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Research Article

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Reopening for Business Post-COVID-19: Augmented Reality as a Strategy for Attracting Visitors to a Tourist Destination

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Abstract: Critical thoughts about tourist destinations overcoming and mitigating impacts from COVID-19 lie in the opportunities created by the pandemic. In this paper, an innovative way to attract tourists to Madeira Island and specifically for the Caminho Real (CR) is proposed, assisted by augmented reality. There are important considerations for developing software suitable for mobile devices such as smartphones and tablets; values and benefits for sustainable tourism development and for being an educational experience respecting social distancing; and services included in the augmented reality application. Therefore, some propositions are presented to evaluate the possibility of augmented reality as a secure opportunity to show historical, cultural, and ethnographic aspects when visiting a tourist destination, while respecting social-distancing constraints.

Keywords: Augmented Reality; COVID-19; Social Distance; Madeira Island; QR Codes, Tour Guide

1 Introduction

In 2020, the world faced a new pandemic affecting every sector of economic activity as well as social aspects. Due to public health concerns, or as a precaution, restrictions were imposed and economic activities that were crucial to the survival of populations, and those that allow remote work especially were maintained throughout the pandemic. Due to cross-border movement restrictions imposed by most countries, the United Nations World Tourism Organization (UNWTO) warned of a 60–80% decline in international arrivals due to COVID-19 (UNTWO, 2020b). In fact, 'the 98% reduction in international tourists in May' represented 272.4 billion euros less than compared to the same period in 2019 (UNTWO, 2020a).

A tourist destination like Madeira depends so much on tourism that it stands out as an economic activity. Of a total of 129,100 active people registered in the first quarter of 2019, 74.2% work in services that, within their categorization, indicate that accommodation, restaurants and, similar represent 11.7% of jobs in the region. Only the categories composed by industry, construction, energy, and water (14.9%), and wholesale and retail trade, repair of motor vehicles and motorcycles (13.9%) exceed the hospitality numbers (DREM, 2020). According to Almeida, Soares, and Alves (2013), Madeira Island is preferentially sought for outdoor activities, namely, nature walks. Nevertheless, it is necessary to invest in enhancing its cultural and tourist product (a highland waterway). An alternative to pedestrianism in the *levadas* is the 'Caminho Real' of Madeira, which descends from the construction of the royal road, and is part of a set of land routes considered of greatest importance until the Proclamation of the Portuguese Republic on October 5, 1910. On Madeira Island there are six CRs, the longest of which is CR 23, a circular route 181.1 km long, and the other CRs are one-way paths being used as connections between the CR 23 and the various island geolocations (ACRM, 2020).

Although it is difficult to outline recovery scenarios from COVID-19, the pandemic can be considered a window of opportunity to reactivate a tourist destination through product innovation, the requalification of people, infrastructure, and entrepreneurship. So, the main purpose of this research is to propose an innovative way to attract visitors to the CR by using augmented reality (AR), as an opportunity to show the trail's historical value, as well as other aspects of the cultural, ethnographic, environmental and tourist information at attractions considered relevant along the way on Madeira Island, considering that it

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is a safe way for tourists to visit new places while abiding by COVID-19 restrictions, such as the social distancing.

2 Literature Review

The COVID-19 pandemic has created a new reality, wherein the tourism industry has to work hard to guarantee safety, health, and degrees of physical distance. The achievement of these levels can be facilitated by the use of technology (Seyitoğlu & Ivanov, 2020). Therefore, the use of augmented reality in tourism in a recent past and the opportunity for using it during the COVID-19 pandemic to overcome the tourism sector crisis will be developed more in depth. The application of augmented reality in the 'Royal Way' of Madeira, a natural and cultural tourism product that is currently underdeveloped, is taken into account to understand if it is possible to partly overcome the tourism industry's depression on an island that is highly dependent on tourism.

2.1 Augmented Reality and Tourism

When looking at the diagram proposed by Milgram et al. (1995, p. 283), we easily identify two extremes composed by the real and virtual environment. As illustrated in Figure 1, its combination over the Reality-Virtuality (RV) continuum is called Mixed Reality (MR), giving way to Augmented Reality (AR) and Augmented Virtuality (AV).

AR allows immersion into an experience formed by real and virtual components, being a combination of previously worked content with moments of real-time observation. In this environment, it is also possible to integrate users' sensory components, such as sight, smell, and hearing. AR enhances users' experience in the real world by making use of 2D/3D images associated with characteristic audio-visual describing an object or procedure being displayed, despite having to be present at the location and to make use of a camera to capture the real world (Olar et al., 2019).

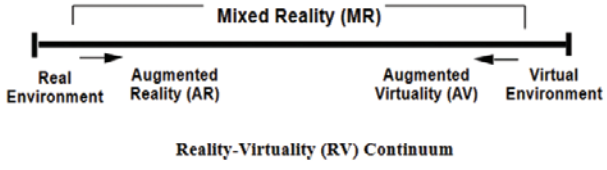

Figure 1: Simplified depiction of an RV Continuum (Milgram et al., 1995, p. 283).

For better understanding of AV, imagine a synthetic world composed of several 3D figures depicted on a virtual map capable of 'exceed[ing] the bounds of physical reality by creating a world in which the physical laws governing gravity, time and material properties no longer hold' (Milgram et al., 1995, p. 283).

The blend of both environments (AR/AV) requires clarifications on the properties and the multidimensionality of their projections. Thus, Milgram et al. (1995, p. 287) provide these definitions:

- *Reality*: that is, some environments are primarily virtual, in the sense that they have been created artificially, by computer, while others are primarily real.
- *Immersion*: that is, virtual and real environments can each be displayed without the need for the observer to be completely immersed within them.
- *Directness*: that is, whether primary world objects are viewed directly or by means of some electronic synthesis process.

Considering how information is available and how we can access its content in the environments listed above, there are technological contributions to the development of a variety of areas—namely, tourism—that use AR applications. Despite serving the purpose of interacting between user and tourist resource, the use of virtual content combined with the geolocation of points of interest, the ease of carrying technical equipment, and the ability to synchronize virtual contents with the real environment, there are limitations in existing studies in terms of how AR is used in the context of tourism and the impacts on tourist behaviour and tourist destinations (Azevedo & Alturas, 2019). In regard to consumer behaviour, and 'the current terms of action of public and private actors in this area' (p. 1), the authors proposed the Technology Adoption Model and distinguish the enormous potential for application in products focused on recreation and learning. They consider a set of external variables capable of feeding both perceived utility and ease of use. These are related to the attitude and the behavioural intention of use, while being the intention that outlines the real use of the system with AR (Azevedo & Alturas, 2019).

Kounavis et al. (2012) dedicated their work to understanding how AR applications are related to tourism. Referring to the leading edge, the authors mention the use of geo-tags and 2D/3D graphics displayed over a real view in a specific location with points of interest (POIs). Beyond RAM capacity, Wi-Fi, or 3G to 5G and high-speed CPU, mobile devices must have a gyroscope and a GPS to enable the AR application. Applications can deliver AR contents to a variety of multimedia formats with the possibility of integrating into social networks online,

with an added value to users of being linked and sharing their experience. In the field of tourism, AR applications can be used as a precise tourist guide, delivering specific information in every POI or triggered by associated tags. Although AR has multiple uses in tourism, suiting different needs, it requires mostly an internet connection. Thus, locations with low or inexistent coverage will experience challenges to fully run the AR application.

The 5G network infrastructure is considered the ultimate technology and benefits AR/VR to a point that information flows much faster with reduced delays, allowing more precise interactions by rendering better graphics and enhanced real-time data streaming and being displayed on users' devices. It is expected to increase the quality of service in a way that applications suffering from low quality of image, disconnecting, or freezing will become more reliable for usability (Orlosky et al., 2017). The new 5G allows for better and faster interconnections, making it possible to operate accurately in real time at the remote physical distance. For example, when conducting training in a corporation, sessions can be conducted remotely and combining interactions in different physical spaces or geographic locations (Torres Vega et al., 2020).

In engineering, AR is applied to automation and is part of a product of mixed experiments visible through a portable device. This way, it is possible to use virtual components to guide handling or assembly of real parts. Others can be used for learning and training in virtual environments, reducing costs and physical space of a manufacturing lab (Calderón & Arbesú, 2015). More examples for using AR can be taken as the integration in an industrial unit assembly line as a visual tool overlaying physical objects and parts, while reducing the task-level-of-difficulty for operators (Syberfeldt et al., 2015). Layona et al. (2018) developed AR for educational purposes related to human body anatomy. Such an application was thought for students' interaction with 3D objects, instead of using textbooks and mannequin. Moreover, organ descriptions and respective positions in the body are provided during the interaction.

In the field of sports, AR is often used for training purposes in which players try to cover specific goals set for improving their performance and/or technique. The same technology also assists the decision process from referees and as an innovative way for presenting the competitions. For example, setting video cameras, sensors and microphones on ping pong tables can give the distance and speed measurements related to where the ball hits the table, as well as tracing the greatest areas for playing the match, and disclosing strategies and tactics simultaneously (Bozyer, 2015).

Back to the field of tourism, Cianciarulo (2015) explained the use of AR in an Italian museum as an application playing an important role in visitors' perception of local traditions in Viggiano. The technology was also used to raise awareness regarding the importance of the local institution. Despite being a small village, Viggiano has a strategic location for pilgrimage where the image of the Black Madonna of Viggiano can be admired. While there are a variety of attractions drawing visitors to numerous locations in Southern Italy, the Museum of Viggiano aimed for a unique educational experience to learn about the objects and tools displayed, all assisted by AR. In the museum, POIs were selected to test AR, interpret, and interact with objects. A blend of tools was used to produce AR; for example, videos and interviews assisted to explain practices and techniques related to specific tools and infrastructures from the past century.

In Norway, an AR offline application developed for tourist purposes in historical Oslo was evaluated. For a heuristic evaluation, five specialists tested usability issues and revealed enthusiasm due to the possibility of pointing the camera, displaying antique images from a database, and because related information can be read with a single click (Chen, 2014).

A more developed concept was presented by Olivencia et al. (2015), who pointed out that AR applications for tourism purposes usually do not provide recommendations. Therefore, the authors developed a model based on user preferences and attributes within a certain context, then displaying some recommendations during the visit. For each POI, the AR application manages inputs delivered by a modular architecture based on the user's profile, a collaborative filter set by the group to whom the user is assigned, contents recommendation from previous visits, and planning of a visit highlighted by what the user likes most to visit, or settings for preferential topics of the visit. The application is so interactive that users can express their satisfaction level, adding value to the AR setting and can be used as an additional tool to increase the potential of a tourist destination and more sustainable management of available information. Williams et al. (2017) addressed the usability of AR by testing a tourist application in the tourist destination of Oxford, England. By recruiting six adults travelling with their families, encouragement was observed using images rather than learning from the story of important buildings. Moreover, from fourteen semi-structured interviews with foreign students from a university in Oxford, information related to major attractions and local restaurants, toilets, and enhanced routes was ranked highly by interviewees. Regarding POIs, distance and reputation are important assets to be consid-

ered when visiting a tourist attraction. Consequently, AR applications should be suitable for a variety of users. 'Most participants remarked that the app was simple and usable. Several even claimed they would be more likely to explore their area if they had the tool' (Williams et al., 2017, p. 3). Relying on earlier planning, users navigated through specific elements using the shortest route. Others followed the POIs in a relaxed way and explored the city, and others used the application to explore the city by occasionally finding new attractions of their interest.

Using AR is foreseen as an opportunity to engage in educational experiences, innovating in tourism and cultural heritage sites (Olar et al., 2019). The iTACITUS (Intelligent Tourism and Cultural Information through Ubiquitous Services) project was developed in 2014 and provided an innovative way for teaching about heritage sites and tourism in the Czech Republic. This work proved to be an opportunity for teaching, using mobile devices with AR technology. By overlaying 3D objects in the real environment and being georeferenced, it was possible to observe relevant details for describing the history of the tourist site, and the same happened with developed multimedia contents (Kysela & Štorková, 2015).

AR has its use in both indoor and outdoor environments, using a global positioning system or a data file when working off-line. Safety became a concern as users tend to interact with the device using AR, diverting their attention. When used in outdoor environments, users are at risk of causing an accident, injuring themselves or others. There are suggestions for minimizing risk, most notably displaying AR merely in precise POIs considered safe or adding audible to navigate along a certain route without showing AR (Rovira et al., 2020). Nevertheless, panoramic AR is an option to indicate safe distances in areas requiring increased safety precautions. For example, Albaqami et al. (2018) studied the pilgrims crowding during Ramadan at the Grand Mosque Al-Haram, in Mecca, Saudi Arabia, where difficulties were pointed to 'language or communication, haji's age, fatigue, minor sense of direction, panic' (p. 23). Despite the sensor-based tracking techniques already in place, through a mobile phone AR application, pilgrims could find POIs by directing the camera to an object and measuring the distance and the best way to get close to it. Moreover, the technology could identify less crowded exit gates, holding the possibility for emergency evacuation in case of panic state or any other condition.

Among the variety of uses and products with AR, its application goes far beyond land locations and can also be used underwater. The iMARECULTURE project used AR to enhance features of the underwater archaeological site of Baiae, in Italy. The application was displayed in the submersible tablet, and divers could visualize and interact with objects and local marine life found on the site. Developing AR applied to a storytelling of a submersible site was one of the objectives of the project focused 'in raising European identity awareness using maritime and underwater cultural interaction and exchange in (the) Mediterranean Sea' (Skarlatos et al., 2016).

With the COVID-19 pandemic, the use of AR can be more easily accepted by individuals, due to physical distance restrictions. Next, some reflections of the COVID-19 impact on the tourism sector and some opportunities that can arise from this crisis will be presented.

2.2 Tourism after COVID-19: Reflections and Opportunities

In 2020, the world suffered a massive change, the spread of the COVID-19 pandemic. Changes have occurred, and are still occurring, in every dimension of human life, with major impacts on health, economic, and social aspects. For now, there is no solution, cure, or control for this new pandemic (GPMB, 2019); so, companies must adapt their offer to this new scenario, where consumer behaviour has dramatically changed, from a co-creation to a social distancing environment. Therefore, it is crucial to understand the new consumer behaviour, especially in services where the customer has a high level of involvement in the service design and processes, such as tourism services (Dortyol et al., 2014; Franco & Meneses, 2020). The tourism sector is known for its complexity, where there is a great deal of focus on the service process and the role of the customer in creating experience (Chang et al., 2014). Thus, understanding customers' experiences is the biggest effort for tourism and hospitality service providers, where customers can co-create the experience, and, therefore, the service can be personalized to generate a unique experience (Scholl-Grissemann & Stokburger-Sauer, 2012). Customer orientation is vital to identify needs and to nurture a long-term relationship, focusing on keeping customers loyal, to buy back the service and to enjoy the experience once again (Homburg et al., 2009). However, tourism systems have been greatly affected by this new pandemic, for example, air transport, cruises, accommodations, restaurants, festivals, meetings, or sports events. This unprecedented scenario has moved the tourism sector to a non-tourism situation (Gössling et al., 2020). There are pieces of evidence that the tourism and travel industries will undergo major changes and adaptations to survive and reinvent.

Behaviours such as wearing masks, washing, or disinfecting hands, and social distancing are now part of the daily life of every consumer, as it is advised by health authorities to slow down the spread of the coronavirus. This has raised the level of people who shelter in place at home and has increased the spread of new forms of virtual gatherings, to stay connected and to reduce psychological distance (Kirk & Rifkin, 2020). Augmented and virtual reality technologies have been used to facilitate telepresence in digital technologies, reducing psychological distance (Miller et al., 2019). Although individuals have less of a social connection when involved in augmented reality experiences (Miller et al., 2019), the use of technology with techniques of VR and AR can be ideal for developing scenarios of full immersion in a tourism place or activity (Simancas Cruz et al., 2020), combining existing physical tourist places with virtual reality places, or characters can provide a memorable experience for the customer. The augmented and virtual reality technologies can be an opportunity to overcome social distancing and to once again consumers and tourism service providers together. The virtual space is now part of everyone's life. The COVID-19 pandemic has pushed forward digitalization, virtual assistants, and chatbots, raising the efficiency levels of organizations and generating new business opportunities. Adding the digitalization innovation to tourism activities can be the opportunity for presenting innovative experiences to customers, by videogames, AR, and virtual reality (Simancas Cruz et al., 2020). By providing safe experiences, service providers will be able to convey confidence to tourists in every service process and customer journey. Tourism experiences will change from the COVID-19 pandemic on and will be the key to overcoming the pandemic and to growing.

In this new period, full of changes, the generalization of service providers using technology and, consequently, the greater acceptance that customers have shown, the use of innovative experiences combined with technology can be an opportunity for bringing back tourists to destinations. Suggested below is a scenario of applying augmented reality to a cultural and natural product of an island destination: the Caminho Real of Madeira Island.

2.3 Opportunity for Augmented Reality on the Caminho Real of Madeira

The CRs built during the monarchy in Portugal are freely accessible, and it is the Associação do Caminho Real da Madeira (ACRM), together with local institutions, which is making efforts to recover the routes, making the population and tourists aware of the need to preserve such infrastructures, as well as its role in the recent past. This way, the ACRM, formally constituted 2017, 'aims to defend, enhance, and promote the centennial routes that bring together Madeira's historical, ethnographic, cultural, architectural, and natural heritage in urban, rural and forest contexts, through cultural, educational, scientific,

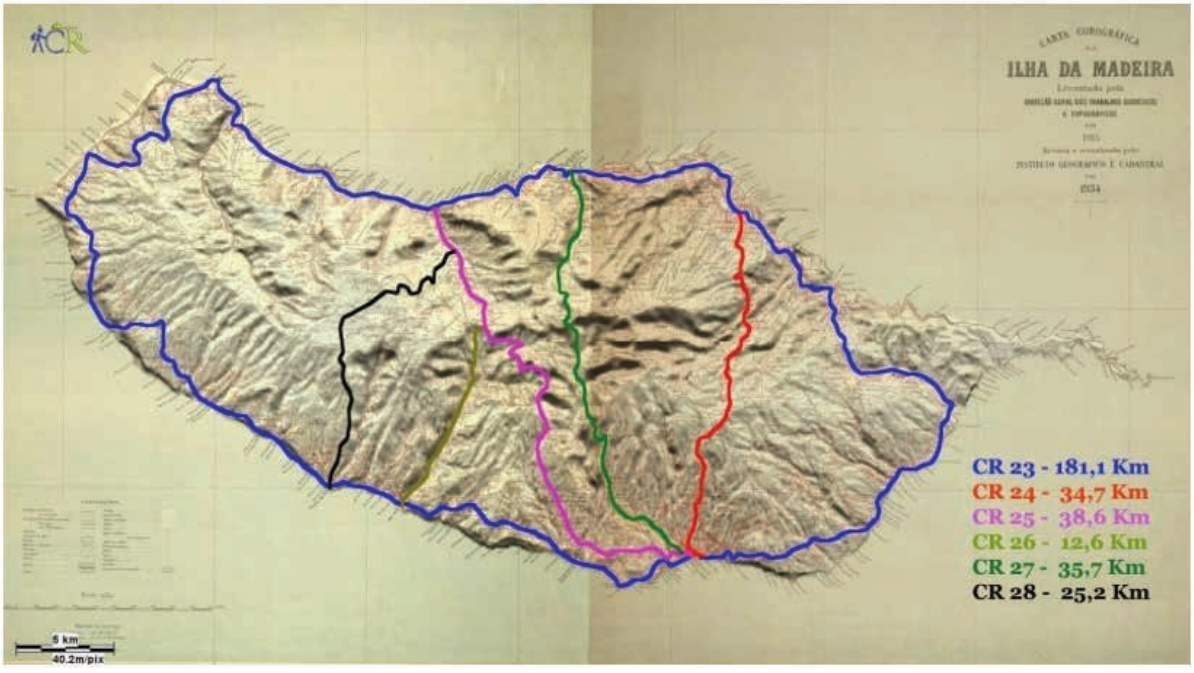

Figure 2: The six routes of the Caminho Real on Madeira Island (ACRM, 2020).

sporting, recreational, social or other activities' (ACRM, 2020).

The CRs identified in Figure 2 illustrate the importance given to facilitate communications and the movement of people and goods on the island of Madeira. While CR23, the longest route, goes around the outer fringe of the island, the shortest CRs allow access to locations within the island and shorten distances between geographical points. The fact that Madeira's Regional Tourism Board intends to revitalize some recommended walking routes enhances the market for this as yet unlisted type of route (ALRAM, 2000). According to the data provided by ACRM in 2018, about 100 to 200 people participate annually in outdoor events and 200 in indoor events. While these are organized punctually, it is estimated that more than 50 people circulate through the CR daily. This registration comes from random information collected with the stamps of the participant's notes stamped at the collaborating entities throughout the CR.

Among walkers trekking the CR along its entire length and those who take part with guides in tourist packages, it is estimated that at least 18,250 people circulate through the CR annually. Thus, a contribution to sustainable development of tourism in Madeira involves innovating the way to visit the island, which, in addition to having many attractions scattered throughout its territory, has a variety of services related to hospitality and tourist service companies mainly concentrated in two municipalities, namely, Funchal and Santa Cruz (Valls et al., 2019). Consequently, economic benefits and employment opportunities are also higher in those same areas. In response to the proposed objective, the discovery of Madeira's CRs using AR is based on some projects that already exist in other parts of the world. Just as Cianciarulo (2015) referred to an Italian museum that used AR to raise visitors' awareness to cultural and ethnographic aspects, the innovative way serves as a reason to visit small towns found throughout the CRs.

Walking and operating a mobile device is considered a dangerous operation, as it can become a distraction and cause users to pay less attention to their surroundings. This can be explained through cognitive absorption from a person fully immersed in an interactive experience (Lin, 2009). The engagement is so strong that the user is only focused on the experience, leading to the flow experience (Csikszentmihalyi, 1990), and with safety being considered a limitation of AR when applied to the CR. The flow makes users develop a sense of control, a loss of self-awareness and dissociating momentarily from the dimension where they are. The third concept is related to cognitive engagement (Webster & Ho, 1997), in which the level of satisfaction is linked to the content displayed in the 'human-machine' setting, exposing curiosity in the experience, simultaneously with the users' emotions and

Figure 3: Navigating the CR and POI, discovering through RA. Source: Associação do Caminho Real da Madeira 2018.

feelings about controlling the environment in which the experience takes place (Guinaliu-Blasco et al., 2019; Lin, 2009; Rovira et al., 2020).

Even though it is considered that the use of applications with RA provides a more reliable guidance system and makes it a tool capable of preventing risks associated with hiking, there is still a need to further such studies relating to personal behaviour and safety (Rovira et al., 2020). This is definitely understood as a limitation.

The AR application developed specifically for the CR has a storytelling component depicting Madeiran ancestral habits and is meant to be standardized for the 10 municipalities on the island, leading to 10 different modules to be developed. Figure 3 gives a clear example for navigation across the CR, and a POI for developing learning contents about the abandoned fortress and its role when in operation.

In addition, the application allows an overview of the modules loaded on the device and manages all information. There is an option to be activated in case of emergency and that makes it possible to know the user's geographic position. This information is considered to be of highly valuable and can be provided to emergency services.

The way to enhance the environmental and landscape attributes, activated by geotagging or beacons recognized on mobile devices, offers a kind of local guide in each geographical position of the CR. Thus, the proposal from Gonçalves et al. (2020) is considered for developing a mobile application to facilitate information about local offers, contemplating interactivity among users through gamification and the possibility of sharing information with other users throughout the CR and using social networks. Suggested by Rovira et al. (2020), it is also intended to associate safety aspects along the route, minimizing the risk of accident combined with a sustainable way of passing POIs inserted in the application. Therefore, some propositions are outlined, to be uncovered if AR can be an opportunity for enhancing the historical and cultural value of the CR as a tourist attraction, considering the COVID-19 constraints.

3 Propositions

The greatest synergies developed will be those that guarantee a unique and authentic experience throughout the CR. The various entities offering accommodation will play a very important role in disseminating information about local activities. The set of socio-economic activities will be studied throughout the CR, as well as cultural and recreational activities. For example, visits to ethnographic museums, art, science or industry, or involvement in agricultural activities were established on Madeira Island. The market is made up of all tourists as well as locals from Madeira Island. The fact is that there is no similar product performing as a tourist guide or designed for educational purposes, while being specific and applicable to the CR. The application is useful for people looking for authentic experiences with local communities, as they are users looking for trekking along the CR. The digital application becomes a complement to navigating through the CR and providing recommended attractions, which can be pre-set by the user, or previously loaded by the system. An added value of using such a system is the possibility of notifying emergency services.

3.1 The Software

The proposed innovation illustrated in Figure 4 aims to use a digital application compatible with mobile devices such as smartphones and tablets equipped with the Android and Apple iOS X operating system. Through technological equipment required by hikers, it will be possible to learn about the history and customs of Madeira Island. For example, in the Calheta area, you can get to know the mills and how they worked. The application will be equipped with audio, video, and 3D, allowing AR

Figure 4: Example of the app for navigating the CR on Madeira Island.

to provide a character in the form of a virtual travel mate telling the story. This can be characterized according to the desired season and the AR will serve as a teaching tool for one of the oldest routes on Madeira Island.

Within the application, users will be able to have an overview of what was already accomplished, such as distances, heights, calories, trekking times, which POIs were seen, what multimedia was visualized, what was shared via email or social networks, and what contents were shared in a collaborative system.

All services such as the ones illustrated in Figure 5 will benefit local communities, boosting the CR, and encouraging walkers to consume local products at each designated strategic point. Using technological equipment requested by hikers, it will be possible to learn about the history and customs of Madeira Island (Cianciarulo, 2015).

The necessary software will be developed by a specialized company, presenting individual packages to the ten municipalities on Madeira to learn about cultural, ethnographic, geographical, and environmental aspects found throughout the CR. The architecture for developing the AR modules will be shared among the ten municipalities of Madeira Island, becoming a growth indicator. The digital application must benefit from a cost-free installation on the mobile device to be used and require creating a user account, only then can modules be purchased upon request for download. The individual cost will range from 3 to 5 euros and the full package will be 20 euros. Therefore, the following propositions are offered:

P1: The use of the AR application in the CR will have a positive impact on tourists' learning local customs.

P2: The use of the AR application in the CR will impact the economic development of local communities.

P3: The use of the AR application in the CR will impact the social development of local communities.

Figure 5: Example of AR indicating local services based on distances from the user. Source: https://reamp.com.br

3.2 Values and Benefits

The proposition meets an authentic and fully integrated experience in the local communities linked throughout the CR. Only then will it be possible to acquire knowledge about the local history and traditions, assisted by AR. Through pre-setting or activation by geolocation, POIs will be triggered by the 'travel companion', who guides and navigates along the CR. One of the biggest shortcomings found in the CR is the indication of accommodation in small towns or the availability for short stays; so hikers are advised to make their reservations in advance (ACRM, 2020). Also, information about local commerce will be made available to users so that locally produced goods can be purchased, necessary accessories for walking, or even the consumption and tasting of typical delicacies in each location (Olivencia et al., 2015).

The application will allow access to the summary of the route already taken and in stages; thus, it is proposed to mark out and build modules by a municipality, where a stage is equivalent to a municipality. The summary function may or may not be associated with programming for the next step. Everything will depend on the number of modules loaded. The application will work with an internet connection, allowing the download of descriptive image and video files of POIs, as well as traceability in case of emergency, whenever this function is activated.

P4: The use of the AR application in the CR will have a stronger influence on booking accommodation.

P5: The use of the AR application in the CR will boost purchases of local products.

P6: The use of the AR application in the CR will ease emergency circumstances.

3.3 Services in the AR Application

The activity of going through the CR with the aid of the mobile application with AR has a direct relationship with the physical creation, sale, maintenance, and support of the product itself and all the services offered. Inbound logistics is limited to registration in a digital platform so that users can view and manage all services requested. This is the starting point for downloading the guide modules with AR, as well as the information services added in the application. The operational form adopted facilitates the use of an AR guide that can be downloaded upon payment of a stipulated amount. All information will be stored on personal mobile equipment or rented. The software has a performance monitoring and periodic maintenance program. One way to improve the provided

services and the AR product is to collect feedback from users.

The outbound logistics will allow users to view the loaded modules on the device and manage the selected attractions, which are created in the user profile. There is an option to activate, in case of emergency, and that makes it possible to know the user's geographical position. This information is highly valuable and can be provided to emergency services.

In terms of supplied services, modules with AR provide specific information about the route; however, there will be digital support for customers that can be merely informative about accommodations and local attractions to visit (Olivencia et al., 2015). For the application to receive updates on available services and relevant information, it is suggested to use the necessary tags showing the CR. These will act as an information point and code conditioning necessary for using AR. Another way of revealing the growth potential is the number of partnerships forged to make the services sustainably offered.

P7: The use of the AR application in the CR will provide users' feedback about the state of the CR.

P8: The use of the AR application will stimulate local business networking.

3.4 The AR Application Under a COVID-19 Scenario

Considering that the COVID-19 pandemic has not been under control until now, the tourism sector and its stakeholders need to reinvent new ways to attract visitors without compromising safety issues and respecting the pandemic constraints, such as wearing masks and social distancing. In a sector where the customer has a high involvement in the service, being a co-creator of the service, the technological advances and applications of virtual and augmented reality already tested in touristic attractions can be seen as an opportunity to overcome all these constraints and still provide an immersive and authentic experience to visitors. Moreover, it can be the trigger to reactivate tourism after a severe recession period, where stakeholders can work together by joining efforts to create an augmented reality product offer of the CR that gives a complete historical, cultural, ethnographic, and social perspective of Madeira Island. Therefore, some propositions are presented:

P9: The use of an augmented reality tourist product will make users respect social distancing restrictions.

P10: The use of an augmented reality tourist product will be perceived as safe to use in the COVID-19 pandemic environment.

4 Findings

To evaluate the propositions suggested above, Table 1 shows a SWOT analysis made for evaluating strengths and weaknesses of using AR in an outdoor environment, targeting cultural and natural tourism products, as well as opportunities and threats perceived in the external environment.

From the SWOT analysis, some impacts and strategies can be drawn to support the development of the application of augmented reality in the Caminho Real of Madeira Island:

Table1: SWOT analysis for using AR in the CR.

Strengths - Historical, cultural, ethnographic and environmental values of the trail; - Connection to emergency services using geographic location; - Authentic experience in remote areas of the island; - Sharing information through social networks; - Tourist packages including accommodation booking; - Connection to the local community; - Independent guidance system along the CR; - Storytelling along a long-distance route found on an island;	**Weaknesses** - Underdeveloped cultural and tourist product; - Destruction of some parts of the path; - Safety issues regarding distraction when using the application;
Opportunities - AR immersive experience; - The use of AR to innovate in tourism sites; - Awareness to multimedia contents; - Greater acceptance of technology by consumers; - Network of business of local handicraft;	**Threats** - COVID-19 pandemic restrictions; - Massive reduction of international arrivals in 2020; - Consumer behaviour changes regarding physical and social distancing;

- investment in an inventory list from all valuable assets found along the trail and converting them into planned tourist products respecting responsible practices and local identity;
- the use of storytelling to attract visitors to rural areas along the CR and enhance tourist experience linked to less-visited areas, local communities, and safety—this can play an educational role when used to explain about local traditions or historical attributes;
- signing social distances between hikers, as well as safe distances to dangerous parts of the CR; and
- engaging users to local attractions and local agenda set to increase visits.

5 Conclusion, Limitations, and Contributions for Future Research

It is concluded that the use of AR to discover and navigate a tourist attraction (Williams et al., 2017) is an alternative to information boards that are usually located on the ground. This is because there is a tendency for this type of equipment to deteriorate and they are not always visible or contain legible information. A reliable application can be evaluated based on the feedback obtained on its performance and usability (Olivencia et al., 2015).

This article contains information about a tailor-made AR project allowing users to interact with their surroundings as well as learn about the customs and traditions of Madeira Island, while walking along the CRs. This approach to stimulate the movement of people around the island—namely, through smaller but high-value locations—becomes an awareness-raising initiative on alternative ways to discover a tourist destination (Cianciarulo, 2015). Also, the fact that the proposed application is offered in digital form allows any user to have the dexterity to go through the CR without hiring tour guides. Although job creation should be encouraged, it will be intrinsically related to each location capable of assisting and serving hikers. Also, it can be integrated into the application as a list of local guides to hire, or other services to hire.

The application is a contribution to Madeira Island as a destination and contributes to exploration of the long-distance hiking route by using an innovative tool, enhancing responsible practices and enabling learning about the island's heritage. Moreover, visitors flow, and profiles can be analyzed for developing enhanced approaches for sustainable development in the less-visited areas of Madeira Island. Thus, tourist management and business models have room for improvement.

The safety aspect, as suggested by Rovira et al. (2020), is vital and allows viewing steps to be followed along a safe route, or even activating an emergency service whenever necessary. This way, the emergency services will be informed about the user's geolocation and what type of aid will be necessary. Moreover, in the COVID-19 pandemic environment, safety is taken to a new level, where social distancing is a requirement in any part of the world. The use of an augmented reality product can be an opportunity for overcoming these constraints and for reactivating the tourism sector.

The first limitation found was the strength of the GPS signals to allow accurate geolocation so that the 3D images can be overlaid with landmarks, monuments, or buildings. Inaccurate information on the geographical position means that, for example, by superimposing the outdated 3D model of the 'Water clock, or the ruined fortress', which today are architectural heritage assets in the CR23, passing through *Caniço*, where the view will be mismatched. Another important limitation to consider is the fact that the CR is not marked out and investment will have to be made at an economic level to position beacons (Gonçalves et al., 2020) to activate the hardware used to run the application with AR. To this end, it will be very important to promote an innovative approach for navigating the CR close to regional and local authorities, encouraging commitments and partnerships on the ground.

Another limitation is the lack of research about the tourism flow in the CR, observing users' behaviour when using AR in an outdoor environment. Also, the fact that 5G technology is not readily available is also considered a limitation related to quality, data transfer rate, and digital interaction with the surrounding environment. Finally, as mobile equipment varies, the user's experience becomes more difficult to control and only through users' review or reported issues can the application be improved.

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