

Design and development considerations for serious games to assist in the rehabilitation of patients with back pain - An overview

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1. INTRODUCTION

In this paper, we present a survey of serious games for rehabilitation of back pain. We explore the need and context for the serious games for back pain rehabilitation and compare key features of contemporary games in this category. This study sets the context for future PhD research work in creating the games for patients with back pain.

Physical therapy is the branch of medicine that deals with the rehabilitation of patients using specific exercise interventions to help patients improve or regain physical abilities (Charles Patrick Davis, 2021). Rehabilitation can help reduce pain and improve mobility in patients with injuries or musculoskeletal conditions. However, some patients may lack the motivation for physiotherapy or they may lose interest mid-intervention. Maintaining patient engagement in physiotherapy becomes a challenging task health care professionals. Patient motivation is a key factor in rehabilitation success and the challenge is to ensure patient motivation and engagement remains high. Digital games can provide a fun and engaging experience and game technology, in combination with other ICT technologies, can applied to a broad range of fields including healthcare (Göbel et al.). Serious games refer to digital games where the primary function is not just entertainment but to achieve at least one additional goal such as learning or health related (Dörner, Göbel et al. 2016).

2. CONTEXT

Physical rehabilitation is a useful way of treating various back pain conditions. Conventional physical rehabilitation such as physiotherapy is useful but have various limitations for the patients as well as health care providers. For the former, there can be issues around motivation, fixed appointment times,

travel implications and long course of intervention. For the latter, there are issues around missed appointments as well as financial, workload and expertise implications (Bonnechère et al., 2016). Unsupervised exercises that may end up worsening the condition (Liao et al., 2020).

It is a proven fact that serious games-based learning has a positive effect on making changes in health-related behaviour (Göbel, Hardy et al.). Serious games have found many applications in health particularly in rehabilitation of patients who have suffered injuries or stroke. Rehabilitation using games has been utilised for the treatment of stroke, injuries, trauma, spinal pain, neurological pain and arthritis. Some commercial games have also been used for rehabilitation purposes and with limited success.

There are three key rules that remain the same for rehabilitation games; firstly, the game should be fun to play and enjoyable in order to keep the level of motivation and engagement in patients high. Secondly the game should be customisable to allow for specific exercises for the respective needs of the patient. Lastly, there needs to be a measure of assessment to record and document the patient's performance (GestureTek, 2016).

One factor that plays a key role in player motivation is the player's own imagination that builds upon the fantasy world of the game and keeps them engaged with the game and help break the monotony of routine exercise (Van Der Spek et al.).

3. EXPLORATION METHOD

In this study, our focus has been on three key terms "rehabilitation", "game" and "back pain". Papers selected are from year 2018-2021. A total of 106 papers were found. After taking out repeat titles and unrelated papers, sixteen papers were selected. We used an exclusion/inclusion criterion based on age range of 18-60, and limiting one paper per author

team. Based on these criteria, four papers were identified.

type, c) player movement/motion (localised or full body), and d) clinical or home setting. Details of the study are given in Table 1.

Following elements were considered during the study: a) medium used for input & output, b) game

Age range	Input /output	Game type	Body part movement	Clinical/lab or home setting	Reference
18-60	12 camera Vicon Bonita Motion Monitor software, unity, head mounted display, hand controllers, Vive™ trackers system,	Matchality, Fishality, and Dodgeality	Lumbar flexion excursions	Lab	(France and Thomas, 2018)
18-65	Wireless motion sensor (Valedo®Pro, Hocoma)	Guiding a caterpillar Guiding a fish	Lumbar spine and pelvis, pelvic tilt	Clinical	(Matheve et al., 2020)
40	Microsoft Kinect Xbox	Soccer ball	Lumbosacral movement		(Mbada et al., 2019)
18-25	Pro-Kin system PK 252 N Techno body	Shooting game	Trunk movements (flexion, extension and lateral flexion)	Clinical	(Nambi et al., 2021)

Table 1: Summary of studies on back pain rehabilitation

4. CONCLUSION

Using games for physical rehabilitation of back pain is an active area of research. Current studies are mostly based on non-specific chronic back pain. Important considerations for serious games for patient rehabilitation are economy, motivation, time and reduction in therapist needed for each session.

In our survey, we did not find any adverse effects of the games made particularly for back pain being identified.

With the advancement of gaming technology and rise in serious games for rehabilitation, the aesthetics of games and game design is also gaining importance. Our future work will be focussed on using escapism and fantasy to drive the game aesthetic and game play in order to increase and enhance patient motivation and engagement in serious games development for rehabilitation of patients with lower back pain.

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