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Review of Sensing and Robot Solutions to Stroke Rehabilitation, Focusing on Upper Limbs

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***Abstract*—The abstract goes here.**

***Index Terms*—Stroke, robot, sensors.**

I. Introduction

THIS review is intended as a resource for people wishing to do further research into robot or sensor systems for rehabilitation of stroke victims with hemiplegia. Systems based on functional electrical stimulation (FES) will not be covered in this review.

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A. Effects of a Stroke

1) Right or Left Hemispherical Stroke: A stroke in the right or left hemispheres of the brain can cause partial or full paralysis down the opposite side of the body (hemiplegia). It can also cause problems with short term memory [1].

Right-hemispherical strokes can also cause the victim to suffer a loss of spatial awareness and an impairment of judgment that manifests as impulsiveness [1].

Left-hemispherical strokes can cause the victim to develop problems with language (aphasia) and may effect their judgment in the opposite way to right-hemispherical victims, becoming ponderous and unsure [1].

2) Cerebellar Stroke: A cerebellar stroke affects balance and co-ordination and can cause dizziness and nausea [1].

3) Brain Stem Stroke: Brain stem strokes are the most dangerous as this is the part of the brain that controls essential functions such as your heart, breathing and swallowing [1].

A stroke in the brain stem can also cause full or partial paralysis in either or both sides of the body [1].

B. Traditional Rehabilitation of Stroke Patients

The most basic aim of stroke victim rehabilitation is to allow the victim to regain thier independence. The management of stroke patients is broken down into three areas: acute care, rehabilitation care and community care [2].

1) Acute Care: This is the stage of care that covers preventing further strokes and making sure the patient is breathing and their heart is beating. The patient's bladder and bowel function should be checked at this stage along with their ability to perform the actions associated with such. The patient should also be brought to a point whereby they can move, albeit with impairments. The last element of care at this stage is emotional support to the patient and their family [2].

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2) Rehabilitation Care: This stage of care is all about improvement, it's about setting goals, developing a plan and then monitoring the patient's progress against these. It is about getting the patient back on their way towards normality or at least towards 'functional independence'. It is also about getting the patient to a stage were they're ready to go home [2].

There are several tests through which the patient's motor and sense function can be evaluated, a popular one is the fuglmeyer test which score the patient out of 100 for the whole body (66 for upper limbs, 34 for legs). This score can then be used to measure improvement over the course of treatment.

3) Community Care: This stage of care is all about reintegrating the patient, into the community and potentially into work as well if they had a job. It is also about providing support to the patient and to their family and any carers they might have. The patient should also continue with their rehabilitation plan as it is likely that further improvement can still be achieved [2].

C. How Sensing / Robots can Help

Robots for upper limb rehabilitation as they exist at the moment are systems for monitoring position of all or part of the arm, often linked to a game or simulation in a virtual environment. [REF]

These robots are helpful to rehabilitation because they can provide detailed feedback which provides useful information to the physiotherapist and potentially a sense of achievement to the patient, allowing them to monitor there own progress. Linking the system to a game or simulated environment also helps to improve the patient's motivation. [REF]

There is evidence that use of robots in rehabilitation leads to functional improvements in the patient but there is some question as to whether this is much of an improvement over traditional methods (i.e. not involving a robot). [REF]

1) What they need to be able to do: At the most basic level the system needs to be able to accurately measure and report the position of the limb (or section of limb) that it is to be used to aid in the rehabilitation of.

In order for the system to be more effective as a rehabilitation tool it should also be able to support the limb in order to help reduce the likelihood of injury to the patient and it should also comfortable to use for extended periods. [REF]

It has also been shown to be helpful for the system to incorporate some form of interactive virtual environment, such as a game, in order to increase their motivation and maintain their cooperation. [REF]

2) Challenges: Impersonating a physiotherapist.

II. Sensors

A. Position/Movement Sensors

Mapping position in space: accelerometers, strain gauge, ...

B. Angle Sensors

Mapping angle (e.g. at joints): potentiometers, magnetometers, ...

C. Force Sensors

Mapping force (gripping/pushing): QTCs, force resistors, ...

III. Robotic Systems

A. InMotion2 and InMotion3

based on MIT-MANUS

B. ARMin

IV. Systems in development

V. Other Possible Approaches

VI. Discussion

Discussion goes here

VII. Conclusion

The conclusion goes here.

Appendix A
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Appendix one text goes here.

Appendix B

Appendix two text goes here.

Acknowledgment

The authors would like to thank...

References

[1] National STROKE Association Web. 14th Apr. 2012 http://www.stroke.org/site/PageServer?pagename=EFFECT

[2] physiotherapy-treatment.com Web. 5th Apr. 2012 http://www.physiotherapy-treatment.com/stroke-physical-therapy.html

John Charlesworth Biography text here.