Sporting chance

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VR gives people the opportunity to experience how it could be to play against the best players.

A trickle of sweat runs down your forehead. You are on centre court, standing before a sell-out crowd. Mark Philippoussis stares you straight in the eye before arching back ready to sling-shot one of his bullet serves straight at you. You tighten the grip on your racquet in nervous anticipation.

Before you know it, you have swung your racquet and returned serve and after a short rally you back-spin the ball straight past Philippoussis to win the point - and the crowd goes wild.

It helps that you have temporarily been bestowed with the skill of No.1 seed Roger Federer - but the crowd can't tell the difference.

But back in the real world they are prising away your virtual reality mask - cutting your moment of glory short.

Virtual reality technology is at the stage where it can make you feel like a sports star - and now international sporting institutes are developing VR programs that might be able to turn you into one.

"Virtual reality is a new way to give people the opportunity to experience first hand how it could be to play against the best players in the world," says Paul Hawkins, the British developer of Hawkeye tennis and cricket virtual worlds.

"Put on the headset and you're immersed in the same virtual world as you see on TV. If you're bowled a bouncer you'll be ducking out of the way. You'll get a whoosh if it comes close to your head."

Hawkeye virtual reality games are found at professional cricket and tennis matches across the globe. All a keen sports fan needs to do is step onto the mock cricket pitch or half-tennis court, take the bat or racquet in hand, don the virtual-reality mask - which blocks out all other vision - and the player will be immersed in another world.
"The technology works by tracking the player's moves using electro-magnetic sensors - they track the person's head and bat to a couple of millimetres," says Hawkins, a sports enthusiast with a PhD in artificial intelligence.

Aerials on the bat or racquet and the mask of the player emit electro-magnetic signals that are read by the virtual reality software.

"When the sensor tracks the head's movement it changes his field of vision within the virtual world. There is a sensor on the bat that is tracked which means as he swings the bat, the virtual bat mirrors the movements he's done so he's able to hit the virtual ball within the game," says Hawkins.

In the latest development by Hawkeye, a player can watch his favourite cricketer bowl a spin delivery and then seconds later play the VR game and face that exact ball.

"By combining six cameras on the field you can work out the 3D trajectory of the ball," says Hawkins. "This is then converted into a number of x-y-z positions and sent via a network to a package that is read by VR software so a player can face the ball that has just been bowled."

Hawkins previously worked at a large research and development company developing missile-tracking technology and says similar technology is used for the sporting application. "The model flight of a ball predicts the future path of the ball - similar technology to tracking fighter jets and predicting where they will go," he says.

So while any old cricketing fan can be made to feel like Michael Clarke, opportunities are arising for virtual reality to be used for training athletes.

The TNO in the Netherlands, a technological research organisation similar to Australia's CSIRO, is in the process of developing a virtual reality system for use in sport.

The project is being run by human movement scientist Professor Nico Delleman in conjunction with a professional Netherlands soccer team, PSV Eindhoven.

The first stage of the research involved soccer players wearing wireless transmitters throughout their games. The transmitters send out radio frequency signals that are picked up by sensors along the sidelines.

"After recording the x and y positions of players on the field we then replay it in the virtual environment. So you can see how much free space a player has around him, how many metres others have travelled," Delleman says.

"We can look at the game from any point in space - whether from the middle, from the stands or a bird's-eye view. You can also look through the eyes of a particular player." The software is able to connect the player to a digital mannequin - a computer image of a real person. "So it becomes animated like [the] computer game FIFA 2000," Delleman says.

The virtual reality images are then projected, life-size, onto a domed screen and players and coaches can choose to watch the game from any point in space. From here, coaches can develop skill drills or point out game strategies.

"At the moment we are trying out things, it is not a full system," Delleman says. "The virtual reality doesn't react yet but the player has to react to what is going on."
Delleman says the first step to wider use is to make the transmitters smaller and more wearable. "For example, sensors on the body or to integrate into clothing. We also want to find the location of individual body parts - so we can go to other sports more easily. So you get position and posture." Delleman says volleyball is a sport where both position on the court and body location are essential for meaningful analysis and feedback.

"It is a breakthrough having this amount of accuracy in a large volume," Delleman says. "What will be the next breakthrough will be to come up with analysis software to bring this enormous amount of data down to key figures - giving coaches immediate feedback on whether things are going right or wrong."

In Australia, research is being undertaken to create intelligent three-dimensional simulators so, eventually, there can be interactive play in the virtual environment. For the past two years, Dr Vladimir Ivancevic, a Defence Science and Technology Organisation senior research scientist specialising in modelling and measurement of human performance, has been developing a human muscular-skeletal system designed for the prediction of injuries.

The biodynamics software takes "all the forces you can imagine" into consideration - including gravity, inertial forces, velocity, friction, tendon elastic forces and muscular mechanics. "It is just a simulator at the moment," says Ivancevic, "but now we are releasing its centre of mass so it can move around within the three-dimensional space and we are building in intelligence."

He intends to use adaptive fuzzy logic to create an intelligent model that will know what to do as a situation approaches it. "We have the best software in the world but it is still a bit challenging because such a thing does not exist."

Ivancevic, a mathematician with a sport science background, is hoping his intelligent, free-moving "human performance engine" will be completed in the next year.

He uses tennis as a model to develop the use in sport for his "game-like" software. "There are two players, one to one, it is a relatively simple game," he says. Ivancevic intends to approach the Australian Institute of Sport to discuss the potential of his software in training when he has completed its development.

Damian Farrow, skills acquisition specialist at the AIS who investigates ways to use technology in training, says the institute is a step back from using virtual reality.

Its use is limited because the images in the virtual world are animated, he says. "You don't actually get the skills transfer you think you might get because it is a different environment."

The AIS uses what it calls "augmented reality" training or "interactive visual simulation", which involves projection of video-recorded images on a life-size screen to assist players in their off-field, off-court play.

"Athletes train exceptionally hard these days. Fitness staff have them training as much as they can in a physical sense."

If they trained any longer they would increase risk of injury or fatigue, says Farrow, and this is where the opportunity for augmented reality training comes in. "They practise in a perceptual way rather than the player being on their feet."
The sports with the highest uptake of this technology at the AIS are netball, basketball, AFL and soccer, Farrow says.

By using life-size projections and placing a player in an artificial situation they can watch the athlete interact with the vision. "We measure how they read the situation - their decision-making time and accuracy," Farrow says. "It is about how to make fast, rapid decisions."

While virtual reality hasn't been incorporated into training in Australia yet, Farrow says it will be in the future.

"As technology gets better I have no doubt we will head down that line. And then we could do all sorts of things. We could make a game harder than it really is so then the real game would be really easy in comparison. We could speed things up in the game scenario - so there would be more time to execute skills in a real game."

DSTO's Ivancevic admits there are limitations to using VR technology to improve the skills of top athletes. Fifteen years ago he worked as the biomechanical adviser to world champion sprinter Carl Lewis and Ivancevic says it is much easier to create these systems for training use for the general population than it is for elite athletes. "They are already very advanced so there is very little you can do to improve them."

He says world No.1 tennis player Federer doesn't even need a coach to improve the standard of his play. "And he doesn't need any science," says Ivancevic.

Similarly, Hawkins, who has approached the UK National Cricket Academy to develop training potential with his Hawkeye game, acknowledges there are still hurdles to overcome.

"It is not quite realistic enough at a top level. There is a difference between how it looks within the virtual world and the real world."

In the meantime, while the technology is being developed for use in sports training, Hawkins just hopes the sports simulation will encourage people to get active.

"Part of the Hawkeye is to encourage people into sport. Give them the taste for it and encourage people to go and sign up at their local club," he says.

"Computer games have taken people away from sport. This is a way of coming full circle and using technology to get people back to sport."

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