ROKE MANOR RESEARCH LTD

MICROSOFT KINECT® GESTURE RECOGNITION
SOFTWARE FOR STROKE PATIENTS

Using the Kinect® Microsoft technology, a team at Roke Manor and Southampton University have developed a self-monitoring exercise for post-stroke sufferers. The goal now is to create a unique medical gesture recognition device which post-stroke sufferers can use at home to speed up their rehabilitation process.

Roke Manor Research Ltd lies hidden in the depths of the English countryside. It has long provided classified technology services to the UK Ministry of Defence and various Government departments, alongside its commercial customers. The approach to the Manor would make a perfect setting for a James Bond film.

PLESSEY ROOTS

The house and estate were bought for £13,000 in 1956 by Sir Allan Clark whose family managed Britain’s former leading radio telecoms and defence electronics company, Plessey. The house became Plessey Research Roke Manor Limited, and in this capacity served as the location for the “Radio Research group into Electronic Warfare”, which came to establish Plessey as a leader in this field.

While much of the research at Roke continues to be related to the defence sector, a growing proportion feeds into commercial projects. One example is the “Hawk-Eye” software, which Roke developed to track the flight of a cricket ball in Test series cricket matches. This adaptation of “missile-tracking” expertise helped to revolutionise the television coverage of Test Cricket. The rights were acquired by Sony who have adapted it for other sports, such as tennis, as anyone watching Wimbledon on television will have seen.
NEW HEALTHCARE GROUP

When Roke was part of Siemens, it did some work in medical areas like large medical scanners, but this was always tied to Siemens. Under its new owner, Chemring plc, it has been encouraged to extend its activity, hence the formation of a Healthcare Group in 2011, which can look for opportunities to apply Roke’s expertise in wireless communications, sensors and information systems. It is also building on its heritage in medical scanners to work on projects such as implantable pacemakers, wireless hearing aids, and contactless measurement of physiological vital signs.

Simon Wickes, Roke’s Healthcare Group Manager, was recruited to co-ordinate the healthcare strategy. His area of expertise is in the field of bio-mechanics, which he previously applied whilst working for the Ministry of Defence on aircrew injury, and areas like chronic exertional compartment syndrome, aircraft passenger seat design, and military clothing and equipment. He also used his bio-medic skills to help double-Olympic gold medalist James Cracknell and TV presenter Ben Fogle to prepare themselves, physically and mentally, for their race to the South Pole.

HISTORY OF ROKE MANOR RESEARCH LTD

- 1956 - Founded as Plessey Research Roke Manor Limited by the Plessey Company.
- 1990 - Passed to GEC Siemens in a joint takeover.
- 1991 - Became wholly owned by Siemens AG when GEC sold its 50% shareholding to Siemens Plessey Electronic Systems.
- 2010 - Roke was acquired by the Chemring Group Plc.
The first product on which the healthcare group is working is a stroke rehabilitation gesture recognition device. The work has come out of a longstanding collaboration with the nearby University of Southampton’s School of Computing. One of the researchers in the School, Dr Cheryl Metcalf, specialises in using engineering techniques in physical rehabilitation; she was applying this to investigate differences in wrist movements and hand function between unimpaired and chronic stroke victims.

As Roke has particular expertise in visual processing, this presented a good match for their respective skills.

The University group can also guide the clinical process as it has done studies in several aspects of post-stroke rehabilitation and developed a suite of hand movement activities which have been sold to healthcare providers in the UK and the USA. Roke’s work therefore is grounded in the University’s experience in end-usability, clinical research, as well as functionality.

**KINECT®**

Two MA students in the School of Computing were assigned to develop a set of algorithms to track the position of hand-wrist movements and render them into a single hand model. Roke provided the technical leadership, and proposed the idea of using Microsoft® Kinect as a simple gesture recognition device.

The University’s algorithm is the baseline which has proved the feasibility of using gesture recognition technology. New Roke is making the algorithm more robust so that it can understand more precisely the complex movements of the hand and wrist interaction.

Roke can either use the existing Microsoft Xbox with Kinect, or buy the camera unit in the handheld “bar” unit from PrimeSense, which supplied the unit to Microsoft, and build its own medical version. At present, the preference is to build its own. A low-cost option would be to use the ultra-cheap, credit card-sized Raspberry Pi single board computer as the graphics processor (the Raspberry Pi is a stripped down single board computer designed by the Chief Technology Officer of Broadcom Ltd Cambridge to help promote programming skills; it is sold by the Raspberry Pi Foundation).

**CHALLENGE**

The problem as well is the Microsoft Kinect system is only able to monitor whole limb movements; it cannot distinguish the minute movements of the hand under every condition. To resolve this is one of the most challenging tasks facing the research team. The main difficulty is that fingers and parts of the hand obscure individual finger placements and movements. The challenge is to develop a model which is robust enough to track individual finger movements across the 20 degrees of freedom, and upwards, of a hand, using a single camera unit.

**STROKES**

Strokes are the single major cause of severe disability in the UK, claiming 50,000 new victims each year in the UK. It is estimated that every year half of stroke patients experience upper limb problems. The UK health and social care services spend £2.5 billion on care and rehabilitation each year. Anything which reduces the amount of time that a patient needs to see health professionals will free up resources and help to reduce costs.
HOME REHABILITATION
Roke’s aim is to offer a product designed for “home rehabilitation”. The device therefore will be internet-enabled in order to provide real-time data transfer between the physiotherapy clinic and the patient’s home. The likelihood is that Roke will sell the gesture control units to physiotherapy clinics which will then either sell them or lease them to patients.

The expected benefits are that it will reduce the need for stroke victims to visit clinics so often. It will also serve as a good complement to the home-based physiotherapy care service which is already offered to patients in the UK. This service however is stretched by lack of resources, which according to a recent report by the UK Stroke Association, is holding back the recovery of stroke survivors.

HOME EXERCISE BENEFITS
Stroke sufferers are expected to use the device for 40-45 minutes, five times a week. The interactive device is expected to encourage people recovering from strokes to do more regular and precise exercises. As a result, users are also expected to be more interested to report their progress to their physios and to follow up advice the physios give them. Communication and outcomes will therefore improve and patients will recover faster.

Wickes says a full working prototype should be ready in the latter part of 2013. It will then need to go through a rigorous testing and validation phase prior to gaining regulatory approval for its introduction. Roke will entrust specialist distributors, initially in the UK, to sell the device. Once interest is validated it will expand sales to other territories.
The quality of the exercises will be important to the success of the rehabilitation service. Therefore the next objective is to create a series of computer games which make the rehabilitation experience more rewarding. These games could adapt to each individual’s ability and encourage them to reach their rehabilitation goals - for example by feeding back higher scores if their joint movements improve.

OTHER OPPORTUNITIES

The healthcare group is also thinking about other applications for gesture recognition. One example given is using gestures to control surgical instruments in hospitals in order to improve efficiency and reduce infection risk. Other applications include recognition of sign language through to using hand gestures to control settings in a car. The new healthcare group may have plenty to keep it busy.

www.roke.co.uk