Robodocs rolling into clinics

by Daithi ó hAnluain

Thanks to advances in mechanical systems and computer science, useful, functioning 'Robodocs' are starting to appear in European and US hospitals.

A huge variety of robotic devices are now being used in surgery, training and patient care. Telemedicine takes advantage of cameras, videoconferencing and the Internet to transmit quantitative and qualitative data on remote patients. Meanwhile, Internet links have allowed a specialist in New York to remove a gall bladder in France.

In Japan tiny, robotic, fur-covered teddy bears provide companionship to people in retirement homes and alert staff if there is no movement in the room. In the US, robotic devices, sometimes controlled by surgeons wearing virtual reality goggles, are improving accuracy and safety in brain and cardiac surgery.

Medical students today are also using prosthetics and 'haptic' devices – which use motors to imitate sensation – to practice tasks like arterial injections on a piece of plastic that accurately mimics human tissue. Similar devices can be used to teach student doctors how to palpitate an artificial abdomen that behaves like the real thing. It can even imitate specific conditions, like a swollen appendix.

Robotic rounds

The future has arrived and can be seen trundling around California's UC Davis Medical Centre. A humanoid robot is performing a doctor's daily rounds as part of a multicentre telemedicine trial. Patient and doctor communicate through the 'robodoc' camera, microphone and video monitor.

Urologic surgeon Lars Ellison MD is part of the multicentre study and uses the Robodoc system to perform his daily rounds from his home or office. He currently uses a joystick to guide his robot around the hospital. Both the doctor and patient can see and hear each other, and the robot's camera can zoom in to provide a view of the patient's vital signs and surgical incision.

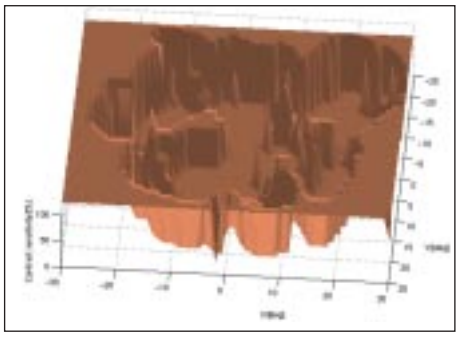
"We think using a robot that allows us to personally visit and check up on our patients after surgery will prove safe and effective. This is another form of "telemedicine," which is becoming increasingly important because it can enhance the quality of care by helping doctors, nurses and other healthcare professionals do their jobs more efficiently and effectively." said Dr. Ellison

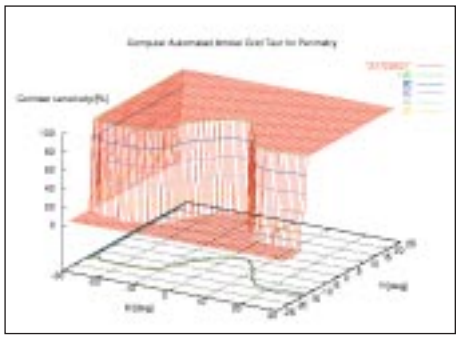
He says that patients appear to be happy with the robot. They would rather see their own doctors via robot than see another unknown doctor in person.

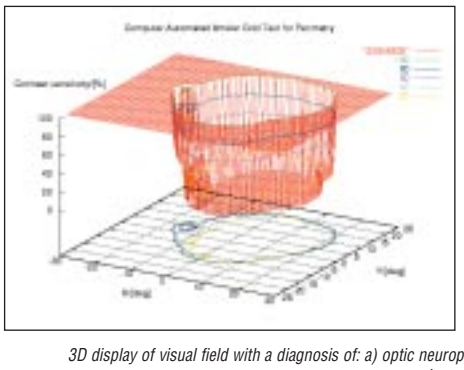
Dr Ellison notes that the Robodoc system could find application in many areas. For example, the robot could bring doctors to quarantined patients or to patients in remote locations or disaster areas.

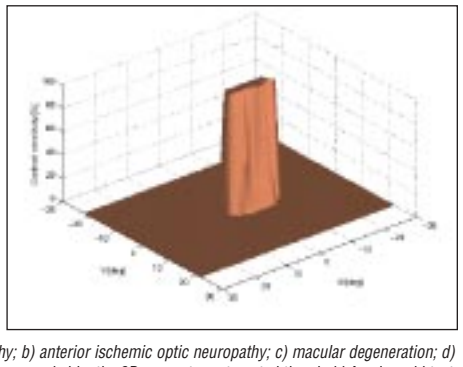
Wolfgang Fink PhD, a senior researcher with NASA's Jet Propulsion Laboratory, who works on machine learning and artificial intelligence, says he believes the Robodoc could save time.

"Particularly if it can go from room to room on its own, visiting all the patients who are due a doctor's visit in turn, so the doctor doesn't waste his time piloting the robot around the hospital." he said.









Courtesy of Wolfgang Fink PhD

3D display of visual field with a diagnosis of: a) optic neuropathy; b) anterior ischemic optic neuropathy; c) macular degeneration; d) glaucoma; recorded by the 3D computer-automated threshold Amsler grid test.

Pharmabots

Robots are playing an increasing role on the pharmacy side as well. One pharmacy robot now in use in US hospitals can fill a prescription in about 10 seconds. Once an order is typed into the system the robot plucks up a bottle, finds the required pills and counts out the number of pills required for the prescription. The system takes seconds and reduces human error, particularly errors related to doctor's infamous handwriting. The robot also checks for contraindications and possible drug interactions.

The Veterans Affairs Medical Centre in Houston, Texas went one step further when it acquired a pair of robotic couriers to deliver medications and supplies on demand. Currently the robots complete a 'round' of 20 nurses' stations each, saving the nurses' valuable time. The robots can also go on a solo run to one station with urgently required supplies.

The Pharmabots and the Robodoc could serve some functions in an eye hospital, but it will be some time before ophthalmology will benefit from sophisticated applications like robotic surgery, said Steve Charles MD, a vitreoretinal surgeon and inventor of robotic surgery equipment, in interview with *EuroTimes*.

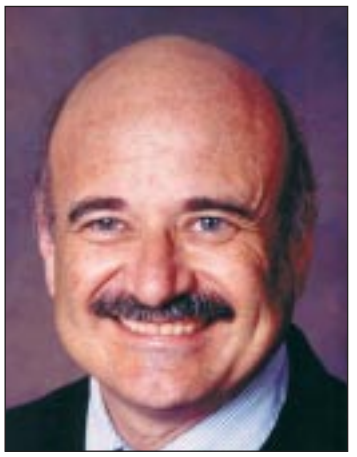
"I do not anticipate the use of robotics in ophthalmology. Eye cases are done under local anaesthesia while robotics requires general anaesthesia. The reimbursement for eye surgery is insufficient to support this technology."

Touch screen visual field test

A digital ophthalmologist of sorts is now being evaluated by NASA for deployment on the International Space Station and other manned missions. A computerized visual field test designed by Dr. Fink and Alfredo Sadun MD, PhD uses an Amsler grid on a touch sensitive screen to perform automated perimetry in 3-D. A patient can self-administer the test. Every time the patient notices a missing area on the grid, he or she touches the screen to circumscribe that area.

In an advance on standard visual field testing, once the patient circumscribes the visible areas of the Amsler grid by touchingthe screen, the computer repeats the test with varying intensities of light. The result is a contrast sensitivity test across the area of each Amsler grid on the visual field test.

"The test is much more sensitive than a standard automated perimetry test. In that test, test points are spacedsix degrees apart from each other, horizontally and vertically,



Alfredo Sadun

Wolfgang Fink

which assigns 36 square degrees of visual field to each tested point. This can miss defects in the visual field, or it can exaggerate defects."

In contrast, Fink and Sadun's system can have a resolution up to 15 arc minutes.

"We had one patient who tested a clear visual field at six degrees spacing with standard visual field tests, and even one degree with our novel test, but when we did a test to a resolution of 15 arc minutes we found a defect," said Dr. Fink.

He says that the real advantage of the system is its readouts. Using visual field and contrast sensitivity data, the system creates a 3-D profile that provides unique topographical profiles of visual field defects.

"You could have had a stroke of the optic nerve, or glaucoma or optic neuritis and the standard visual field test would be pretty useful because it could tell you that the impairment is in the optic nerve. It remains for you to figure out which disease it is," said Dr. Sadun.

But with the new test, doctors can immediately grasp the exact condition. The results pinpoint conditions like anterior ischaemic optic neuropathy and macular oedema, but it will also detect and characterize tumours, strokes and other neurological conditions. Ultimately, the researchers hope to add software that could offer a preliminary diagnosis based on the probability of disease for a given 3D pattern.

Closer to home, literally, an EU funded project demonstrated the potential for using remote monitoring of patients with chronic conditions. Researchers in Glasgow developed a Doc@Home device that can monitor patients in the home. Patients answer a series of questions or plug in a blood pressure monitor, electrocardiogram or other device such as a blood glucose monitor. The robotic doc also lets the patient know when he or she should get to the hospital to see the real thing.

Alfredo A. Sadun, MD PhD
asadun@usc.edu

Wolfgang Fink PhD
wfink@krl.caltech.edu