

Integrating force feedback into therapies for impaired hands

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A kid is receiving virtual door opening training under the guidance of a therapist.
Credit: The Hong Kong Polytechnic University

The Hong Kong Polytechnic University has successfully developed a novel training programme using haptic technology for impaired hands

that cannot function normally. This programme is unique as it provides force feedback, which creates a true sense of weight to the user through the control device.

Our hands are essential to our lives; we need them in all daily tasks including eating, bathing and getting dressed. However, even the simplest tasks are challenging for people with impaired hands due to various conditions such as [cerebral palsy](#), stroke and ageing. Fortunately, they will soon benefit from a new [training](#) technology which may greatly improve their conditions.

In response to therapeutic needs, a computerized training programme against impaired hands has been developed at the School of Nursing of The Hong Kong Polytechnic University. Patients being trained are supposed to exercise their hands through playing a series of well-designed computer games that simulate everyday tasks, such as opening a locked door with a key or pouring tea into a cup. While playing, their hand movements are monitored and recorded by a haptic device, which is connected to the control unit held by the patient at one end, and a computer at the other. The haptic device then feeds the data into the computer, resulting in the instant reflection of the patient's actions in the animation on screen.

In addition, the [haptic technology](#) which the programme employs is more true-to-life than similar programmes, as feedback is provided through the force created by the control unit to players. For example, they can literally feel the weight of a simulated bottle diminishing as the water is being poured out. Such kind of precision will greatly enhance training effectiveness and improve the patient's coordination.



The prototype of the haptic platform customized for self-care training. Credit: The Hong Kong Polytechnic University

Game-based therapies are highly motivating. Firstly, playing 3D games in colourful animation is more interesting than monotonous physical exercises. Secondly, a reward system incorporated in the programme is sure to fuel a sense of competition and accomplishment. "Our games are designed to be engaging. When players make successful attempts, they get bonus points. And as they win, they move on to the next level, where more attractive rewards are waiting," said Dr Kup-sze Choi, the leader of

the research team. It is satisfying for players to work their way up and keep going with the therapy, thereby improving their hand functions.

Compared to physical training, computer simulated training is a safer option when sharp or breakable objects are involved, making practices on preparing simple meals with a knife possible. It is also less likely to be interrupted by undesired circumstances. Dr Choi explained, "For instance, the hands of cerebral palsy sufferers are usually stiff, weak and prone to uncontrolled movements. If they practise pouring real tea in repeated sessions, they may make spills all over the place and end up soaking wet, requiring the healthcare workers to clean up the mess. That is not a good thing for both the trainee and the trainer." With computer simulation, there will be no such interruptions.



The haptic platform technology developed by Dr Kup-sze Choi and his team has won a Silver Medal at the 42nd International Exhibition of Inventions of Geneva. Credit: The Hong Kong Polytechnic University

To cater to different degrees of disability, the programme has a built-in difficulty mode with which the level of difficulty can be adjusted with the touch of a button. Therapists can also monitor their patients' progress easily, as the system keeps track of their movements and performance.

The effectiveness of this [training programme](#) was preliminarily confirmed, as a similar tool aimed to improve hand-writing was tested on the children at the Hong Kong Red Cross Princess Alexandra School. The results have shown a marked improvement in the time they needed to complete the task after two weeks of training. More tests and trials are on the way, and the team expect that a longer period of computer-assisted training will yield greater benefits. The training system has already won a Silver Medal at the 42nd International Exhibition of Inventions of Geneva in Switzerland.

According to Dr Choi, computer simulated training using haptic technology will widen the access to rehabilitation and help more patients with impaired hands . In the future, the team will work on combining this computer-aided rehabilitation programme with traditional therapy in order to optimize the training system and benefit more patients.

Provided by Hong Kong Polytechnic University

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