

Rubber Ball to Cloud Rehabilitation[©]

Musing on the Future of Therapy

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Abstract—We can trace the origins of virtual rehabilitation to the late 80s when sensing gloves were used to determine the degree of hand tremor in patients with Parkinson, and virtual environments were investigated as a medium to train wheelchair navigation. At the first Medicine Meets Virtual Reality conference in San Diego in 1992, we proposed a unified system where sensing gloves were used to diagnose and train patients post hand surgery. Other researchers pioneered the use of virtual environments in phobias, attention deficit, post-traumatic stress and other conditions. In 1996 researchers interested primarily in VR phobia treatment started the CyberTherapy conference series, and VR-based physical therapy, occupational therapy, therapy for learning deficits, and amnesia were reported at the first International Conference on Disability, Virtual Reality and Associated Technologies. By 1997 the National Science Foundation funded a study of rehabilitation at a distance between Rutgers and Stanford universities, located on either side of the United States. These beginnings used color-coded virtual rubber balls and haptic gloves to program the mechanical work done by the patient's affected hand. An artificial separation existed in the clinical practice between physical or occupational rehabilitation and cognitive therapy, due in part to separate education tracks. Nonetheless virtual reality researchers realized that the same hardware could be used in either physical or cognitive rehabilitation, and all that needed changing was the simulation software used. We thus coined the term “virtual rehabilitation” to encompass the continuum of therapy. In 2002 the associated conference started in Switzerland as the International Workshop on Virtual Rehabilitation. This later became the Virtual Rehabilitation International Conference series which you are attending today. While “virtual rehabilitation” was initially met with some skepticism by therapists who were concerned patients will misunderstand it, nowadays the term is better understood. To help further recognition for this emerging field, a new society was formed in 2008, the International Society for Virtual Rehabilitation (www.isvr.org), which is a co-sponsor of this conference. The merging of physical/occupational therapy and cognitive therapy is not due solely to the modularity offered by the hardware and software used in virtual environments. Another cause is the fact that patients affected by certain neurologic and motor deficits often have psychological and other cognitive co-morbidities. A well known example is depression associated with some types of stroke or with societal isolation that often follows the inability to have regular employment. The same tele-rehabilitation systems that are projected for large scale use to train patients in their home, may also be used to reduce the sense of isolation. Video games that are now being investigated as a way to reinvigorate therapeutic interventions could also be used in future game

“tournaments” among teams of people with disabilities, or among people with disabilities and their families and friends. Virtual environments could then be used to customize the games and allow a patient to succeed, greatly boosting morale. An extreme example is the use of virtual hand avatars controlled by people with amputated arms, an application which we pioneered back in 2003. Popular awareness of and demand for virtual rehabilitation is expected to grow, which in turn will trigger changes in the way therapists are educated and accredited. A new field of study will emerge, as will the way therapists and psychologists will be re-certified. Certainly the way licensing, insurance, even liability clauses follow local geography is archaic, and a more global certification program is expected to emerge. The one-to-one paradigm of therapy will also change, with one therapist performing “multiplexed” tele-rehabilitation. This is expected to reduce treatment costs while also increasing access to therapeutic care worldwide. Certain technologies will need to advance to act as force multipliers and to help therapists handle the expected workload increase. One supporting technology will be home-based robots which will not only clean, cook and guard, but extend their use to provision of therapy, especially physical therapy. Advances in technology will provide the ability to take therapy anywhere, anytime, addressing current limitation due to geographical location, lack of transportation, limited therapist availability or endurance. This will be facilitated by the proliferation of portable computing/communication terminals coupled to powerful mega-servers, in what is called today “cloud computing.” We predict that cloud computing will be extended to “cloud rehabilitation” by transforming these portable devices into rehabilitation systems. In cloud rehabilitation the library of disability-specific software simulations or games will reside on a third-party “cloud” of web servers. This is where clinicians will log on to set up rehabilitation regimens, follow up patient progress, insure compliance and monitor safety. By concentrating software maintenance and licensing to a unified web structure, the current information technology problems that plague healthcare institutions will be alleviated, the portability of medical data improved and the defense against unauthorized access to medical data boosted. The way to cloud rehabilitation seems straightforward – new types of input devices to measure the patient's input, games that allow clinically meaningful variables to be stored and therapeutic regimens set and monitored, distributed databases storing medical data securely, reliable and encoded communication, and of course, more computer savvy patient and therapist populations.

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