



Usability evaluation of a virtual reality smartphone app for a living museum

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Abstract

This paper elaborates the empirical evidence of a usability evaluation of a VR and non-VR virtual tour application for a living museum. The System Usability Scale (SUS) was used in between participants experiments (Group 1: non-VR version and Group 2: VR version) with 40 participants. The results show that the mean scores of all components for the VR version are higher compared to the non-VR version, overall SUS score (72.10 vs 68.10), usability score (75.50 vs 71.70), and learnability (58.40 vs 57.00). Further analysis using a two-tailed independent *t* test showed no difference between the non-VR and VR versions. Additionally, no significant difference was observed between the groups in the context of gender, nationality, and prior experience (other VR tour applications) for overall SUS score, usability score, and learnability score. A two-tailed independent *t* test indicated no significant difference in the usability score between participants with VR experience and no VR experience. However, a significant difference was found between participants with VR experience and no VR experience for both SUS score ($t(38) = 2.17, p = 0.037$) and learnability score ($t(38) = 2.40, p = 0.021$). The independent *t* test results indicated a significant difference between participant with and without previous visits to SCV for the usability score ($t(38) = -2.31, p = 0.027$), while there was no significant differences observed in other components. It can be concluded that both versions passed based on the SUS score. However, the sub-scale usability and learnability scores indicated some usability issue.

Keywords Usability · User experience · Google Cardboard · Mobile guide · Smartphone app · Virtual tour · Virtual reality

1 Introduction

The technological advancement in virtual reality (VR) has changed the way people interact with technology, particularly at cultural heritage sites. As a result, there is a significant increase in technology that offers a richer presentation of objects, buildings, and other features of cultural heritage sites. Recently, many virtual galleries of static two-dimensional (2D) images of objects on the internet are being replaced with applications that offer panoramic views of real places. Panorama enables a person to visualise places by rotating them at any angle on the computer screen [1], while VR video, also known as panoramic stereoscopic video, is viewed through VR output devices [2]. Virtual tourism has

transformed the tourism industry by providing virtual tours that provide two functions. Firstly, it provides a complementary source of information, and secondly, it presents artefacts through a unique approach. Thus, a virtual tour transforms cultural heritage by removing geographical and material boundaries. Tussyadiah et al. [3] and Huang et al. [4] indicated that using the VR-based information prior to visits had a positive impact on visitors. Furthermore, it aided in decision-making [5], increased perceived enjoyment [6], and created a positive attitude change towards a location (i.e. [3, 7]).

Museums and cultural spaces are embracing the use of mobile museum technologies [8]. While the use of mobile technologies at cultural heritage sites is not new, the advancement of smartphone technology has opened an avenue for an alternative platform to create virtual tours to improve visitors' experiences using VR technology [4, 9–13]. Moreover, institutions such as museums, libraries, cultural heritage sites, and institutes of higher learning can use the technology to enhance visitor experience [14]. As

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