TOGETHER WE CAN **OPEN UP THE FUTURE**

The Open University

LEARNING TO WALK AGAIN AFTER A STROKE

How haptic bracelets can restore confidence and independence

Restoring an individual's ability to walk, or 'gait rehabilitation', is a fundamental objective for anyone suffering from gait impairment as a result of a stroke or other neurological condition. Being able to walk again independently and unaided is essential to independence and overall quality of life.

Yet after completing standard rehabilitation, approximately 50% - 60% of stroke patients still experience a degree of impairment and approximately 50% are partly dependent on others in their every-day activities. Furthermore, current rehabilitation is expensive and individuals are rarely able to undergo therapy outside of specialised clinics.

There is a clear need for cost-effective rehabilitation, easily usable by individuals, to improve gait in everyday settings: a need that The Open University recognises. Consequently, a small project team, led by Dr Simon Holland, has developed a unique and pioneering approach, based on low-cost, wearable technologies, to allow patients to improve their gait outside of hospitals or clinics.

The result is a rehabilitation process that patients are able to undertake independently - using the technology

in their own time, without the need for costly equipment. Early trials suggest that this technology can be successful in encouraging rehabilitation amongst patients suffering from movement impairment, offering help with limb coordination, movement, pace and rhythm. The research has enormous potential, not only to provide effective and economical means of rehabilitation, but also to significantly improve the lives of thousands of individuals suffering from the physical effects of a neurological condition.

Using haptic technology in healthcare

The OU is at the forefront of innovative research and design, bringing to life a diverse range of research projects that have a demonstrable impact on individual lives and society at large. Indeed, it is this value – to create and disseminate research that is of inherent social value - that drives the University's work and overall mission.

Demonstrating this perfectly is the development of groundbreaking haptic technology, led by Dr Holland. Haptic technology, meaning communication through the sense of touch, is an exciting and pioneering form of wearable technology. Currently in its prototype stage, it consists of four self-contained and lightweight wireless bracelets for wrists and ankles.

Within each are small computers and vibrotactiles, which provide virtually instantaneous (felt within 6 milliseconds) vibrations to the user. The bracelets measure limb movement and generate carefully timed rhythmic 'touches' to synchronise and improve limb coordination. For example, they can enable the wearer to keep to a particular pace, or provide touch about changes needed to their gait.

Initially developed for use within music – helping drummers to learn new rhythms and keep to a beat – the technology was soon identified as one that could have significant relevance and importance within the field of healthcare.

Pilot study

The bracelets have been successfully trialed in collaboration with the Sensory Motor Neuroscience Research Centre at Birmingham University. An initial pilot study was carried out in June 2013 at the Worcester Motion Capture facility with a stroke survivor volunteer, to investigate the use of the haptic bracelets for haptic cueing for purposes of gait rehabilitation. Although this was a single pilot, the results were extremely promising. The volunteer stroke survivor commented: 'this helps me to walk in time. It's just sort of having an even pace […] which helps me stand up straight and walk properly'. Furthermore, preliminary analysis of the data suggested better range of movement once the individual wore the bracelets and an increased flexion at the knee.

Aims and objectives

With this initial pilot study indicating the potential success of haptic technology in rehabilitation, the University is now seeking further support to progress the development of this innovative form of rehabilitation. With additional funding, the project will be able to achieve the following objectives and aims:

- To discover how wireless wearable systems for rhythmic haptic stimulation can be best developed and applied for gait rehabilitation and the improvement of limb co-ordination.
- To find out how the technique can be best refined for different conditions, e.g. hemiparetic stroke, Parkinson's, cerebral palsy or MS.
- To find out how to adapt the technology to suit individual differences between survivors.
- To develop effective, low cost prototypes of the haptic bracelets.
- To demonstrate clinical effectiveness.
- To develop appropriate supporting technologies that give greatest power and ease of use to the end user. For example, smart phone apps or batteries.

How your support can help

Below are examples of how additional support would be used to develop the Haptic Bracelet technology:

Stage 1: £10,000 – The Pilot Phase

This would enable us to pilot the technique with different neurological conditions, e.g. hemiparetic stroke, Parkinson's, cerebral palsy. This would be achieved through the creation of a paid internship.

Stage 2: £100,000 - Proof of Concept

This would enable the team to build on Stage 1 and produce evidence of its clinical effectiveness within laboratory settings. This funding would support the creation of a dedicated post-doctoral post for eighteen months and access to clinical grade motion capture facilities.

Stage 3: £500,000 - Evidence of Effectiveness at Home and in Everyday Life

This funding would allow the project team to build the technology needed for patients to use this technology independently, within their own home. The funding would support a dedicated post-doctoral post and PhD post for three years.

Stage 4: £1,000,000 - Ready for Market

This would enable all of the above and in addition allow us to create and produce the eventual product - the Haptic Bracelets - which would be ready for market.