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Link to video: <https://www.youtube.com/watch?v=h7c54RdqqjU>

**How a tabletop robot may revolutionize physical therapy delivery**

Written by Laura Otto

A longstanding problem with stroke patients left with restricted functioning of their hands is that many miss their physical therapy appointments, slowing their already incremental recovery pace.

Habib Rahman, the Richard and Joanne Grigg Professor and mechanical engineering chair at UWM, is working on a platform that dramatically reimagines how physical therapy is delivered, improving convenience and results for patients.

Rahman, whose lab has been developing a portable, assistive robotic arm, the iTbot, is now taking the research to the next level by putting the assistive arm at the center of a system that therapists can use to assess and treat patients when they are not in the same location.

With the platform that Rahman is building, patients’ physical abilities are evaluated on their home-based robotic arm, providing all the information that clinic-based equipment can offer.

Their performance data is streamed in real time and appears on the physical therapist’s computer screen. But it’s more than just a dashboard.

“We are essentially creating a digital twin of the patient’s evaluation – a virtual model of the physical robotic arm as the patient uses it appears on the therapist’s screen,” Rahman said. “All the data the robotic arm collects in the real environment you can see on the digital twin.”

**Games make it work**

Patients play computer- or tablet-based games designed with input from therapists. These games will push the home user to build muscle strength and a greater range of motion by moving the arm’s handle with their impaired hand.

In one game, for example, the patient sees an array of closely spaced balls and uses the robotic arm to touch each one in succession. Once they can do that, the balls appearing on the screen are spaced out wider, so the reach is further.

The games approach makes it more appealing for patients to complete their therapy. Patients often have trouble sticking with their exercises if they don’t feel like they’re progressing.

“They are improving in clinical visits, but they may not perceive it,” Rahman said. “When they see their game scores go up, however, that gives them more satisfying proof. They can see that progress when they get to the next game level.”

**Benefits for the therapist too**

Therapists, meanwhile, have complete control of the robotic arms, remotely calibrating or adjusting it in response to the patient’s abilities, said Inga Wang, UWM professor of occupational therapy, science and technology, who partnered with Rahman to test the platform with patients.

With VR/AR goggles and an internet connection, [a remote therapist can even see actual interaction](https://youtube.com/shorts/FK_ONZ6QiVQ?si=-4S5Q31-G0DQcYJ_) between the patient and their robotic arm in the patient’s environment.

In the traditional clinic setting, the robotic arm benefits the therapist as much as the patient by reducing their physical strain and automating repetitive exercises so that patients’ time is spent more efficiently.

“This kind of technological innovation is needed,” Wang said, “because one-third of physical and occupational therapists themselves experience musculoskeletal injuries due to the physical demands of conventional therapy.”

**A closer look at what is happening**

When a person experiences a stroke, the nerve damage that occurs prevents the patient’s muscles from receiving appropriate signals from the brain. The extent of debilitation varies. The purpose of rehabilitation therapy is to help the brain re-learn motor functions, Wang said.

The iTbot assistive robotic arm offers three distinct therapy modules.

* With passive therapy, the device gently moves the participant’s limb without their own effort. This stretches muscles without pain and reinforces correct movement patterns.
* Active-assisted therapy enables people to complete prescribed exercises with just enough support to gain full therapeutic benefits.
* Resistive exercise therapy involves the same tasks as active-assisted therapy but adds varying resistance levels to challenge the user further and build endurance.

**Competitive grant funding**

To fund this work, Rahman was awarded a one-year Switzer Research Distinguished Fellowship Grant from the National Institute on Disability, Independent Living, and Rehabilitation Research, part of the National Institutes of Health.

The fellowship’s goal is to support development of technology that can improve rehabilitation or foster independent living for people with disabilities.

Rahman wanted to answer these critical questions in the research project:

* Can the system offer passive, active-assisted and resistive therapy as effectively as in-office-delivered therapy?
* Can the system cost the same or less than traditional therapy?

While those questions require further research, Rahman and his lab have observed potential for the system to achieve both aims. They are solving all the technical hurdles encountered by patients who are testing the system and making improvements based on their feedback.

While the project is specifically focused on hand functioning, the lab is validating the system’s proof of concept.

“Because the robotic arm is portable, we’ve created a framework that could be adapted to deliver other kinds of therapy too,” he said. “For example, if someone with a leg fracture is immobile in the hospital, that person could receive therapy by bringing in the arm – even if the therapist is somewhere else.”