Welcome to the Machine: Computer Games That Care for You

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Google's new image recognition software Goggles is a step up for mobile phones and artificial intelligence. It takes a picture of a landmark or a wine label and does a web search for information on the location or the vintage. The software's "perception" has been compared to the way a baby comes to understand objects in the world. It's one of many piecemeal advances being made towards the science fiction promise of "self-aware" machines. In the multi-billion dollar global computer gaming industry, using artificial intelligence (AI) to create virtual characters for interactive games is a hot topic. Gaming is a multi-billion dollar entertainment industry, bigger than Hollywood. But AI has serious applications as well with the techniques developed for gaming now being harnessed for educational, medical, military and training simulations, notes Lundy Lewis, a visiting professor at the University of New South Wales (UNSW) where computer frameworks are being developed for the increasing use of interactive games in rehabilitation and aged care.

Business and other organisations have long envisaged that virtual workers will one day help with repetitive tasks. In 2010, *Scientific American* magazine predicted that self-replicating, self-teaching, adaptive robots were likely by 2050, although it noted that "the biological basis for consciousness" was still debatable. Robots can build cars faster and better, but replacing knowledge-based workers is a massive challenge. One field of real progress is developing conversational artificial intelligence (AI) in the areas of games, learning and call centres. Elementary robots that chat – chatbots – are becoming familiar on websites.

At furniture store IKEA, the chatbot is "Anna", a young redheaded character who fields text questions about Swedish homewares and furnishings. On the website of one of Australia's big four banks, National Australia Bank (NAB), an online assistant appears as a bespectacled young woman who answers frequently asked queries, usually by referring questioners to the relevant part of the bank's website. MyCyberTwin, the Australian software company that developed NAB's online assistants, also has Sarah, a more lifelike figure in a suit, who moves her lips and blinks as she delivers a sales pitch. Sarah claims: "I have a human personality and am trained to think through complex tasks. And my advanced brain learns and adapts from experience. As I chat to a person I build their profile, answering questions and responding to each person individually. In fact most people forget they are talking to an avatar..." Sarah is not silly. When asked if she enjoys chatting online, she responds: "I like to talk about it in general, but I also like to focus conversation around MyCybertwin products." She insists she can deal with complex problems 24/7, as well as frequently asked questions. Yet engaging conversations are still a big challenge. Australian financial services firm AMP featured a chatbot for 12 months on its website but found it was not used enough by customers and proved less effective than talking to a real person.

Cosy Up to Your Screen

An increasingly common strategy in call centres is using attractive, life-like artificial characters who can have a "spoken" conversation with consumers, says Dutch futurist and founder of chatbots.org, Erwin van Lun. The aim is to make them "brand agents" who generate emotions in customers when conversing, so customers feel a relationship with the character and the brand. "Computers have tried to simulate human conversation for 50 years. We have made some progress in some specific areas, but it is very hard because there are hundreds of thousands of subjects to cover. We are the only species on the planet that uses language. We not only talk about things but also about abstractions of things, not to mention humour,

mistakes and idioms – and we are very intelligent. It is a huge task, yet breakthroughs are happening all the time," says van Lun.

Developments in conversational artificial intelligence are paralleled by advances in computer games research where robot characters seemingly have minds of their own. Lewis, who teaches game design and development at Southern New Hampshire University in the US and recently held a seminar at the Australian School of Business on serious applications for gaming technology, foresees university courses online allowing a new student to walk into a virtual campus, meet the virtual professor and discuss the course – and take the exam in a virtual exam room. He also anticipates a role for virtual therapists – engaging characters that can answer back will be helping to correct golf swings or ensure people do their stretching properly. These characters may not only put fun into rehabilitation by getting patients to stand up and play tennis with on-screen characters, but also monitor a patient's performance and report to doctors.

Research is building on existing interactive games as exercise tools, including Dance Dance Revolution, Sony's EyeToy (a camera using computer vision and gesture recognition to interact with PlayStation2 games), Nintendo's Wii and the body-response Xbox Kinect games that ran hot off the shelves during Christmas 2010.

Nine of Victoria's 16 rehabilitation centres are already using motion-sensitive technology, which includes remote wireless controllers, such as "power gloves", and pressure-sensitive balance boards for movements such as running, to make players' movements interact with the game. "The games monitor your movements in reaction to onscreen characters, so when they throw a baseball and you try to hit, it knows if your swing actually connects with the ball. The research idea is to have the game react to your actions in other useful ways," says Lewis. "In rehabilitation exercises, the physics of your movements can be used to guide people as they work out. The game can tell if you are going too fast or are stretching enough to build up a particular set of muscles. If you are overdoing it, the on-screen character might say, 'Hey, slow down there.' Or, 'Let's do another 10 of those.' And report to the therapist on your progress." Combining this with conversational AI to answer questions has many further uses, Lewis predicts.

The prospect of virtual personal trainers makes sense in the context of treating an ageing population in an era of rising health costs, according Pradeep Ray, the director of UNSW's Asia-Pacific ubiquitous Healthcare Research Centre (APuHC). Healthcare organisations are pursuing preventive healthcare through fitness and good nutrition. "Thanks to the development of the internet and the increasing speed of network data transmission, it is now possible to pursue wellness through electronic games that are entertaining too," Ray says. "However, most of the current games are tuned to the needs of the younger population. That's why researchers have started work on the development of games for the elderly as part of independent living initiatives in various parts of the world." These include the Ambient Assisted Living (AAL) projects in Scandinavia, TigerPlace in Missouri in the US, and the Technology Research for Independent Living (TRIL) in Ireland. APuHC researchers have joined with the Falls and Balance Research Group at Neuroscience Research Australia to work on similar projects for aged care in Australia.

Virtual Therapists

Physiotherapist Kelly Bower, of Royal Melbourne Hospital's neurological unit, says playing computer exercise games helps balance and dizziness problems because many of the games require precise weight shifting, good trunk control and single leg balance, plus encouraging rapid head movements that patients avoid for fear of dizziness. Generally patients enjoy the games that can improve strength, endurance, balance, coordination and cognition. On the downside, games that are not specifically designed for rehabilitation can be difficult and discouraging for some patients and even encourage poor movement patterns. Researchers believe this provides an opportunity for artificial intelligence to make the games more responsive and to replace the therapist or active agent in rehabilitation, education or other fields. Lewis, who has a background in AI applications to solve problems in networking and telecommunications, believes networks are important to realise the full potential of enjoyable interactive games that liven up the often dull and repetitive nature of rehabilitation exercise, particularly when continued at home after patients have been discharged from hospital.

Games may offer a means for rehabilitation specialists to remotely assess compliance of patients with their rehabilitation therapy and monitor changes in function over time, suggests Ray. "Although the use of

technology for monitoring health at home is now widespread, an as-yet unexplored challenge lies in integrating information technologies with rehabilitation games. This keeps the health professional informed about compliance and progress of the exercise, while the patient performs her/his prescribed rehabilitation routine at home. Therefore, there is a strong need for a computational framework to support the medical professional and patient by using an agent-based architecture – where agents are pieces of software that act on behalf of human roles, involved in the rehabilitation process."

Putting agents or robots with artificial intelligence (AI) into interactive games is exciting the games industry. Although the games industry has embraced the term AI, it usually means that the on-screen characters only look intelligent by using facial expressions, and by running, jumping and crying like a real person, or even by their hair blowing in the wind. Mentally engaging a player requires both high-end graphics and accurate physics. The major challenge is "traditional' AI", an intelligent agent system who perceives their environment and decides to act in pursuit of some goal.

Gaming AI has been limited. For instance in a shoot 'em up game, the options open to the virtual gunman are hard-coded using finite state mechanisms, which are elementary computer science technology compared to the advances in traditional AI. The popular game Halo uses "behaviour tree" technology and the horror game, F.E.A.R., uses rule-based reasoning systems that are old news to traditional AI, according to Lewis, who concedes these techniques are useful, but limited. More sophisticated AI involves logic-based, case-based and fuzzy reasoning. But gamers like to modify and build on their games and fuzzy logic used in a recent game was found to be too complicated for them and became a turn-off for companies selling the games. The cutting edge in gaming circles remains artificial life using neural networks, genetic algorithms and artificial immune systems. Combined with parallel technologies, such as chatbots, it is delivering a new evolution in artificial intelligence with myriad uses.

