

# Chapter 13

## Towards Interactive Virtual Environments through Handheld Devices for the Disabled: A Performance–Evaluation Perspective

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### ABSTRACT

*The successful integration of novel interactive virtual environments for everyday life applications may constitute an important indication towards similarly employing Virtual Reality (VR)-related technologies in primary care. This chapter presents the results of a usability study that makes use of an Android-based handheld device for investigating disabled users' performance in using an intuitive interactive VR interface for pain assessment. A convenience sample of seven wheelchair users was asked to evaluate the interface and involved the use of non-participant direct observation, note taking, and thinking-aloud protocol to collect the necessary data. The evaluation results demonstrated good acceptance and a generally positive performance of the participants when they completed a set of predefined interaction tasks. It is anticipated that the findings of this study may have good practical implications to the assessment of pain and could open the way for increasing the use of such technologies in everyday healthcare provision.*

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## 1. INTRODUCTION

Today's information-intensive society is characterised by an increasing number of people who demand easy and on-the-spot access to information in order to improve the delivery of some of the existing everyday services. Technological advances of recent years have certainly contributed in making it possible to exploit the benefits of *mobile computing* to support the paradigm of 'anytime, anywhere access' (Perry et al. 2001, p.3) to new approaches of data gathering and information provision through a wide range of handheld devices. At the same time, similar advances in graphics hardware have also made it possible for such handheld devices to have the computing power needed to use Virtual Reality (VR) technology as a new approach for visualizing a wide range of content, on the go. VR is the simulation of a real or imagined environment that can be experienced visually in the 3-Dimensions (3-D) of width, height, and depth, and that may additionally provide an interactive experience.

The integration of VR technology and mobile computing has already brought about new possibilities thanks to the capability to provide a wider range of intuitive services. Clinicians and researchers are becoming increasingly aware of the benefits that this integration could similarly provide in healthcare and there is now a need to display VR health-related content on handheld devices for several medical applications. To this end, in this chapter we bring this integration in the field of pain assessment, which is characterised by the high prevalence of pain and the limited efficient intervention that seems to currently exist (Haefeli and Elfering, 2006; Jamison et al. 2004; Lee, 2001; Mannion et al. 2007; Ohnmeiss, 2000). We present a study for investigating the usability of a novel Android-based VR application for pain assessment, which has been enhanced with

multimodal functionality for improved interaction with the VR content, by a group of disabled people. This study attempts to explore the extent of the usability of this integration, especially by those less physically able to interact with such technologies. The underlying hypothesis is, therefore, that the successful usage of the developed mobile VR-based application by disabled users could contribute to the design of such solutions for a wider range of everyday healthcare applications for these people than merely pain assessment, which in its turn could have a significant impact on the overall quality of patient care.

The chapter is organised as follows. Section 2 presents a number of example cases that make use of the integration between mobile computing and VR for everyday life applications. In Section 3, the background of the study is presented and the scene for the subsequent methodology and analysis sections is set. Section 4 presents the developed application and provides a walkthrough to its main functionalities. In section 5, the study methodology is discussed, and finally, in sections 6 and 7, we present and discuss the findings of this study.

## 2. MOBILE VIRTUAL REALITY IN EVERYDAY LIFE

The application of VR technology on mobile devices for everyday services is not a recent trend. Researchers have been studying the implications of mobile VR technological solutions on a wide range of fields, with findings suggesting a high level of viability and acceptance. Indeed, mobile VR has introduced a new approach to providing intuitive services within a variety of settings.

Perhaps one of the most popular application areas is the employment of these technologies within highly mobile contexts such as traveling and touring. A particularly interesting example is

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