Vague Gestures:

Game Input for Burns Patients

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EXTENDED ABSTRACT

For burns patient range-of-motion rehabilitation, remedial exercises play a very important part (Edgar & Brereton 2004; Rrecaj et al 2015). Vision based sensors have been successfully used for motivating patients to perform these exercises (Mousavi & Khademi 2014; Perry et al 2014; Voon et al 2016). Particularly important with burns patients, visual sensors as a means of control eliminate the need for controller dysinfection. Virtual reality technology has also been applied to rehabilitation as a means of distraction from pain and discomfort (Holden 2005; McSherry et al 2018; Sharar et al 2008).

This paper presents the initial stages of a project which combines these two technolgies, to create an immersive game-like environment to both distract from discomfort and encourage rehabilitation. A game-like robot hospital will encourage patients to perform their range-of-motion exercises via them helping/repairing virtual robots. However, the goal of our research is for effective *vague* gesture control. Gestures may be vaguely detected due to reasons such as: patient injuries inhibiting the enaction of gestures; bandages or compression gloves/suits interferance; the inacuracy of vision based sensors (Hondori & Khademi 2014); and the loss of fidelity when detecting appendiges like fingers beyond a fairly short range (Ma & Peng 2018). These reasons can lead to visual gesture detection lacking clarity, thus becoming *vague*.

In typical visual gesture recognition, gesture images are examined in isolation from other factors. To help clarify poorly detected hand gestures, multi-scale gesture detection (Neverova et al 2013) can be used, where hand gesture recognition is combined with body gesture recognition. We take this further by using extra environmental and situational information to help clarify gesture recognition and provide better gestural classification. The approach being taken is to use these

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additional factors to make predictions via the use of temporal machine learning (Koppula & Saxena 2015; Sadegh et al 2017; Shi et al 2018). Past performance (training data) can be used to generate action-sequence modelling. The modelling of past action-sequences can then be applied to currunt actions to provide a prediction of a future gesture before it is completed. In essence, the system has an understanding of the scene, which enables it to better determine what an enacted gesture may be.

While the aim of this paper is to clarify vaguely detected gestures, if a gesture can not be determined to any decernable degree, the system may still recommend a gesture based entirly on prediction. This would be akin to a person making assumptions about the actions of others. For a non-critical rehabilitation system, this is acceptable. The machine learning components will additionally incorporate feedback to allow the system to also react to a patients progressive recovery. Working with occupational therapists, it is expected that real patients will be eventually used to validate the system as a remedial tool. A gesture recognition system that can seemingly understand imperfect gestures in a way that matches human expectations, may help the developed gamified rehabilitation tool become more versitile and rewarding to use.

BIO

Rodney Zsolczay is a PhD candidate who has a strong interest in Augmented Reality, Gesture Control, and Gamification.

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BIBLIOGRAPHY

Edgar, Dale and Brereton, Megan. 2004. ABC of burns: Rehabilitation after burn injury. *BMJ: British Medical Journal* 329, 7461 (2004), 343.

Holden, Maureen K. 2005. Virtual environments for motor rehabilitation. *Cyberpsychology & Behavior* 8, 3 (2005), 187–211.

Hondori, Hossein Mousavi and Khademi, Maryam. 2014. A Review on Technical and Clinical Impact of Microsoft Kinect on Physical Therapy and Rehabilitation. *Journal of Medical Engineering* ArticleID 846514 (2014).

Koppula, Hema S and Saxena, Ashutosh. 2015. Anticipating human activities using object affordances for reactive robotic response. *IEEE Transactions on Pattern Analysis and Machine Intelligence* 38, 1 (2015), 14–29.

Ma, Xuhong and Peng Jinzhu. 2018. Kinect sensor-based long-distance hand gesture recognition and fingertip detection with depth information. *Journal of Sensors* 2018.

McSherry, Theresa; Atterbury, Michelle; Gartner, Sarah; Helmold, Emily; Searles, Denise Mazzacano and Schulman, Christine. 2018. Randomized, crossover study of immersive virtual reality to decrease opioid use during painful wound care procedures in adults. *Journal of Burn Care & Research* 39, 2 (2018), 278–285.

Neverova, Natalia; Wolf, Christian; Paci, Giulio; Sommavilla, Giacomo; Taylor, Graham and Nebout, Florian. 2013. A multi-scale approach to gesture detection and recognition. *In Proceedings of the IEEE International Conference on Computer Vision Workshops*. 484—491.

Parry, Ingrid; Carbullido, Clarissa; Kawada, Jason; Bagley, Anita; Sen, Soman; Greenhalgh, David and Palmieri, Tina. 2014. Keeping up with video game technology: Objective analysis of Xbox Kinect and PlayStation 3 Move for use in burn rehabilitation. *Burns* 40, 5 (2014), 852-859.

Rrecaj, Shkurta; Hysenaj, Hajrie; Martinaj, Merita; Murtezani, Ardiana; Ibrahimi Kacuri, Dafina; Haxhiu, Bekim and Buja, Zene. 2015. Outcome of Physical Therapy and Splinting in Hand Burns Injury. Our Last Four Years' Experience. *Materia socio-medica* 27, 6 (2015), 380.

Sadegh Aliakbarian, Mohammad; Sadat Saleh, Fatemeh; Salzmann, Mathieu; Fernando, Basura; Petersson, Lars and Andersson, Lars. 2017. Encouraging LSTMs to anticipate actions very early. *In Proceedings of the IEEE International Conference on Computer Vision*. 280–289.

Sharar, Sam R; Miller, William; Teeley, Aubriana; Soltani, Maryam; Hoffman, Hunter G; Jensen, Mark P and Patterson, David R. 2008. Applications of virtual reality for pain management in burn-injured patients. *Expert review of neurotherapeutics* 8, 11 (2008), 1667–1674.

Shi, Yuge; Fernando, Basura and Hartley, Richard. 2018. Action anticipation with rbf kernelized feature mapping RNN. *In Proceedings of the European Conference on Computer Vision (ECCV).* 301–317.

Voon, Kimberly; Silberstein, Ilan; Eranki, Aditya; Phillips, Michael; Wood, Fiona M and Edgar, Dale W. 2016. Xbox Kinect based rehabilitation as a feasible adjunct for minor upper limb burns rehabilitation: A pilot RCT. *Burns* 42, 8 (2016), 1797– 1804.