Chapter 9
Using Leap Motion and Gamification to Facilitate and Encourage Rehabilitation for Hand Injuries:
Leap Motion for Rehabilitation

Jamie Taylor
University of Kent, UK

Kevin Curran
University of Ulster, UK

ABSTRACT
Injuries to the hand are more common than those of any other body region and can have considerable financial, time-measured and psychological impact on not only the victim but also the community as a whole. Hand rehabilitation aims to return people to their pre-injury roles and occupations and has proved largely successful in doing so with the potential for technology to improve these results further. However, most technology used in hand rehabilitation is based on expensive and non-durable glove-based systems and issues with accuracy are common among those that are not glove-based. This chapter proposes the use of accurate, affordable and portable solutions such as the Leap Motion as a tool for hand rehabilitation. User feedback can be provided primarily through an animated 3d hand model as the user performs rehabilitative exercises.

INTRODUCTION
At present, it is common for individuals with hand injuries to undergo rehabilitation using no technical aids. Efforts to improve rehabilitation through the use of technology have led to a number of systems being proposed, where most of these systems are glove-based, with only a few alternatives. The glove-based systems are (for the most part) prohibitively expensive (O’Donnell, 2010), and the few alternatives such as Kinect (Connolly, 2012) can suffer from portability and accuracy.
issues. It should also be noted that none of these system take advantage of gamification. Gamification is the use of game-like elements in traditionally non-game like settings, and has been proven to increase user enjoyment and participation.

In response to this need for new rehabilitation technologies, this chapter suggests that there is scope for motion-based systems such as the newly released Leap Motion\(^1\) to assist in rehabilitation. This chapter outlines the potential for such a system to assist in hand rehabilitation. We believe that the Leap Motion, a new, recently released motion-based device has yet to be investigated as a tool for hand rehabilitation. We suggest that it should be accompanied by a software in the form of an animated 3D hand model which will reflect the users hand movements in real-time. The results from the exercises can then be stored for later viewing by either the patient or a clinician. Furthermore, the addition of gamification elements to the proposed system can help encourage patients to adhere to prescribed exercise programs. We next investigate current techniques and technologies used in the field of hand rehabilitation to better inform the design of such a motion-based capturing system.

Of the treatments listed above, it is “design and implementation of home exercise programs…” and “instruction in home exercise programs” that are of particular relevance and interest. (Lavamon, 2013) Points out that such hand therapy exercises should be “motivating, repetitive, interesting, challenging and graded”, (Amini, 2011) adds that these exercises should incorporate “usual and customary occupation activities…”, this is important, given that the aim of hand therapy as described above is to return patients to their occupational and pre-injury roles. At present, it is common for home exercise programs to be performed without the use of technological aids or systems. Hand therapy offers a high success rate as a treatment for hand injuries. Of those studied and treated in (Case-Smith, 2003), 80% returned to work after an 8-week course of treatment consisting of 13 hours of treatment on average. These results are of particular relevance because during this time, the occupational therapist was the patient’s sole provider of rehabilitation ser-

Table 1. Non-Operative/Postoperative Hand Therapy Treatments

<table>
<thead>
<tr>
<th>Preventative, Non-Operative, Conservative</th>
<th>Postoperative Rehabilitation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Management of acute or chronic pain</td>
<td>Management of open or sutured wounds</td>
</tr>
<tr>
<td>Desensitization following nerve injury or trauma</td>
<td>Control of hypertrophic or hypersensitive scars</td>
</tr>
<tr>
<td>Sensory re-education after nerve injury</td>
<td>Reduction of swelling</td>
</tr>
<tr>
<td>Design and implementation of home exercise programs to increase motion, dexterity and/or strength</td>
<td>Fabrication of orthoses to protect surgery or increase movement</td>
</tr>
<tr>
<td>Training in performance of daily life skills through adapted methods and equipment</td>
<td>Instruction in home exercise program</td>
</tr>
<tr>
<td>Splint fabrication for prevention or correction of injury</td>
<td></td>
</tr>
<tr>
<td>Conditioning prior to returning to work</td>
<td></td>
</tr>
</tbody>
</table>

BACKGROUND

Hand rehabilitation therapy is a form of occupational therapy (Burke, 2009). Hand rehabilitation/therapy is focused on “…enabling the client to regain functional use of the traumatized arm and hand … and return to their pre-injury occupations.” (Case-Smith, 2003). The treatment offered by hand therapy can be divided into two main categories; these are preventative, non-operative and post-operative. Using the information presented in (American Society for Surgery of the Hand, 2011), a more complete list of treatment options offered through hand therapy can be compiled and is presented in Table 1.
Related Content

An Experimental Evaluation of the Effectiveness of Endogenous and Exogenous Fantasy in Computer-Based Simulation Training

Insights into the Impact of Social Networks on Evolutionary Games
[www.igi-global.com/chapter/insights-into-impact-social-networks/20161?camid=4v1a](www.igi-global.com/chapter/insights-into-impact-social-networks/20161?camid=4v1a)

Evolving Bots’ AI in Unreal™
[www.igi-global.com/chapter/evolving-bots-unreal/66321?camid=4v1a](www.igi-global.com/chapter/evolving-bots-unreal/66321?camid=4v1a)

An Adventure in Usability: Discovering Usability Where It Was Not Expected
Holly Blasko-Drabik, Tim Smoker and Carrie E. Murphy (2010). *Serious Game Design and Development: Technologies for Training and Learning* (pp. 31-46).
[www.igi-global.com/chapter/adventure-usability-discovering-usability-not/41066?camid=4v1a](www.igi-global.com/chapter/adventure-usability-discovering-usability-not/41066?camid=4v1a)