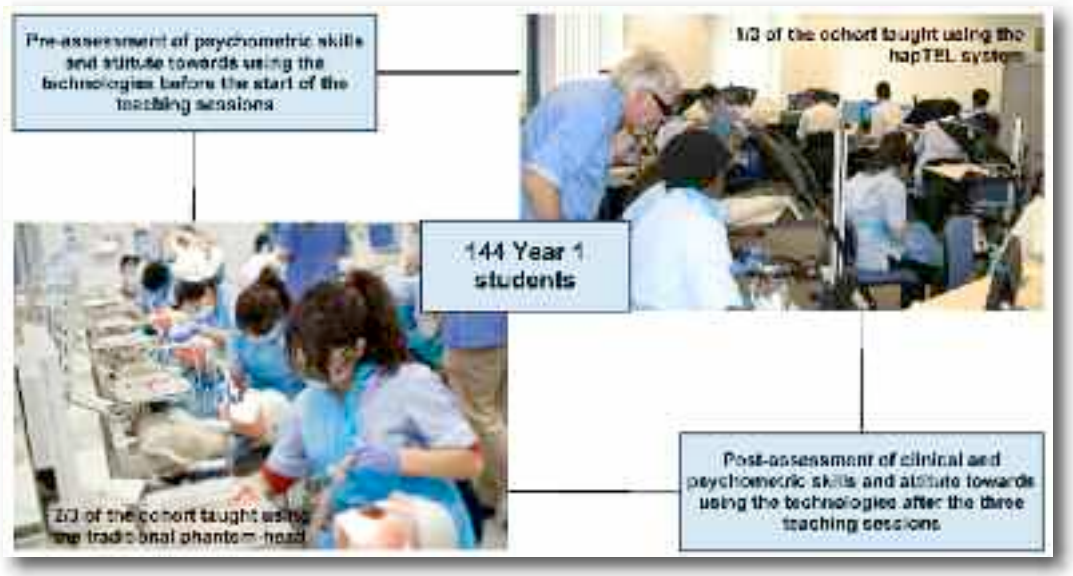

Figure 2: The educational evaluation settings for the traditional and hapTEL lab activities.

Project Outcomes

The project has obtained many useful outcomes from this large study.

The first difficulty students encounter is learning to hold the instruments correctly and ergonomically positioning the patient. Further, they often use too much pressure for too long with the concomitant removal of too much dental tissue. The hapTEL system allowed them to go through this process repeatedly without destroying plastic or natural extracted teeth which are in short supply. The students were able to learn clinical skills to expeditiously prepare carious virtual teeth and transfer these skills into the real clinical environment. The student and tutor could also play back a video to examine the technique and to see how much decayed versus healthy tooth they had removed.

Comments included, "The device has taught the students to become more self-critical and that skill is just as important as the manipulation."

"When you first come into dentistry everything is very alien to you, the way you position your hand, the tiny movements that you need to perform procedures. These are difficult to achieve. The hapTEL system allows you to repeat a task over and over again, it gets ingrained into your muscle memory, and improves your manual dexterity."

The results of the large-scale tests showed no statistical difference between the groups; hapTEL trained students performed equally as well as traditionally trained.

Cost Savings using the hapTEL System

Traditional training is performed on a mannequin with plastic teeth. The research showed that an advantage of the hapTEL system is the instant analysis, review and repetition. One hapTEL device costs approximately £10,000, compared with the £30,000- £40,000 price for a traditional simulator with the added cost of using multiple plastic teeth. Multilayered anatomical plastic teeth cost approximately £16 each.

Future Developments

This study has shown that the hapTEL system can provide equally effective training as the traditional system with the additional advantages of costing less and providing documented individualized feedback to every student. The same hapTEL system could be used for dental hygienists, medical and nurse education on a wide variety of procedures from suturing to injections. Further technological developments would provide the opportunity to broaden its application to other fields and contexts. For example, patient rehabilitation after stroke is possible, improving motor skills with feedback and monitoring of progress.

At the moment, the hapTEL system is still being developed, but additional functionality will make it a marketable product that could be made available to other healthcare institutes for tutor-led or independent study.

Acknowledgements: hapTEL™ is part of the Technology-Enhanced Learning Programme (TEL) funded by the United Kingdom, Economic and Social Research Council (ESRC) and the Engineering and Physical Sciences Research Council (EPSRC) Award Number: RES-139-25-0387 (http://www.haptel.kcl.ac.uk).

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Annual Review of Cybertherapy and Telemedicine 2011
Advanced Technologies in the Behavioral, Social and Neurosciences
Editors: B. K. Wiederhold, S. Bouchard, and G. Riva

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Cybertherapy – the provision of healthcare services using advanced technologies – can help improve the lives of many of us, both patients and health professionals, while tackling the challenges to healthcare systems.

Virtual Healers
Brenda K. Wiederhold, Ph.D., MBA, BCIA

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Virtual Reality in the Mental Health arena is barely over a decade old. Because VR is still such a young and focused field, the members of its community have come together as a tight-knit family. In Virtual Healers, Dr. Brenda K. Wiederhold, herself a pioneer of VR, sits down in casual one-on-one interviews with more than a dozen of the top researchers of this select group.

Virtual Healing
Brenda K. Wiederhold, Ph.D., MBA, BCIA

$ 19.95

Along with aliens and time travel, virtual reality (VR) is often thought of as a science fiction dream. Though it was developed nearly five decades ago, the use of VR in the private sector, particularly in the field of patient care, has become a possibility only in the past decade. As programmers are creating more detailed and interactive environments, the rapid advancement of technology combined with decreasing costs has turned VR into a promising alternative to traditional therapies.

Virtual Reality Resources
By Brenda K. Wiederhold, PhD, MBA, BCIA

$19.95

We, at the Interactive Media Institute, realized early on that it was relatively difficult for professionals wanting to break into the Virtual Reality (VR) field to locate relevant information. While the material was out there, there was no clear organizational structure or database to link it. To solve this problem, we have put together Virtual Reality Resources, a relevant compilation for researchers and clinicians alike.

CyberTherapy Conference Archives 1996-2005
A Collection of all abstracts from the past 10 years of CyberTherapy
By Brenda K. Wiederhold, PhD, MBA, BCIA

$ 29.95

A decade ago, CyberTherapy, then still in its infancy, only existed as a specialized Virtual Reality and Behavioral Healthcare Symposium at the Medicine Meets Virtual Reality (MMVR) Conference. It is now clear that in 1996, we had only begun to realize what promise might lie ahead for both VR technology and the CyberTherapy Conference.

iACToR Resources

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Ask the Expert:

Q&A Ashfaq M. Ishaq

Executive Chairman
International Child Art Foundation

"The power of the arts to foster creativity and develop empathy is overlooked. Since creativity and empathy are preconditions for a just, prosperous, and nonviolent world, we should all champion global art programs."

Brenda K. Wiederhold: Tell us about your background and experience

Ashfaq M. Ishaq: I started my career at the World Bank headquarters in Washington DC conducting economic research on entrepreneurship and small industry development in 1980. The bank's research department had acquired an IBM System 360 at that time which opened possibilities for econometric analysis of primary data which we had collected. I coauthored a book which was published by the Oxford University Press in 1987 and by that time I had joined the economics faculty at the George Washington University. Soon thereafter I wanted to leverage my economic development and teaching experiences into advisory services. So I opened a project development company in Washington which eventually became successful by the mid-1990s. I had to close this business in 2001 to devote all my time and energy to the International Child Art Foundation (ICAF).

BKW: What inspired you to found the International Child Foundation?

AMI: I was always interested in creativity and my research on entrepreneurship deepened this passion. It frustrated me that economics dealt with productivity alone and not creativity. I was asking myself why innately creative children grow up to become bureaucrats. E. Paul Torrance, who is considered the father of creativity, documented the "4th-grade slump" in the creativity of children through his longitudinal and cross-cultural studies. Something happens to us at that age, be it conformity or being educated out of our creativity. How to help children overcome their creativity slump? The least cost and more effective approach is to employ the arts. But there was no national art organization for American children, nor an international arts organization for the world's children. The ICAF had to fill this vacuum.

"We are also developing a virtual creativity playground (VCP) because if a child's creativity is not encouraged, it could be lost forever."

BKW: Tell us more about the background of the International Child Foundation, and the aims of the organization.

AMI: Running the ICAF posed a big challenge as neither I nor my wife had nonprofit experience. I knew that at least initially we had to invest our own funds, which is what we did. Right after incorporating the ICAF we launched an international art competition for children age 8 to 12 to address the "4th-grade slump." In September 1998 the ICAF hosted the

first-ever national children's art festival, held on the National Mall in Washington DC.

The problem with creativity is that it is morally neutral. "The greatest work of art imaginable for the whole cosmos" is how a German avant-garde composer Karlheinz Stockhausen described the 9/11 terrorist attacks on the United States. Creativity alone cannot do the job. We need empathy as well. Creativity and empathy together are necessary and sufficient conditions to build a brighter future for all.

"Neurobiologists inform us that our brains are hardwired for both creativity and empathy. The 4th grade slump and the selfish gene play against our better instincts. It just so happens that the arts can be employed for the development of creativity and empathy."

Neurobiologists inform us that our brains are hardwired for both creativity and empathy. The 4-th grade slump and the selfish gene play against our better instincts. It just so happens that the arts can be employed for the development of creativity and empathy. This is what the ICAF does.

BKW: Could you tell us about your current research?

AMI: Do children through their art offer insights into our creative purpose and potential? Can we, former children, learn from the new generation? What is this learning?

BKW: Do you think the public should be more aware of the issues your organization aim to promote?

AMI: People do not appreciate children's imagination and art and hence it has zero market value. Consequently, the power of the arts to foster creativity and develop empathy is overlooked. Since creativity and empathy are preconditions for a just, prosperous, and nonviolent world, we should all champion global art programs.

BKW: What are the best achievements you have experienced since founding the organisation?

AMI: The ICAF is today a world leader in children's art. Next year we launch the 5th Arts Olympiad (2013-2016). We expect that about two million 8 to 12 year olds worldwide will participate in and benefit from their Arts Olympiad experience. This innovative art and sport program inspires them to embrace the Artist-Athlete Ideal℠ of the creative mind and healthy body—mens sana in corpore sano. Although the ICAF receives little financial support, its work is essential and its achievements incredible.

It has been especially important to break with history and bring children's voices to major conferences where we have organized children's panels. Instituting the "World Children's Award" is another achievement. Introducing a child's imagination to the adults is what we do every day. We continue to convince contemporary art museums to dedicate at least one room to art by children.

BKW: Could you explain what the World Children's Festival is about?

AMI: The festival honors the Arts Olympiad winners from U.S. states and participating countries. In 1999 we produced the first World Children's Festival and ever-since the festival is held quadrennially as Olympics of children's imagination and co-creation. Child performers and musicians from around the world apply to showcase their talents. Architects, engineers, scientists, technologists, writers, Olympians and other professionals come to Washington at their own expense to host workshops and activities for the children, who arrange their own workshops as well.

This educational festival has grown into a global showcase for STEAMS Education℠ which integrates Arts and Sport with STEM disciplines (science, technology, engineering and mathematics) for children's holistic development. The 5th World Children's Festival will be held in Washington in 2015. It is free and open to the public, so you are most welcome.

BKW: How has technology impacted your work?

AMI: When we started in 1997 all communications were by snail mail, which was very costly and time consuming. Today, about 80 percent of our work is online. The ICAF was one of first civil sector organizations to publish a we bsite in early 1998. We added digital art as a category to the Arts Olympiad in 2004. At the 1st World Children's Festival in 1999, very few teachers and parents had E-mails. At the 4th World Children's Festival in 2011, nearly all the children had E-mail addresses. The current issue of ChildArt magazine is on Games & Online Experience. We are also developing a virtual creativity playground (VCP) because if a child's creativity is not encouraged, it could be lost forever.

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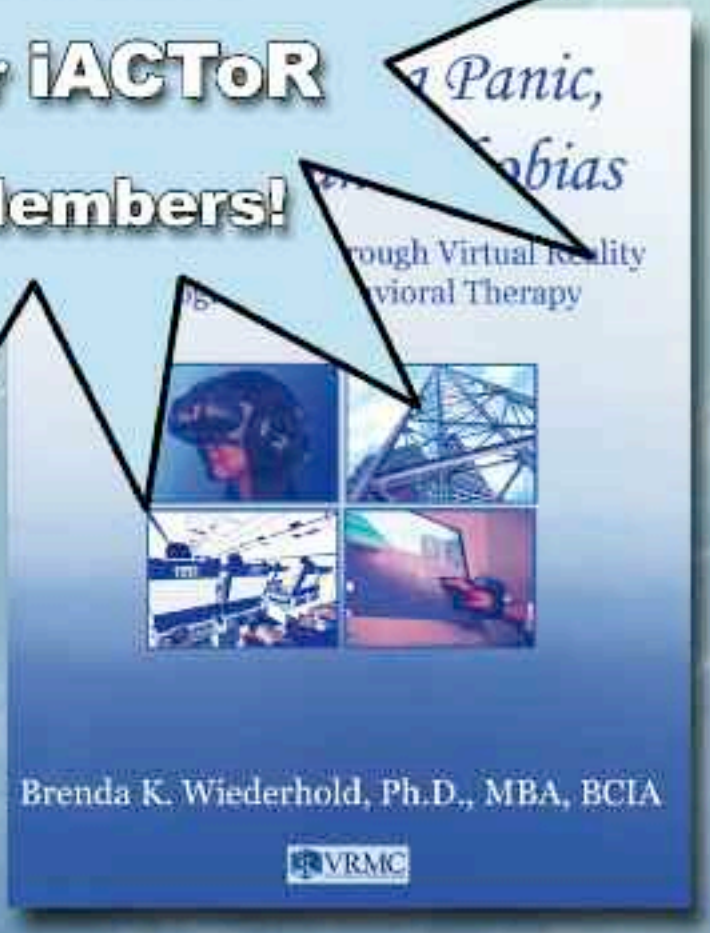

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Achieving Success Through Virtual Reality and Cognitive-Behavioral Therapy

By Dr. Brenda K. Wiederhold, PhD, MBA, BCIA

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This book is essentially divided into two parts: a discussion of anxiety and its physical and emotional effects on sufferers. While Virtual Reality Therapy is described, its use is not necessary in order to follow the suggestions in this book. The lessons and worksheets included can help in a variety of areas, not just anxiety, but anger, mild depression, and feelings of helplessness.

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FROM WHERE WE SIT:
Augmented Reality for an Active Ageing European Society

By Hannes Kaufman

Augmented Reality (AR) per definition combines the real and the virtual and is interactive in real-time. In addition, virtual and real objects are registered in 3-D space to pinpoint their positions for precise overlays. AR has been in the news a lot in recent years, mainly because of AR Apps on smartphones. AR has a lot more to offer though.

Hardware setups are versatile and range from mobile devices to immersive lab installations. Just as versatile are the application areas ranging from industrial uses (automotive, manufacturing, etc.), training and education, modeling (architectural planning), design, visualization (scientific, medical, information), entertainment and more recently, the widening spectrum of possibilities in the medical domain, rehabilitation and therapy.

The most visible area of research in AR in recent years has been localization. Tracking the positions of persons and objects in 3-D as accurately as possible in indoor and outdoor environments is the challenge here. Vision-based solutions, in combination with additional available sensors, deliver the best and most promising results these days.

In Europe we have a strong research community working on AR in a wide range of application areas. In order to pursue interesting and promising new application ideas, especially in the medical domain which is one of our priorities, funding is always critical. In most European countries we rely mainly on three sources of funding: (1) National basic and applied research funding institutions, (2) the European Union Framework Programme and (3) industry. Due to the economic situation, the national funding programs are about to be cut.

However, faced with an ageing European society and with hardly a country exempt from problems financing pensions and healthcare, the European Commission seems to be taking a different route by investing in research and driving innovation forward.

In the current Framework Programme 7 (FP7), the European Union is funding health research in the amount of € 6.1 billion. Within FP7, the "ICT Challenge 5: Information and Communication Technologies for Health, Ageing Well, Inclusion and Governance" has a budget of € 258 million. This sum for health research will be topped in the years 2014-2020 in HORIZON 2020, the new name for the upcoming framework program. There will also be funding opportunities for cooperations with neighboring, industrialized and emerging economies. In HORIZON 2020, € 9.07 billion are reserved for "Health, demographic change, and well-being." This brings interesting opportunities for the AR community.

FP7 and HORIZON cover many topics the AR/VR community is currently working on. As an example, I would like to mention an FP7 project on virtual rehabilitation in which we participated. The PLAYMANCER FP7 ICT Project focused on developing serious games for cognitive behavioral therapy – specifically for patients with eating disorders and pathological gambling – and on serious games for the rehabilitation of chronic back pain patients.

Rehabilitation for chronic pain follows a multidisciplinary approach, which despite the effort, often lacks long term success. Patients fail to translate skills learned in therapy to everyday life. In order to encourage continuous training and ensure impact at a wider scale when it comes to "Active Ageing," technology can and should be used to motivate people to exercise at home.

As an alternative home motion capture system, the low cost Microsoft Kinect was compared to our eight-camera precise motion capture system. The purpose of this comparison within the project was that recorded movement data could provide medical experts with useful information regarding patients' home training such as duration, intensity and correctness.

Overall, the Kinect works surprisingly well. It correctly captured some of the exercises used within our serious game. It cannot measure all required parameters (e.g., head rotations cannot be detected) and lacks accuracy required for others (e.g., velocities of hand/arm movement). For clinical evaluation such a device cannot be recommended due to large errors. However, for health related home use, a Kinect-like depth camera can be used as a full body input device for serious games and other rehab or health programs that do not need supervision.

To reach the general public, using mobile technologies for healthcare purposes seems to have the broadest impact. MIT's CATRA and EyeNETRA projects are perfect examples. AR is predestined to contribute in these areas as well. Regarding mobile and upcoming technologies for elderly people, excellent usability must be of utmost importance. We will see a variety of new approaches and health technologies emerging until the end of this decade. With the excellent funding opportunities on the horizon, we should take our chances to develop and spread successful medical applications based on virtual, augmented and mixed reality.

For more information on the mentioned projects visit:

Continued on page 37

ACROSS THE POND:
Augmenting Perceptions of Society and Self

By Brian D. Wassom

Social media have forever altered the way that humans in general, and North Americans in particular, relate to each other. By supplying us with new tools to shape our own reputations and personas, the same media have changed the way we represent and understand ourselves, as well.

Now we find ourselves on the cusp of a new digital revolution — the moment at which "augmented reality" (AR) technology will liberate electronic data from two-dimensional screens and infuse our physical surroundings with digital content. There is every reason to expect that this development will further "augment" our perceptions of each other and ourselves.

It is already a given that most North Americans use Facebook, Twitter, or some other venue for online expression. These sites tie information that we choose to reveal about ourselves together with content such as photos, messages, or shared locations — that our acquaintances have decided to associate with us.

We all realize on some level that the resulting pastiche of information is not entirely within our control, and that it can sometimes create unwanted perceptions of us. But there is at least some comfort in knowing that the whole exchange takes place "out there," in a virtual place that is less tangible and somehow less "real" because it is accessible only through the screen of a desktop computer or mobile device.

AR, however, promises to tear down the walls between our digital and physical lives. No longer will individuals in our digital social networks need to "look us up" online to discover what is revealed about us there. Rather, they will merely need to quite literally "look up" *at* us through an AR-equipped mobile device — most likely one embedded in the eyewear on their faces. They will see virtual information about us displayed as if it is floating in mid-air over our physical selves. By merely waving a hand, a person standing in front of us might access our Facebook profiles or recent activities, or use a search engine to discover anything the Internet may have to say about us.

For the first time, we will interact with each other's physical and digital personas simultaneously. The comforting chasm between our multiple personas will disappear, to the disconcertion of many.

The effect is likely to be particularly pronounced for Americans, who have long championed the public's collective right to share and access information online. Even those individuals who are comfortable with the knowledge that sensitive, personal information about them is available "out there" somewhere are likely to gain a new appreciation for the European view of privacy when that data is aggregated and made to appear as if it is floating over their heads as they walk down the street.

Experiences like these sound tantalizingly novel in the context of fiction, where they have been explored for decades. Now that our digital and physical realities are actually beginning to blend, however, society as a whole will need to develop new norms to minimize the resulting feelings of awkwardness and intrusion. The adjustments that social media required of us are likely to seem trite by comparison.

"The effect is likely to be particularly pronounced for Americans, who have long championed the public's collective right to share and access information online. Even those individuals who are comfortable with the knowledge that sensitive, personal information about them is available 'out there' somewhere are likely to gain a new appreciation for the European view of privacy when that data is aggregated and made to appear as if it is floating over their heads as they walk down the street."

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CATRA (http://web.media.mit.edu/~pamplona/CATRA/)

EyeNetra (http://eyenetra.com/)

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FURTHER AFIELD: A Taste of AR in China

By Lingjun Kong

Although Augmented Reality (AR) is not a new term in the Virtual Reality field, recently to consumers, this technology has been popping out of nowhere and attacking with force. Marketers are now keen on knowing more and getting involved. In China, there are increasingly more and more agencies exploring AR innovation.

Augmented Reality has come to life with the flexible publishing platforms and powerful camera-equipped devices. Vendors are anxious to learn the next new way to connect with consumers. They are striving to get involved and see how AR can be applied to their products successfully. The current face of AR seems to only be the tip of the iceberg and will only be a matter of time before it reaches a tipping point, becoming indispensable in consumers' lives.

Like the rest of world, China is innovating and accepting AR into their mobile technology swiftly. In May 2011, Senscape launched China's first indigenous AR platform, which is currently compatible with Android and iOS. The platform is intended to be a universal API for developers to build AR objects, which users can then access through the Senscape App. The upcoming applications of the Senscape platform will be expanded to include applications in e-commerce, branding, tourist information and interactive game plays.

The project's developers have mentioned many possible applications for the software: branding and e-commerce functions, interactive games with GPS, virtual tourist information booths, and educational tutorials. Similarly, AiSIDE is an alliance of software developers that support using AR for iOS and Android development and licenses technology from the German-based AR company, Metaio. Along with the gradually established AR platforms, more and more AR applications have started to penetrate into people's everyday life.

Volkswagen China is a frontier at this arena. Volkswagen recently demonstrated the power of AR by launching its first AR-based marketing campaign in China. They featured a pull-out steering wheel in their company's magazine advertisements. Readers could enter into an AR "race" via the company web site and compete to win prizes. Notably, of the 50,000 people who participated in the virtual race, nearly 7% signed up to take an actual test-drive of a Volkswagen vehicle. Advertisers are finding new ways to utilize AR and tie it back to old-fashioned methods of marketing to increase their effectiveness and sales.

Another AR app from Volkswagen is "Electric Café" which educates and inspires people in China about the energy efficiency of the Volkswagen Golf electric car. Users of the app are able to scan everyday household items, such as a refrigerator or toaster, and an AR experience would be created around that appliance, showcasing just how far you could drive a Volkswagen Golf on the same power it takes to run that appliance.

Tencent recently launched an AR mobile Chinese translator, "Intelligent Eye." Simply by aiming the camera at text in need of translation. Tencent's product offers Mandarin learners a free, valuable tool that can translate English, French and German into Chinese and vice versa. Tencent plans to add othe features like AR landmark tagging, and logo recognition in the near future.

Although current efforts are still in their infancy and it will take time to see how the technology rolls out, this is an exciting advancement. The implications and consumer involvement are far too interesting for it to simply come and go. Plus, the number of users of computers and smartphones are massive in China. The potential for AR technology in marketing, the social sector, entertainment and healthcare is huge and most organizations have yet to investigate this digital phenomenon. The technology is so new and revolutionary from the consumer point of view. I am really excited to see AR become mainstream in China. – it should happen soon!

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C&R in the Netherlands

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"Alongside countries like Italy, Spain and Germany, the Netherlands are at the forefront in Europe for implementing new technologies in order to refine our comprehension of different mental illnesses and to improve the quality of various treatments. Since the Netherlands is a wealthy region, investment in the academic field is generally sufficient and promotes the development of high-standard research facilities."

The standard of living of the Dutch population is amongst the highest in the world. Indeed, the Netherlands' human development index (a measure of three basic dimensions of human development: education, health and income) is considered to be very high and the country is ranked third out of 187 countries with comparable data. It is also interesting to note that Dutch people are not only known for their prosperity and well-being, but also for their satisfaction with life. In fact, according to surveys, the Dutch population is one of the happiest in the world, with almost 90% of people reporting themselves satisfied in their everyday life.

Furthermore, the Netherlands are distinct for their people's progressive ideas about various social issues. For example, legislation and regulation about controversial subjects such as prostitution, use of marijuana and euthanasia are definitely *avant-garde*.

Mental Health in the Netherlands

Many epidemiology studies have been conducted in the Netherlands in the past decades and they have greatly contributed to our understanding of psychopathology. Thus, the portrait of the mental health situation in the Dutch population is becoming well defined and government's health and social policies seem to be improving accordingly.

According to the Netherlands Mental Health Survey and Incidence Study-2 (NEMESIS-2), 18% of adults aged 18-64 in the general population had suffered from a mental health condition in the past year. This percentage rises to 43% for the presence of a mental disorder at some point in their lifetime. More specifically, according to the Netherlands Study of Depression and Anxiety (NESDA), approximately one out of three individuals in the Netherlands will be affected by depression or anxiety disorders at some time during their lives. Amongst all mental health disorders, depression contributes to the highest strain on health services. Similarly, sufferers of depression are also most likely to require and use medication.

Statistics also show that Dutch inhabitants with a lower level of education, lower income and those without paid employment have greater chances of developing a mental health disorder. Fortunately, since 2008, the mental healthcare services developed a program in which people can benefit from a whole year of free services. More precisely, the first year of mental health services is entirely covered by the general healthcare insurance policy.

Moreover, Internet-based psychotherapy is now recognized by Dutch regulatory health bodies as a valid alternative to regular therapy and is even reimbursed through public health insurance. Such social policies reveal the government's genuine interest regarding mental health is-

Population (Million)	16.85
Life Expectancy (Years)	79.68
Fertility Rate	1.66
Population Median Age (Years)	41.1
Population Density (Persons Per Sq Km)	492.07
Percentage of Urban Population	83%
Annual Population Growth Rate	0.37%
Unemployment Rate	5.5%
Hospital Beds (Per 10,000)	4.25
Percentage of the Population Satisfied with Current Healthcare System	90%
Prevalence of Panic Disorder, 12 Months (Percentage of General Population)	2.2%
Lifetime Prevalence of Mood Disorders (Percentage of General Population)	17.9%
Total Expenditure on Health (as Percentage of GDP)	10.8

sues and testify to their sincere will of offering cutting edge services to their population.

Research Facilities in Netherlands

Alongside countries like Italy, Spain and Germany, the Netherlands are at the forefront in Europe for implementing new technologies in order to refine our comprehension of different mental illnesses and to improve the quality of various treatments. Since the Netherlands is a wealthy region, investment in the academic field is generally sufficient and promotes the development of high-standard research facilities. For instance, two important research teams – University of Amsterdam and Delft University of Technology – use head-mounted displays in their projects related to the field of cyberpsychology.

Research Areas and Topics

Exergaming (a combination of active video gaming and exercise), Virtual Reality (VR) exposure therapy for anxiety disorders, level of presence and therapy outcome, interapy (Internet-based psychotherapy), and virtual environments to study paranoia and psychosis are important fields of research that are highlighted by Dutch researchers. The improvements in the field of cyberpsychology are hastening developments in these topics of interest.

Dutch Projects in the Spotlight

Recently, two important research projects have been completed at the University of Amsterdam under the supervision of professor Paul M. G. Emmelkamp, clinical psychologist. The aim of the first controlled trial study was to compare VR exposure therapy (VRET) with in vivo exposure in the treatment of panic disorder with agoraphobia (PDA). Results have shown similar effects for the two treatment modalities. Dr. Emmelkamp says, "Such work is of great interest because there is a clear need for controlled clinical studies regarding the treatment of more complex and prevalent anxiety disorders like PDA, social anxiety, posttraumatic stress or obsessive-compulsive disorder."

The second research project's goal was to measure the effect of Internet-based psychotherapy (INTERAPY) on subjects affected by Posttraumatic Stress Disorder, burnout, depression, eating disorders and panic disorder.

The results gathered from nine controlled trials showed that patients' improvements in the Internet-based psychotherapy condition were comparable to those of the subjects who received classical (face-to-face) cognitive behavioral therapy. In a subsequent series of 1,500 regular patients, Internet-based CBT was found to be equally effective as the treatments in the randomized controlled trials.

Moreover, according to Dr. Emmelkamp, "Patients' reaction to the online psychotherapy

was positive and they seemed to be highly satisfied at the end of the treatment." In summary, a decade of online therapy research has provided compelling support for the efficacy and effectiveness of Internet-based cognitive behavioral treatment. In the Netherlands, the implementation and dissemination of such technology has begun and is supported by reputable healthcare professionals.

"Internet-based psychotherapy is now recognized by Dutch regulatory health bodies as a valid alternative to regular therapy."

Another interesting project in ICT research will soon take place at the University of Amsterdam. This innovative study will combine Internet-based psychotherapy with VRET, two methods that have shown promising results as mentioned earlier. This new treatment for social phobia will include exposure sessions to avatars that could be completed online. Of course, if effective, "this project is a great demonstration of the potential of information technologies in the treatment of mental disorders," says Dr. Emmelkamp.

Dr. Willem-Paul Brinkman with the Interactive Intelligence Group at Delft University of Technology has also dedicated his time towards pioneering works implementing VR techniques for mental healthcare. "The group's research mission is to create synergy between humans and technology by understanding, shaping and using fundamentals of intelligence and interaction," he explains. "Our research finds applications in multiple contexts, such as healthcare, well-being, entertainment, safety and security."

Drs. Emmelkamp and Brinkman recently partnered to work on a project "Computer support for anxiety disorder treatment at home" (CATCH) project funded by the Netherlands Organisation for Scientific Research (NWO). "We developed a VR exposure therapy system specifically designed to expose patients with social phobia to various social situations," says Dr. Brinkman. "Patients can engage in free speech dialogue with virtual avatars, which the therapist can control for specific phobic stressors." The effectiveness of the treatment is currently being evaluated in an extensive RCT.

Looking to the future role of advanced technologies in healthcare, Dr. Brinkman says, "Considering demographic changes in the western world and rising national healthcare costs, patient self-management systems will become more important. In this context, the use of eCoaches seems an important element in patient empowerment and a way to reduce face-to-face consultation with care providers."

The Future of ICT Research in the Netherlands

Even with promising results in research, the implementation of new technologies in the treatment of mental illnesses in the Netherlands still faces major challenges and obstacles. Indeed, one of the most important difficulties is the transfer of knowledge from the academic community to common clinical practice. The use of new technologies has presented many advantages and is associated with great satisfaction in service users, but some practitioners show resistance to change because it makes them feel somewhat obsolete. In other words, some clinicians may fear being replaced by computers.

Another important issue related to the implementation of new equipment like HMDs is the lack of training on how to use VRET and appropriate technical support. In order to efficiently use such technology, clinicians may need help in case of deficiencies of the equipment or for installation. According to Dr. Emmelkamp, one of the solutions might be to "create central locations where practitioners could use the equipment and demand technical support when needed."

Finally, since people around the world are becoming more and more familiar with new technologies, another challenge in ICT research will be to keep up with the products offered by the competitive industry. For example, the graphic quality of video games improves continuously so the virtual environments created in the future will have to meet the same expectations or otherwise they will seem outdated.

Nevertheless, the support for these technologies is leading to exciting developments in the treatment of mental health disorders. The Netherlands will undoubtedly use these advancements to continue offering cutting-edge care for its population.

Sources:

Personal communication with Paul M.G. Emmelkamp, Ph.D., Willem-Paul Brinkman, Ph.D., World Health Organization, Organisation for Economic Co-operation and Development, Trimbos Institute, and Netherlands Study of Depression and Anxiety.

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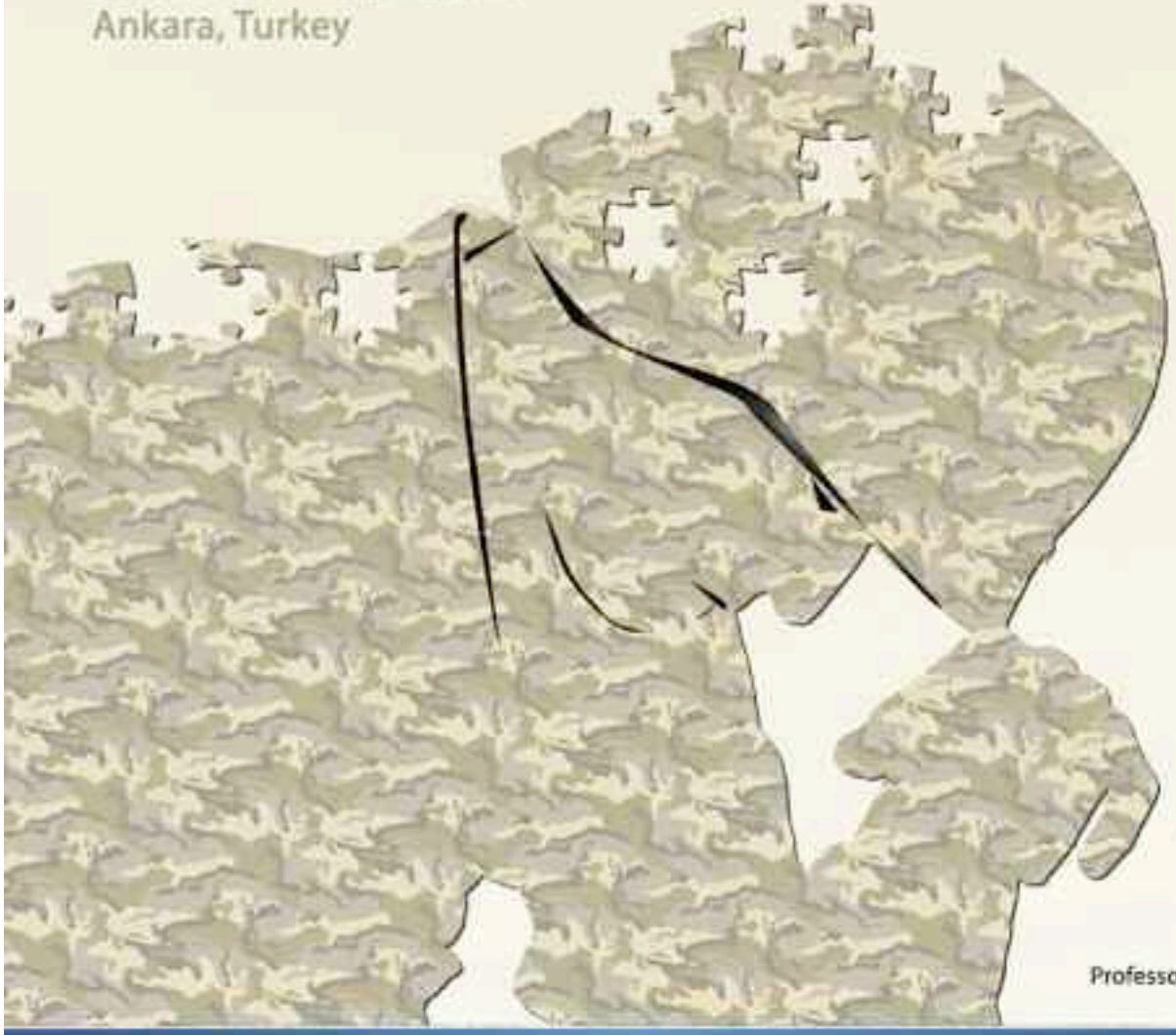
Invisible Wounds - New Tools to Enhance Posttraumatic Stress Disorder Diagnosis and Treatment

June 18 - 28, 2012
Ankara, Turkey



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THE VIRTUAL REALITY MEDICAL INSTITUTE

YOUR PARTNER IN:

Clinical Validation I Commercialization I Dissemination

Via our combined communications platform, we inform and educate stakeholders on transforming healthcare through technology, leading the way to:

Patient Empowerment – Improved Dissemination of Services
Increased Quality of Life for all Citizens

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The Official Conference of the International Association of CyberPsychology, Training & Rehabilitation (iACToR)

CYBER[17] will bring together researchers, clinicians, funders and policymakers to share and discuss trends in healthcare and technology. CYBER[17] continues to seek input from a wider segment of the scientific community, and is interested in attracting experts in clinical therapy and rehabilitation, cognitive sciences, social sciences, and computer sciences dedicated to *shaping the future of health & well-being*.

Key focus areas will include:

1. **The Impact of Technologies as Tools:** technology's use in training, therapy, rehabilitation, and education to improve the quality and availability of healthcare.

2. **The Influence of New Technologies:** technology's influence on behavior and society (e.g., positive technology for well-being, healthy ageing, and inclusion).

3. **The Imprint of Social Networking:** the exploration of social networking tools on individual behavior and societal relations.

4. **New Technologies/New Terms:** studying the psychological aspects of new areas influenced by technology (e.g., cyberfashion, cyberadvertising, cyberstalking).

For more information please visit
http://www.interactivemediainstitute.com/conferences.html
or e-mail cybertherapy@vrphobia.com

2012 CALL FOR PAPERS
SUBMISSION/REGISTRATION DEADLINES:

Abstract Deadline
Submission: March 1, 2012
Notification of Acceptance/Rejection of Abstract: April 1, 2012
Full Paper/Presenter Requirements Deadline: June 1, 2012
Early Registration Deadline: July 1, 2012