Game Concepts for Health, Therapeutic Robotics, and Performance Enhancement

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Overview

- Games for Health
- Game play devices with possible therapeutic applications
- Some sample game projects at UCI
- Games for sports and assisted performance training
- Game-based therapy/rehabilitation protocols
- Games and tele-rehabilitation
- Recommendations
Some findings on Games for Health/Therapeutic Applications

- The design and utility of a game to realize therapeutic value is not obvious.

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<tr>
<th>Criteria for Stroke Rehabilitation</th>
<th>Criteria for Elderly Entertainment</th>
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<td>Adaptability to motor skill level</td>
<td>Appropriate cognitive challenge</td>
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<td>Meaningful tasks</td>
<td>Simple objective/interface</td>
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<td>Appropriate feedback</td>
<td>Motivational Feedback</td>
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<td>Therapy-Appropriate ROM</td>
<td>Element of social activity</td>
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<td>Focus diverted from exercise</td>
<td>Appropriateness of genre</td>
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<td>Creation of new learning</td>
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<td>Sensitivity to decreased sensory acuity</td>
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<td>Sensitivity to slower responses</td>
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<th>Game</th>
<th>Stroke Rehab</th>
<th>Driver's SEAT</th>
<th>Whack-a-mouse</th>
<th>Tetris</th>
<th>Computer Chess</th>
<th>Trivial Pursuit</th>
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Games for Health

• Four focus areas for enabling human behavior change for health
  – Increasing physical activity and performance
    • Mobility/dance exercise; overcoming obesity; increasing agility
    • Nintendo *Wii* *Sports* and *Wii Balance Board*
  – Improve self-care
    • Training or learning games for facilitating patient recovery or understanding purpose of care protocols
  – *(Healthy)* Lifestyle improvement
    • Diet; mitigating easily transmitted diseases/ailments
  – Facilitating therapy
    • Technology-mediated therapy (games often focus more on evaluating potential of new technology in therapy)
• New game play devices are expanding the possibilities for games for health
Game play devices with possible therapeutic applications

- Simulated devices
  - *Guitar Hero* guitar; *Rock Band* drum set
- Haptic wheels, trackballs, and joysticks
- Force-feedback play controllers (racing game wheels, pneumatic bladders)
- Multi-sensor play controllers (including video capture, infra-red, accelerometers, neurological sensors, electro-goniometers (SEMG), etc.)
  - *Wii Remote* and nunchuk
- Multi-jointed, body-worn sensors as play controllers
  - Data gloves
  - GypsyMIDI
Game play devices with possible therapeutic applications

- Endoscopic surgery training “joysticks”
  - Simball 4D joystick adapted to therapeutic game play for stroke rehabilitation
  - [http://www.g-coder.com/content/view/7/6/](http://www.g-coder.com/content/view/7/6/)

- 3D, real-time video motion capture enabling *mixed reality game play* spanning physical and virtual worlds
  - *Project Natal* at Microsoft
  - In-game characters can interact with human players through gestures and body movements
  - [http://www.youtube.com/watch?v=g_txF7iETX0](http://www.youtube.com/watch?v=g_txF7iETX0)
Games for sports and assisted performance training

- *Wii Sports* (best selling game for Nintendo in 2007; 45M copies sold worldwide through 2009)
  - Boxing
  - Bowling
  - Golf
  - Tennis
  - Baseball

What's next?
Sample of Games Developed at UCI GameLab

- Collaborative science learning game (SLG) environment at Discovery Science Center
  - *DinoQuest* and *DinoQuest Online* (DQO)
- Collaborative game world for semiconductor or nanotechnology fabrication
  - FabLab training simulator for Intel (highlighting “gowning process”)
- Collaborative virtual world for envisioning possible cultural and technological opportunities with avatars and virtual (computer controlled) bots
  - Intel Research (w/ Linden Labs)


Mixed reality games for informal science education for K-6 students and families

http://www.DiscoveryCube.org/
Web-based science learning games for informal life science education for K-6 students and families

http://www.DQOnline.org/
Semiconductor/nanotechnology fabrication training game

FabLab Demo Reel
Semiconductor/nanotechnology fabrication training game

working in a cleanroom

- Suit made of ultra clean material
- Battery pack for air filter system
- 2 pairs of gloves: nylon & latex
- 2 pieces of foot gear: disposable shoe covers & outer booties
- Helmet includes air filter unit
- Will also wear hairnet & safety glasses
- Belt
Envisioning collaborative virtual worlds 2010-2012

Virtual Life in 2010+
a vision of the future

Virtual Life Demo Reel
From an outsider's perspective, therapeutic or rehabilitation protocols denote *specifications* for how to achieve some outcome state(s), given inputs, constraints, and set of operations.

- Such protocols can be represented computationally, when formalized, and thus the protocols can be treated as “software processes”
- Software processes can be enacted through interactive (Web) applications, and empirically measured, assessed and replayed.
- Medical protocols can thus be viewed as software, and such software can be designed to operate within other software, such as a computer game, or game-based virtual world
- Thus, we can investigate, design, and refine such protocols with online games!
- Similarly, we have the potential to design and refine (sports) performance improvement protocols in ways that can be integrated within computer games and associated game play devices
Virtual worlds (like Second Life) can be used to support various kinds of tele-medicine and tele-robotics applications/tasks.

“Rehabilitation” tasks supported can include:
- Remote observation, tele-consultation, role-playing and identity switching through avatars, device data collection, device software updates, collaborative product/prototype development, and more.
Recommendations for Therapeutic Robotics Games

• Prototype and refine multi-skill, multi-level games that can be rapidly tailored for individual capabilities, supported by therapeutic robotics
  – Via games that are pre-programmed to support diversity of play
  – Games whose user controls are integrated with therapeutic devices
  – Alternatively, assess existing games to determine their potential usage
  – Nintendo *Wii Sports*?

• Develop game-based virtual worlds that provide life-situation tasks for personal accomplishment and improved socialization opportunities
  – Exoskeleton gowning and user-device service tasks
  – Multi-player games for that mix players/avatars with varying physical capabilities (including those that may be virtually induced)
Recommendations for Therapeutic Robotics Games

- Investigate, design, and refine alternative therapeutic rehabilitation schemes using assistive robotics integrated with online game environments
  - Specify medical protocols as computational specifications
  - Collect empirical measurements/observations to show performance change
- Design, prototype, and refine an online virtual world for collaborative engineering of therapeutic robotics devices, games, rehabilitation protocols, and performance data collection
  - Such an virtual world can be used to facilitate on-going collaborative R&D between Panasonic and UCI
  - Such effort can leverage new UCI Computer Games and Virtual Worlds research projects (current funding >$3M), research center, and its research infrastructure
- Massively multi-player online robotics learning game (MMO-RLG) world
  - A virtual world that provides different support services and learning opportunities for all parties involved in facilitating use of assistive robotics applications.