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Designing Accessible Experiences for Heritage Visitors Through Virtual Reality

Virtual reality offers significant opportunities for inclusive tourism, especially at heritage destinations where full accessibility is often limited by site characteristics or conservation issues. This study applies a user-centric methodology for the design of accessible heritage tourism experiences through virtual reality, with a focus on visitors with mobility impairments. It addresses the early-stage design research aimed to understand the needs and expected core elements of digital accessible experiences from visitors' perspective. Through a multimethod explorative research, personas and scenarios are developed to inform the subsequent co-design of virtual reality solutions along the visitors' journey. Methodological and practical implications are discussed.

Keywords: tourism experience design, accessible tourism, virtual reality, heritage tourism, User-Centred Design

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Introduction

Accessibility is an important area of innovative tourism research and practice, given the increasing concern about social inclusion of people with disabilities and equal opportunities for all, the significant contribution of accessible tourism to cultural development and its potential for economic growth at destinations (Kastenholz, Eusébio, & Figueiredo, 2015; Michopoulou *et al.*, 2015). Research in this area emphasizes the use of Information and Communication Technologies (ICT) to improve the travel experience according to the needs and requirements of the accessibility market (Buhalis & Michopoulou, 2011; Ribeiro *et al.*, 2018).

Virtual reality (VR) technologies offer significant opportunities for accessible tourism (Guttentag, 2010; Hobson & Williams, 1995; Tecău *et al.*, 2019). Research highlights their potential to provide access to heritage sites where physical or perceptual barriers cannot be easily eliminated to allow full tourism accessibility (Guttentag, 2010; Plimmer, Pottinger & Goodall, 2006). Although research on VR in this context is growing, it neglects the challenges involved in the design of immersive experiences for enhanced accessibility. Existing studies investigate VR adoption at heritage sites (Agostiano, 2016; Jung & tom Dieck, 2017) and its impacts on the user experience (Paladini *et al.*, 2019; Jung *et al.*, 2016; tom Dieck, Jung & Michopoulou, 2019). However, design methods and processes are crucial for the effective implementation of VR to enhance heritage tourism experiences (Han *et al.*, 2019; Southall, Marmion & Davies, 2019) and deserve further research. In this regard, there is a call for more studies to advance user-centric, purposeful design of VR in tourism, especially in relation to the initial stages of the design process aimed to capture needs and desires that are really meaningful for users (Han & tom Dieck, 2019).

This study investigates how to design more accessible experiences for heritage visitors through VR with a focus on visitors with mobility impairments. It applies a User-Centered

Design (UCD) approach to ensure that the virtual experiences are designed and developed upon a full understanding of the needs, expectations and requirements of visitors, in line with the theoretical foundation for tourism experience design (Tussyadiah, 2014). This paper presents the findings of the initial explorative stage of the design research, which was aimed to capture users' needs and core elements of the VR-enabled experience along the visitor journey as a basis for the subsequent co-design activities with users. Through a multimethod approach, it develops personas and scenarios, considering accessibility needs, engagement with heritage, ICT use in tourism and VR use. It provides insights into the application of user-centric design methodologies for tourism experience design and discusses methodological and practical implications of human-centered approaches for developing digital tourism experiences.

Literature Review

Research in the area of accessible tourism increasingly addresses the role of ICT to enhance the travel experience, showing its critical role in improving information search, decision-making, planning through increased efficiency, trust, safety, personalization, empowerment (Buhalis & Michopoulou, 2011; Ribeiro *et al.*, 2018). In this regard, it stresses the need to adopt a user-centered approach to ensure that the systems meet the requirements of the target users (Michopoulou & Buhalis, 2013).

Recent research has begun to explore the role of VR for developing more inclusive tourism (Tecău *et al.*, 2019). VR experiences are characterized by users' sense of being physically present in the virtual environment (Steuer, 1992), which is found to influence users' enjoyment, attitude and behavioral intentions of users in the tourism context (Tussyadiah *et al.*, 2018).

Heritage tourism is a key area for the application of VR and digital solutions for enhancing visitors' experiences in relation to physical, perceptual and intellectual accessibility.

Making heritage more accessible is important to foster access to culture, a right that must be guaranteed to everyone according to the Article 27 of the Universal Declaration of Human Rights. Previous research considers VR as a useful tool to provide disabled visitors with alternative forms of access to those cultural heritage sites that are threatened by public access and/or where physical access barriers cannot be easily eliminated due to conservation requirements or prohibitive costs (Plimmer, Pottinger & Goodall, 2006; Guttentag, 2010). Plimmer, Pottinger & Goodall (2006) highlight the use of VR to provide a different experience that could also be more rewarding than the onsite visit for all the visitors. By contrast, they also note the significant barriers of accessing technologies for many disabled people, relating to cost, need for assistance, inability to get adequate training and possibility that they may not perceive the virtual experience as an acceptable substitute when the rest of the visitors are able to make an onsite visit. In this regard, Guttentag (2010) raises the need to address users' perception of authenticity of alternative forms of access based on VR and to investigate the factors that influence the acceptance of VR experiences as a satisfactory substitute of tourism experiences, including user's personal characteristics, importance assigned to authenticity, VR characteristics, and situational factors.

Based on a case study of a mining museum, Jung & tom Dieck (2017) address VR use to provide an engaging on-site experience of the physically inaccessible part of the site (i.e., underground mines). Recently, tom Dieck, Jung & Michopoulou (2019) explore impacts of and requirements for VR applications at cultural heritage sites from the perspective of elderly tourists with reduced mobility, which can be considered as a form of disability. They find that VR is valued by these visitors for the possibility to experience parts of the site that would otherwise be unreachable as well as to share the visit experience with the other members of the group. Further, their study highlights the use for storytelling as one of the key elderly tourists' requirements of VR application.

Paladini *et al.* (2019) focus on the reconstruction of inaccessible monuments and sites through 3D scanning technology and show how VR experiences can support access to knowledge and a better understanding of the cultural value according to a broad meaning of accessibility, which does not only refer to physical and perceptual barriers. The work by Agostiano (2016) addresses immersive applications within the realm of the so-called compensatory solutions, the final “resort” in the case of full impossibility of direct accessibility. It emphasizes the application of the principles of Universal Design to consider not only the various forms of disability, but also the heterogeneous nature of visitors and their cultural diversity in facilitating physical, sensorial and intellectual access to heritage. In the same perspective, Arengi & Agostiano (2016) suggest that research and practice in this area should become *concept-driven* and that the design of applications has to bear in mind the users’ profile to which it is intended. Fogli *et al.* (2017) note that this approach is often neglected, since existing solutions often present accessibility barriers and ‘one-size-fits-all’ contents. In their study, Universal Design principles are applied to enhance the user experience of cultural heritage, making both content and interaction accessible to different types of users and ensuring long-term sustainability of the solution. They further propose a meta-design approach to inclusive design that places visitors’ needs, backgrounds and physical characteristics at the center of the design activity (Fogli & Arengi, 2018). According to Lauria (2016), the design challenge for accessibility to cultural heritage requires a collaborative interdisciplinary work involving experts on accessibility and conservation, representatives of disability organizations, IT developers. Further, Minucciani & Garnero (2015) stress the need to organize virtual heritage applications according to a holistic experience perspective - just as real tourism - to see their full implementation.

Methodology

This study applies a UCD methodology (Abrás, Maloney-Krichmar & Preece, 2004; Norman & Draper, 1986) for investigating the use of VR to provide accessible experiences to heritage visitors with mobility impairments. Literature in the area of human-computer interaction supports the use of UCD methodologies for an intensive and extensive engagement of users in the design process, involving them as co-designers in all the iterative design cycle (Bødker *et al.*, 2000), also in relation to users with disabilities (Ladner, 2015). Further, UCD is supported as a preferred approach for the development of accessible VR solutions (Jerald, 2015). With specific regard to the context of cultural heritage, recent studies adopt UCD for creating digital solutions and AR/VR experiences to better understand users' needs and expectations, and evaluate design alternatives (Beltran *et al.*, 2018; Bettelli *et al.*, 2019; Schaper *et al.*, 2018; Southall, Marmion & Davies, 2019).

Building on the standard ISO 9241-210:2010, UCD methods for interactive and mobile digital solutions ensure that: 1) the design is based upon an explicit understanding of users, tasks, and environments; 2) users are involved throughout design and development; 3) the design is driven and refined by user-centered evaluation. In this study, this approach is combined with tourism experience design (Tussyadiah, 2014; Zach & Krizaj, 2017) to consider the special characteristics of users' experience, behaviors and context. It follows an iterative design cycle that involves users and stakeholders from the beginning of the design process throughout the stages of development, testing, optimization of the new solutions. The approach considers users' needs and contribution to design and other relevant stakeholders as well, thus combining demand and supply perspectives. The experience design process is articulated into the three main stages on explorative, generative and evaluative research (Tussyadiah, 2014). The initial explorative design research was conducted through a combination of different methods as detailed in Table 1, which enabled to gather relevant information to identify target groups for

the VR solution as well as to uncover elements of accessible heritage tourism experiences that are potentially relevant VR development, acceptance, sustainable implementation and maintenance. The questionnaire administered through the online survey was structured into four main sections to profile potential users and was pre-tested by people with mobility impairments and representatives of disability associations. Participants were identified on the basis of the range of potential stakeholders involved in the provision and consumption of accessible tourism products, in line with Buhalis *et al.* (2005). The notes taken during the interviews and focus group discussion were analyzed through thematic analysis in order to identify key elements and expectations of digital accessible experiences in heritage tourism.

Table 1. Summary of the methods and participants

Method	Type and number of participants	Purposes
Online survey	Respondents with mobility impairments identified through purposive and snowballing sampling in collaboration with disability associations (54)	To profile users based on their tourism behaviors and accessibility needs, engagement with heritage, use of ICT in heritage tourism experiences, VR use and autonomy
Focus group	Expert researcher on accessible tourism (1) and representatives of disability associations (5)	To collect information about relevant aspects of the visit experience with a focus on accessibility barriers and the role of technologies
In-depth interviews	Representative of local heritage conservation authority (1) Representative of local municipality with expertise on tourism accessibility (1) Representatives of disability associations (3) Visitors with mobility impairments (5) Specialized tour operator (1) Founder of a web booking platform for accessible travel experiences (1)	To examine in depth the experiential accessibility issues from different points of view, to gather information on user profiles, to explore the sustainability of the future digital solution.

Findings

The explorative research allowed identifying core elements of the visiting experience along the entire journey that can be enhanced with VR from users' perspective. Further, it provided insights into the main target groups based on different profile characteristics and

allowed to develop personas and scenarios that will act as a general framework for future design activities.

Identifying core elements of accessible heritage experience with VR

The initial design research provided insights into the core elements of a desirable accessible experience using VR (Table 2) that add to previous studies on ICT for accessible tourism. These elements were manifested as participants' needs for support and suggestions/expectations on how to use VR and are framed within a visitors' journey perspective to better inform service experience design and innovation (Tussyadiah, 2014; Zach & Krizaj, 2017). In the pre-visit stage, VR is expected as a powerful tool for improving the efficiency of information search, a key element highlighted by previous research (Buhalis & Michopoulou, 2011; Michopoulou & Buhalis, 2013). Further, the analysis revealed that the possibility to discover a heritage site through an immersive pre-experience is relevant for empowering the tourism process and motivating visitors with mobility impairments “*to become and feel as true visitors and not just accompanied people in travel*”, as expressed by one participant. In parallel, it can act as an inspirational experience for engaged users who are willing to try new, extraordinary experiences and be culturally stimulated, for example by discovering hidden heritage sites that are not usually included in accessible itineraries. The potential role of VR also emerges in relation to planning, where trustworthiness of the information about accessibility of locations is a key experiential element (Michopoulou & Buhalis, 2013; Tecău et al., 2019). In this regard, the interviews highlighted the opportunity to incorporate VR contents into websites and applications for accessible tourism, in order to enable potential visitors to autonomously verify the real accessibility conditions of places.

Table 2. Expected elements of accessible VR-enabled experiences

Stages/activities in the visitors' journey	Experiential elements	Previous studies	Expectations from design research
Pre-arrival/ information search (offsite)	Efficiency	Information systems (Buhalis & Michopoulou, 2011; Michopoulou & Buhalis, 2013)	An access to relevant information about the accessibility with less effort, time and frustration.
	Empowerment	Mobile applications (Fogli & Arengi, 2018; Ribeiro <i>et al.</i> , 2018)	An additional, novel possibility to access and share relevant information about the accessibility of places
	Motivation	Information systems (Michopoulou & Buhalis, 2013)	A trigger to become a visitor
	Inspiration		A trigger to live new, extraordinary experiences
Pre-arrival/ planning (offsite)	Trust, safety & control	VR (Tecău <i>et al.</i> , 2019); Information systems (Buhalis & Michopoulou, 2011; Michopoulou & Buhalis, 2013)	A way to get more accurate details about the locations, test the accessibility conditions autonomously, familiarize with location to reduce stress.
Visit (onsite)	Awareness & Learning	VR (Paladini <i>et al.</i> , 2019; tom Dieck <i>et al.</i> , 2019); Mobile AR application (Fogli <i>et al.</i> , 2017)	A way to enhance the understanding and learning of the place, history etc.
	Sharing of the cultural experience	VR (tom Dieck <i>et al.</i> , 2019)	A way to share the experience with other members of the group who can fully access the site and avoid marginalization.
	Perceptions of authenticity	VR (Guttentag, 2010)	A way to experience heritage along the reality-virtuality continuum as a complement of the real visit and/or a substitute.
	Narrative modality of contents	VR (tom Dieck <i>et al.</i> , 2019)	A way to experience a guided tour of the site; an autonomous exploration; a storytelling approach
Post-visit/sharing (offsite)	Connectedness		Increased social interaction through sharing comments on the VR experience with the community

The findings confirm previous research on the role that VR can play in relation to some key elements of the cultural experience onsite, including enhanced learning and the possibility to share the cultural experience with the other members of the group avoiding marginalization situations (tom Dieck *et al.*, 2019). With regard to this stage, the research highlighted contrasting views about the use of VR onsite as a substitute or a complement for the real experience and the implications in relation to the perceived authenticity of the experience. For one of the users interviewed, “*The virtual experience should not replace the real visit*

experience onsite rather it should be a complement”. According to another participant, a virtual experience that completely substitutes the real visit could be more engaging and more authentic than one that acts as a complement along the reality-virtuality continuum. This represents one of the key issues that will be addressed in the future co-design activities in order to understand key factors that potentially influence users’ perceived authenticity and acceptance of the VR experiences in this context. Further, the analysis provided insights into the different expectations of users with regard to the narrative modality of VR contents, notably through a linear presentation resembling a real guided tour of the site; an autonomous exploration of the area; an approach based on storytelling. In the post-visit stage, the findings mostly highlighted the expectations of potential users to increase their sense of connectedness with their community through the sharing of VR-related comments.

Identifying target groups and developing personas

The findings further revealed the profile features of the main target groups for the VR-enabled experience in relation to accessibility needs, engagement with cultural heritage, attitude and use of technologies in tourism, including VR. In particular, the online survey provided information to identify two main target groups for the design process, as follows:

1. Users reporting accessibility needs especially in relation to the pre-visit stage with regard to the availability, completeness and trustworthiness of information; they usually take short trips and autonomously organize their travels and visits; they show a low-medium attitude towards technologies, and use them, often not autonomously, especially for information search and planning. They are moderately engaged with heritage, occasionally visit heritage sites;
2. Users reporting accessibility needs also in relation to the availability of new and better tourism services onsite (i.e., variety of itineraries/sites they can visit, quality of cultural

information). They are engaged with cultural heritage, frequently visiting heritage sites; they have a high attitude towards the use of technologies, use them before, during and after the visit and have previous experience with VR. Although this is a smaller group compared to the previous one, it is characterized by a very interesting profile for the development of future scenarios for the use of VR in this context.

The focus groups and interviews provided insights to confirm the previous targets and identify other two groups of potential users, which are considered in order to address the needs of the greatest extent possible of visitors in line with Universal Design principles, as follows:

3. Users reporting physical accessibility barriers once onsite, mostly composed by elderly people, who are already engaged with heritage, frequently visit monuments and sites; they show a low-medium attitude towards technologies for travel/tourism and have no familiarity with VR;
4. Users reporting temporary impairments, such as visitors with fractured legs; this is the most varied group, non-necessarily interested in cultural heritage or in technology.

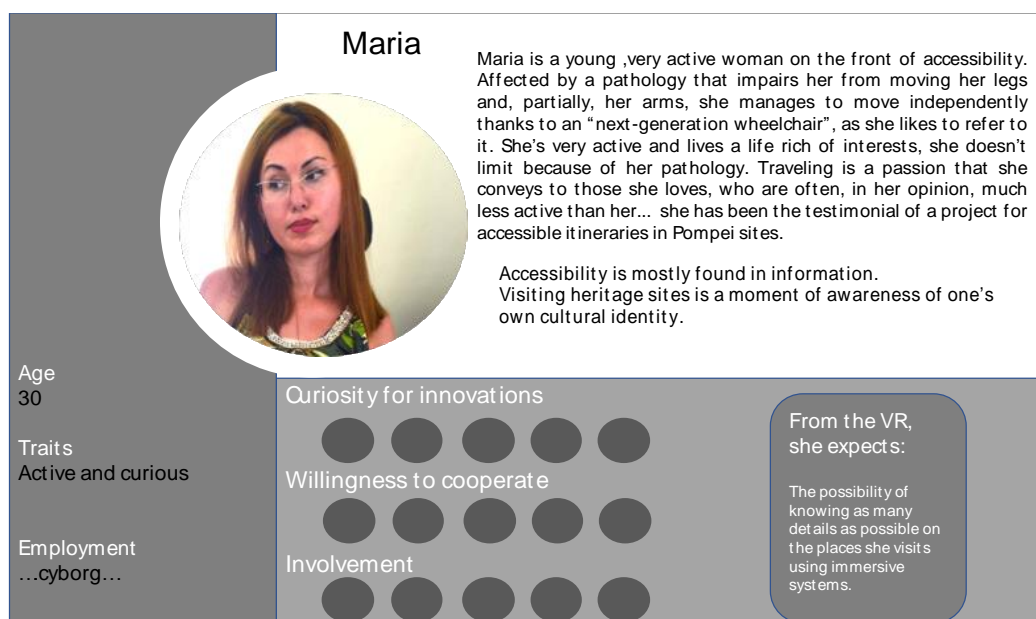
On this basis, four different personas have been developed as fictional users that encapsulate distinct sets of behavior patterns (Cooper *et al.*, 2014). In design research for disabilities, personas cannot replace contact with real users altogether, but are rather used as a supplement, and as a way of keeping a continual focus on the users throughout the project life-cycle (Schulz & Fuglerud, 2012). They have been profiled with a photograph, name, description, and details about specific interests, relevant behaviors and expectations in relation to the digital application to be designed (Burdon, 2006) and are described as follows:

- I. ‘Alfonso’, representing the first group, belongs to an association that supports people with mobility impairments. With regards to travels and heritage tourism he is very

discouraged, since his experiences were never completely positive. From the VR solution, he does not expect a special access for impaired people nor a completely different visit. For him VR is a way to fully share the visit experience with others.

- II. 'Maria' (Fig.1) is a persona representing the second group, with a total impairment of the legs and partial impairment of the arms. Travelling is her passion and in spite of her condition, she is very active. She often participates to projects about accessibility. Her expectation on the VR solution is the possibility of knowing as many details as possible of cultural heritage.

Figure 1. Fictive persona description 'Maria'



- III. 'Marina', the persona for the third group, is an elderly woman, with a great curiosity for heritage, but the aches of age do not allow her to visit the places completely and comfortably. She is not used to using technology at all.
- IV. 'Lorenzo' is designed for the fourth group. He is a 17-years-old boy, with a temporary impairment, a broken leg: he is not interested in visiting cultural heritage, but he is very

Developing scenarios

Figure 2. Scenario n. 2



Conclusion

Despite the increasing emphasis on user-centric approaches for VR in tourism, there is still a disconnect between technology developers and tourism stakeholders and users in the development of virtual experiences (Southall, Marmion & Davies, 2019). In studies on VR users are often mainly involved in prototype testing and to investigate acceptance and usage intentions (Han & tom Dieck, 2019). In this direction, this paper aims to contribute to advance the understanding on how to apply user-centric methods for tourism experience design and innovation in the context of VR and accessibility. The approach used in this research is characterized by an early involvement of users and other stakeholders to understand the different experiential aspects to envision the potential use of VR throughout the visitor journey and support co-design of alternative and/or compensative access solutions.

Though related to the very initial stage of the design process, the paper provides a contribution to substantiate and illustrate the use of UCD approaches and tools in order to develop a shared meaning, vision and scope of the experience among users and designers to be enhanced with digital technologies. This is considered a key challenge in tourism experience design, especially when designing for new service contexts and markets (Tussyadiah, 2014), as in the case of this study. The findings highlight the variety of needs, behaviors and expectations of potential users in relation to the same experience that have to be considered for effective human-centered design and overcoming the limits of one-size-fits-all approaches. In line with the principles of Universal Design, the UCD methodology described in the paper enables the identification of different target groups for the technology, fictional description of potential users (personas), and scenarios illustrating the potential context of VR application to inform the following generative stage of the design process. There are practical implications for producers of digital tourism products as well as organizations in the area of accessible tourism on how to capture the experiential needs of visitors representing an important share of

the tourism market and their contributions to the co-creation of innovation in this context from an experience-driven perspective.

Future research will be directed to apply the presented preparatory tools in generative and participatory design activities (i.e., empathize, paper prototyping, mock-up prototyping, etc.) to co-create innovative applications of VR along the journey as well as identify user requirements for the solutions to be developed.

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