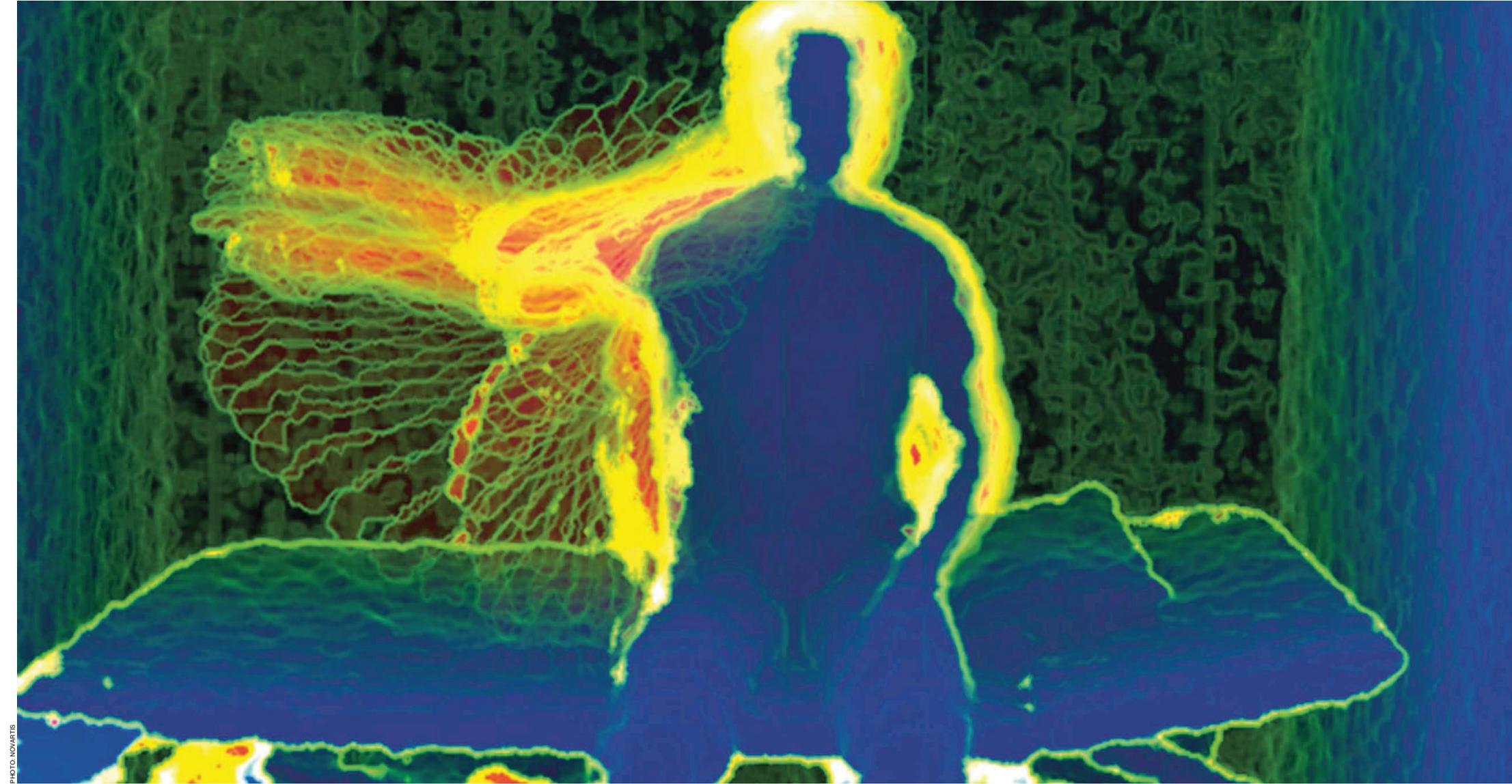


High-tech hopes

Microsoft Research, Novartis and neurologists from the university clinics in Basel and Amsterdam have been working for four years on a new system aimed at improving the assessment of the clinical symptoms of multiple sclerosis. Using Microsoft's sensor technology that was originally developed for its Xbox game console, the system, which is called Assess MS, is currently being tested in Basel, Amsterdam, Bern and Lucerne.
by Goran Mijuk

Color image of a motion sequence by Assess MS.



Marcus D'Souza (above) and Manuela Diederich during an exercise with Patrick Schaefer.

"It's as if I'm dying a little bit every day," says Patrick Schaefer.

About 10 years ago, Schaefer, 47, was diagnosed with multiple sclerosis (MS). "I was just about to get my pilot's license when the disease broke out," he explains. "I suddenly noticed that I was no longer able to focus and I suffered from double vision."

Schaefer, a trained motorcycle mechanic who back then had been working as an insurance agent, had to gradually change his life. "I was able to continue working for a while longer. First, I moved from the field force to the office. Eventually, though, I was only able to carry out simple tasks, until I reached the point when I could no longer go to work."

Schaefer suffers from the relapsing-remitting form of MS and is being treated with Gilenya®, which influences the inflammatory process and helps reduce flare-ups. While the disease progress can be kept in check with medication, dealing with the illness, whose cause is still unknown, remains difficult.

Schaefer struggles to walk, and he also can't keep his mind concentrated for too long. His social life has nearly come to a standstill because of the disease. In public he always walks with a cane, in part to signal to others that he is ill, as his erratic movements sometimes make it seem as if he were drunk.

What will be tomorrow?

A major problem of MS is that the disease progression is unpredictable. "Patients with MS can experience unexpected neurological deficits from one day to the next," explains his treating doctor, Marcus D'Souza, a senior physician at the neurology department of the University Hospital Basel. "There may be symptoms of paralysis, or the patient's vision may be severely restricted or even lost completely from one day to the next. This



uncertainty is psychologically very difficult."

In order to evaluate the disease progression and calibrate the treatment regime, neurologists until recently have exclusively relied on clinical examinations and imaging techniques such as magnetic resonance imaging, using the so-called Expanded Disability Status Scale (EDSS). This records the damage caused by the disease, for example by employing a scale from 0 to 10 to assess how far a patient can walk.

However, EDSS, which has been in place for decades, has some disadvantages. "Despite its standardization, the scale is dependent on the subjective perception and experience of the examining neurologist," explains D'Souza. "Evaluations often differ, depending on who is examining the patient and when. Furthermore, human perception also imposes restrictions on the ability to assess the course of the disease, as the human eye is limited in its capacity for recognizing subtle changes," explains D'Souza.

Game of motion

Ludwig Kappos, Professor and Chair of Neurology at the University Hospital Basel, is well aware of this problem and has for years been looking for solutions that can track the disease progression more objectively.

Likewise, Frank Dahlke, Global Program Head in the Neuroscience franchise at Novartis, knows about these challenges from his clinical research experience. Four years ago, he convinced Kappos that a recording system based on Microsoft's Xbox game console might help objectify the disease evaluation process.

"The development of digital medicine was not as advanced then as it is now," explains Kappos. "But it was clear to me that we could use technological support in the area of MS in order to better monitor the disease progression. A system that records fine-motor activity precisely and can compare it with normal readings or previous observa-

Principal investigator Ludwig Kappos sees enormous potential for digital technologies in healthcare.

tions is enormously advantageous. It provides the physician with precise data that he or she can follow over an extended period."

Machine learning

As a result, Microsoft Research, the University Hospital Basel and Novartis decided to work together to develop a system that records patient movements in the same way as EDSS, but with greater precision.

The project quickly took shape and led to the development of Assess MS. This has a special camera developed by Microsoft, and based on motion sensor technology that generates and records 3D videos of patient movements.

As part of a neurological examination, the camera records, for example, how well a patient can touch his nose with his forefinger or whether the patient is able to balance along an imaginary line on the floor.

Assess MS also uses machine learning. The software trains itself to assess a patient's movements like an expert would – but subtler and with much greater consistency.

The physician can then use these results to assess the disease progression precisely. In future, this could be used in clinical studies to examine the efficacy of new medications.

Interdisciplinary collaboration

Several neurologists are now involved in the project. Besides Marcus D'Souza and Kristina Kravalis at the University Hospital Basel and Caspar van Muster of the Vrije Universiteit Amsterdam, Saskia Steinheimer of the University Hospital Bern and Christian Kamm of the Lucerne Cantonal Hospital are also testing Assess MS.

The challenges of this pioneering project, in which clinical research physicians, Novartis and Microsoft work hand in hand, are considerable. But Novartis is acting as a key enabler.



Above: Caspar van Muster and Saskia Steinheimer during an examination in Amsterdam. Below: Christian Kamm checks a patient's movement on the monitor.

"We have significant experience in the clinical development of new MS treatments, are familiar with the problems of clinical observations and understand the requirements of new technologies to ensure that they can be embedded into clinical research and practice," explains Jonas Dorn of the digital development group, who together with Frank Dahlke is managing the project for Novartis. "We are also familiar with the regulatory requirements and can offer important input in this regard."

Despite all the challenges the collaboration represents an enormous opportunity for Ludwig Kappos. "People sometimes do not speak the same language, and expectations may be different. But we have achieved a lot over the last years and made progress that can be deployed for the benefit of patients."

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In Basel, patients are generally monitored by study nurse Manuela Diederich, who is also responsible for the quality control, organization and documentation of the overall study.

"Technology makes working with patients much easier," she says. "But it doesn't make the physician or the clinical staff redundant. Quite the opposite. Thanks to the technology we can focus on the important things and take better care of the patients."

Patrick Schaefer agrees. He comes to the hospital every six months for a checkup. "Living with MS is difficult. My girlfriend, who also has MS, and I live in fear of the next day. It's important to see something is being done for us. This gives us hope that we will be able to better cope with our disease."

