Building Guidelines for UNESCO World Heritage Sites' Apps

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Abstract—**Technological improvements and access provide a fertile scenario for the creation and development of mobile applications. This scenario of intense production of new software for mobile devices results in a myriad of apps providing information about almost all the cultural segments, including those dedicated to UNESCO World Heritage Sites (WHS). However, not all of the apps have the same efficiency. In order to have a successful app, its development must consider usability aspects aligned with reliable content. Despite the guidelines for mobile usability being broadly available, they are generic, and none of them concentrates specifically in cultural heritage. This article aims to fulfil this literature gap and discusses how to develop specific guidelines for a better WHS experience. It uses an empirical approach applied to an open-air WHS city: Weimar and its Bauhaus and Classical Weimar sites. To build the guidelines, this research compared literature-based guidelines to industry-based ones, extracted from a vast compendium of available apps dedicated to WHS. The instructions compiled from both sources have been comparatively tested by using two built prototypes from the distinctive guidelines.**

Keywords – Interface design; world heritage sites; usability; app; mobile devices.

I. INTRODUCTION

It is far behind the time when, in order to enjoy a historical and cultural experience, it was necessary to visit a museum or to buy a guide to check the information about the monuments and historical buildings in a city. Despite the importance of these institutions and tools, the technology allows the expansion of the concept one step further, transforming cities themselves in open-air museums, by using mobile apps accessible through smartphones that most people carry in their pockets. They can be used to converge information and recreate the museum experience in open-air spaces.

However, to make this experience effective, the apps must follow a particular set of rules, or they can end up influencing the tourism experience negatively by causing frustration when the user tries to retrieve the desired information. To make this experience enjoyable for the user, it is advised to follow guidelines and good practices during the development of an app for touristic purposes. This study goes beyond the touristic aspects and helps to define guidelines that are appropriately applied for WHS scenarios. This research considered a vast range of usability studies and explored the interactions between users and urban spaces. It also includes precise niche requirements for the chosen scenario such as usability applied to elderly groups, as they are an important target group for tourism in Germany.

From a content perspective, it is valid to mention the preparedness of UNESCO WHS. Every recognised site has a vast range of official information available, aiming for different audiences. For example, it is easy to find educational content, ready to be used inside classrooms. For this study, the set of available material related to heritage locations is defined as *target content,* and some of the discussions explore how it is possible to make it accessible and tailored for mobile devices.

It is necessary to say that, despite the popularity of mobile gadgets, the target content does not contemplate guidelines or suggestions for digital applications. It will be explored in Section II. The same section also shows why Germany is relevant as a scenario to develop guidelines for WHS apps, that can have an international application. The research uses a mixed-method approach to suggest the guidelines. It started with the analysis of apps available in the industry through a classification based on affordances [1], identifying features, elements and their use in the mobile application, as detailed in Section III. The analysis revealed one set of guidelines used to create one of the prototypes. Section IV shows how a systematic literature review was used to identify the available articles discussing the topic and, by analysing the content, to extract another set of guidelines used in a second prototype. After the compilation, each one of the guidelines was used to develop their own mobile app prototype, and both prototypes were submitted to a comparative A/B test. Section V deals with the implementation of the two prototypes and also with the evaluation process, comparing the results from both developed prototypes. In Section VI, the evaluation, implementation and results are discussed. In Section VII, a new set of recommended guidelines emerges, considering the evaluation results.

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II. TARGET CONTENT

The focus of this research is on apps that deal with cultural heritage content. Germany is the 5th largest country with of "World Heritage Sites" from the UNESCO's list [2]. The country has 43 cultural sites spread across its territory. From those sites, two of them (Bauhaus and its Sites in Weimar and Dessau; and Classical Weimar) are situated in Weimar - a place where this research is based. These sites are easily accessible, being a perfect sample opportunity for in loco use. There is a vast amount of target content available for the two sites mentioned. It means the information was retrieved directly from official sources to build the two prototypes. By doing so, the test was concentrated on verifying the features, functionalities, and on different ways to display similar information on the app.

Also, Germany is well known for its technological potential. This scenario reflects on services using a digital format, available for different purposes, such as information, education, entertainment, just to mention a few, applied to multiple devices, such as mobile devices, web-based services, and interactive screens.

Taking Germany as a scenario for the empirical approach is a fair way to gain experience and access for innovative projects using mobile devices for cultural heritage.

III. INDUSTRY BASED GUIDELINES

There are many smartphones and tablets' models available on the market, with different features but also constraints. The iOS or Android OS together have more than 3 million published apps, embracing 80% of the German mobile market share. For that reason, the prototypes were developed using a platform that could be accessed by both OS: iOS and Android operating systems. For the same reason, the apps to be evaluated were retrieved from both official stores following the same criteria.

To retrieve the apps from each selected OS markets, a search string was applied, using the following combination of words:

1. UNESCO WHS in Germany
2. Official app market
3. Word search options:
   - UNESCO Germany
   - UNESCO Deutschland
   - World Heritage
   - Welterbe (World Heritage in German)
   - The name of the WHS for Germany, in English and German versions
4. When the WHS refers to "Old Town" or "Parks" of a city, the used search term is "City Name" + UNESCO
5. Dedicated WHS apps

In this work, a *dedicated WHS app* defines an app specially made for the WHS attraction. Generic touristic apps, on the other hand, usually cover multiple touristic attractions and not only the WHS site; the only exception is when the city centre (usually called as old town, inside the WHS context) is considered a WHS itself. In this case, a generic city touristic app may enter in the list, if in its home screen there is an indication of UNESCO or WHS. Following these search criteria, 29 apps dedicated to German WHS sites were retrieved by 25 July 2018.

Other apps were found following the beforementioned search criteria, but they did not offer specific WHS-related content and, therefore, were excluded from the analysis. In some cases, they were *clickbait* apps, using the WHS identification to encourage the users to download it, but promoting other sorts of content, such as touristic tours or *purchase-in app* features. In other cases, sweb-based apps had problems to load the pages. As they were not fully functional – thus not trustworthy to generate guidelines – they were also excluded from the final sample.

The final sample also included generic touristic apps where it was possible to find specific WHS information, despite this not being shown on their home screen. In these cases, it means one needs to go further into the app to discover if a WHS is mentioned or not.

A. WHS App Analysis

The selected apps were analysed and classified from an affordance perspective, observing their properties and usage from a user perspective. This enabled the identification of common features and tools used for the promotion of a WHS. It also allowed identifying unique features and the ones that could be part of the guidelines to build the prototype. The analysis extracted guidelines from layout, navigation, design, and content perspectives. From that, a WHS prototype app was built based on the state of the art observed in the industry (Table I).

The app affordances were analysed from the user perspective, by using the individual expert review technique, in which "an individual expert review involves a single practitioner who is asked to provide feedback on the usability of a UI." [2, p. 37]. After being mapped, the content was distributed under subcategories, adapted from a study about usability guidelines for mobile websites and applications [3], taking into consideration just the app functionalities. This approach allowed the identification of the usability guidelines, plus mapping the visual and content structure from the official apps for WHS in Germany.

B. Industry Overview Guidelines

The industry/market analysis of the available apps for WHS in Germany revealed a set of guidelines used to build a market-based prototype with the most common features and layout, creating an average model to be tested against a literature-review-based one (Figure 1).

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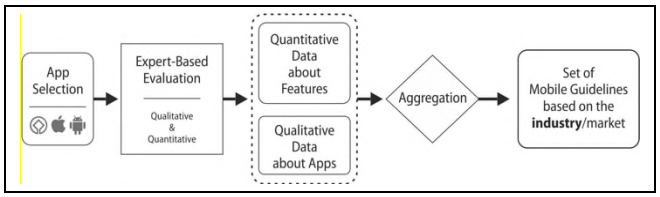

Figure 1. Schematics on the creation of the industry-based guidelines

The prototype following the industry-based guidelines combined the most popular elements presented on the evaluated apps, taking in consideration layout, navigation, design, content style, features and media. The guidelines considered only those elements that appeared in more than 50% of the apps (Table I). The guideline also followed the most prominent qualitative features in regards to elements that cannot be quantified, such as colour, layout disposition, etc.

TABLE I. INDUSTRY BASED GUIDELINES

		Total %
Layout		
L1	Place Content in one screen	41.38 %
L2	Vertical Scrolling	89.66 %
L3	Horizontal Scrolling	17.24 %
L4	Consistency between different sections	79.31 %
Navigation		
N1	Number of Taps to WHS Information	2 (average)
N2	Number of items on main navigation	6 (average)
N3	Navigation Menu visible	75.86 %
N4	One Level Navigation Menu	48.28 %
N5	More Levels	51.72 %
N6	Self-explanatory menu	55.17 %
N7	Enable gestures	48.28 %
N8	Presence of the Back button	72.41%
Design		
D1	Limited use of colours	68.97 %
D2	Wide range of use of colours	31.03 %
D3	Simple design	75.86 %
D4	Polluted design	31.03 %
D5	Use of icons	86.21 %
Content		
C1	Long text	86.21 %
C2	Short text	24.14 %
C3	Info at start screen	24.14 %
C4	No info at start screen	68.97 %
C5	Prevent information loss (when back)	89.66 %
C6	Provides action feedback	41.38 %
C7	Provides share options	20.69 %
C8	Nearby	3.45 %
C9	Tours	41.38 %
C10	Links to external content	41.38 %
Features and Media		
F1	Photo	96.55 %
F2	Photo 360°	6.90 %
F3	Map GPS	68.97 %
F4	Map Static	55.17 %
F5	Video	13.79 %
F6	Audio	44.83 %
F7	Animation Film	6.90 %
F8	AR	10.34 %
F9	VR	3.45 %
F10	Game	3.45 %

It is possible to point that, based on the sample, an average app based on what the industry is offering, would have the following characteristics:

1) Layout
- The content is spread beyond the initial screen, creating vertical scrolling (L2).
- The layout structure will be maintained across the sections (L4).

2) Navigation
- The number of taps to achieve a WHS content from the initial screen is two (N1).
- The number of items in the main menu would vary from four to six (N2).
- The navigation menu is always visible among the sections (N3).
- The content will be spread in different levels, leaving the user to explore further in each section (N5).
- The main menu is self-explanatory, with direct meaning sections (N6).

3) Design
- The use of colours is limited up to three (D1).
- The design is clean and not polluted (D2).
- The use of an icon reinforces the menu and content is present (D5).

4) Content
- The content utilises long text, usually more than two paragraphs (C1).
- No need for introductory or explanation text on the initial screen (C4).
- The prevention of content loss when backing from a section is ensured (C5).

5) Features and Media
- Use photo/illustration along with the text, to reinforce the content (F1).
- Providing GPS or static versions (F3, F4).

These guidelines were used to build the structure and layout of the market-based prototype and how its content was organised. The content was elaborated addressing the WHS in Weimar, retrieving target content available at the official touristic site of the city [4], and from the largest cultural foundation from Weimar [5].

IV. GUIDELINES FROM LITERATURE-REVIEW

This section covers the creation of the second set of guidelines for WHS apps, based on the literature review, to be compared with the app guidelines extracted from the market overview.

While the guidelines from the app market overview took an observational approach of affordances, aiming to generate a model that could represent the average content style and features present on the available WHS apps for Germany, the guidelines acquired from the literature review took into consideration a systematic approach to the

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academic articles. The literature-based guidelines were extracted from publications about mobile app usability, available on research databases. It also took into consideration existing usability models [6] - [10], and official guidelines for mobile development from the leading mobile OS companies (iOS and Android).

The generated guidelines took into consideration studies from the academia and the industry recommendations, connecting and combining different views and approaches on mobile interface design guidelines applied for WHS (Figure 2).

The systematic literature review took into consideration the guidelines from the mobile industry, with an added layer of confirmed guidelines on studies of mobile apps retrieved from academic publications, on platforms, such as: ACM [11], IEEE [12], JSTOR [13], SAGE [14], and Google Scholar [15].

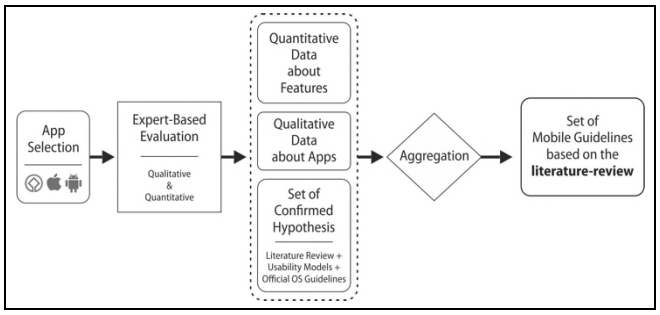

Figure 2. Schematics on the creation of the literature-based guidelines

In order to find academic studies and research outcomes that can contribute to the formation of literature-review guidelines for mobile apps dealing with cultural places, a set of search parameters were applied:

Search Strings:

- "Mobile usability" AND "Guidelines"
- "Mobile usability" AND "App"
- "Mobile usability" AND "Heritage"
- "Mobile usability" AND "Travel Guide"
- "Mobile usability" AND "City Guide"
- "App guidelines"
- "Mobile interface guidelines"
- Published material since 2013, covering five years of publication, considered enough for a literature review [16, p. 53].

The first 50 results in each search string on each platform were sorted by relevance and initially analysed based on their abstract/description to be selected or discarded for content analysis.

A. Selected papers

The aim of the reading selection from the literature review was to find guidelines and interface recommendations for mobile devices to build a literature-based prototype to be tested in comparison with the market-based one. With this goal in mind, studies done on mobile web sites were included, as they address the interface design on mobile screens. Medical and health studies were included just when they addressed mobile interface design and usability, and not therapeutic issues.

Also, studies covering mobile interaction with public spaces were included, as the prototype app will deal with interaction in the city centre of Weimar. The same applies for context-aware and location-based mobile interactions.

Taking into consideration the wide range of profiles of the Weimar's visitors, the selection also included studies on mobile interface for elderly users. Although the guidelines are not focused on educational features, studies on mobile learning were also included, as long as the interface was the research target. This decision was made because the city of Weimar also deals with teenager students visiting and learning about the heritage attractions of the city.

Overall, the analysis was concentrated on direct instructions that could be translated into guidelines. Vague recommendations, such as "create an appealing design" were not considered for being too open for different interpretations.

Based on their titles and abstract, 249 academic publications on mobile usability and mobile cultural heritage were selected, where only thirteen were not accessible due subscription and/or accessibility issues (despite five of them providing a two-pages preview), totalling a 5.2% rate of waste in the original selection, making the final number of selected academic works for reading equal to 236 publications.

The selected readings, apart from those dealing with app interface and usability, dealt with topics such as cultural heritage, mobile tourism, mobile health, mobile learning, older adults, just to mention a few examples. Based on the readings' keywords (when available), a word cloud was generated to illustrate the full range of selected topics (Figure 3).

Figure 3. Word cloud generated from the used keywords from the reading selection.

It can be seen in the word-cloud that the keyword *cultural heritage* does not have the same weight as *usability* or even *app,* for instance. As said, the word cloud was based on the keywords defined by the authors, and it reflects the lack of studies that are specifically dedicated to the relation

between apps and WHS, compared to those related to generic apps.

Each one of the selected publications was read and analysed to find and extract guidelines that could be used for cultural heritage apps. However, the analysis was not restricted to the selection list and was extrapolated, taking in consideration relevant references cited by the publications selected for the sample.

As a procedure, when a guideline or recommendation was found, it was placed in a table following a similar structure as the guidelines extracted from the app-market-overview, adding new categories to correspond to the literature review findings. Overall, the literature-review based guidelines reinforced some and challenged other guidelines found on the industry-oriented overview, creating a new set of guidelines to be tested against the first prototype.

When a conflicting guideline was found (for instance: one author claiming that text should be long and another that it should be short), the one supported by the majority (more than one author endorsing it) was selected; in case of a tie (equal sum of authors supporting opposite views), an expert-based overview technique was implemented to select which one would be selected from the literature-review guidelines list, based on how closely related it was to the research topic.

The guidelines found during the analysis are shown in Table II, using the common ones with the market-based selection with the addition of new literature-based guidelines, distinguished with an asterisk (*) mark. It is possible to note that the literature-based guidelines have similar items with the market-based ones, but with more detailed orientations regarding the content.

TABLE II. SELECTED LITERATURE-REVIEW GUIDELINES

Code	Guidelines	References
Layout		
L1	Place content on one screen / minimizing-avoiding scrolling	[17] [18] [19] [20] [21] [22] [23] [24] [25] [26]
L4	Consistency between different sections (it may include the way the tasks are performed in different sections)	[18] [19] [20] [22] [24] [25] [27] [28] [29] [30] [31] [32]
L5 *	Orientation: provide session title	[25] [30]
L6 *	Providing search bar	[25] [29] [30]
Navigation		
N1	Number of Taps to WHS Information	[30]
N3	Navigation Menu visible	[25] [31] [32] [33]
N4	One Level Navigation Menu	[17] [23] [28]
N6	Self-explanatory menu	[17] [20] [23] [27] [30] [34]
N8 *	Presence of Back button	[25] [26] [32]
Design		
D1	Limited use of colours	[20] [21] [22] [25] [26] [27] [29] [30] [35] [36]
D3	Simple design	[17] [19] [20] [22] [28] [29] [33]
D5	Use of icons	[17] [20] [21] [22] [23] [24] [26] [28] [29] [32] [33] [36] [37] [38] [39] [40] [41]
D6 *	Space between buttons or other clickable items	[19] [21] [23] [24] [25] [26] [27] [33] [42] [35] [39]
Content		
C2	Short text	[17] [18] [20] [22] [24] [28] [31] [25] [26] [32]
C3	Info at start screen	[30] [34] [38] [40] [43] [44]
C5	Prevent information loss (when back)	[17] [28] [29] [30] [31] [44]
C6	Provides action feedback (in some cases, confirmation before deleting/uploading)	[17] [25] [28] [29] [33] [40] [41]
C9	Tours / Routes	[45] [46]
C11 *	Focus / Only display essential information, no more than needed	[25] [31] [41]
C12 *	Clickable buttons with tactile feedback or sound (for Elderly)	[23] [26] [27] [33]
C13 *	Considering surrounding environment	[38] [40] [43]
C14 *	Provide notification of location-based (incorporated into the C17 guideline)	[43] [47] [48] [49]
C15 *	Use of visual clues for visited POI	[18] [25] [48]
C16 *	Screen font large (for Elderly) / optimal size (incorporated into the C17 guideline)	[18] [19] [21] [25] [26] [27] [33] [42]
C17 *	Allowing personalization / configuration	[26] [28] [29] [31] [50]
Features and Media		
F1	Use of Aesthetics graphics (related to “Photos” of market-based guidelines)	[20] [22] [23] [24] [25] [26] [32] [35] [36] [37] [39] [41] [50]
F9	Use of AR (if the app idea allows it)	[37] [51] [52]

The use of maps is one of the features that was not detailed in the literature-based guidelines. From the market-based research, the recommendation is to offer an offline map along with the GPS one. Still, such orientation was not confirmed by the literature, leaving this specific feature open and, as a consequence, allowing to test original ideas.

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For the Augmented Reality (AR) feature, most of the selected studies addressed issues on using this technology, but just a few of them recommended it for a mobile application. Here, it is believed that AR can be indeed an appealing feature for a mobile app, but using such an environment demands an exclusive and sophisticated development which is not the purpose of this research.

Overall, when comparing both guidelines sets (Table III), it was possible to identify unique guidelines in each one, enabling the idea of an A/B test comparing a prototype based in each set of guidelines.

Despite the complexity and extension of the guidelines, some critical elements were not clearly identified in any guideline. However, the relevance requires them to be implemented and compared in the prototypes:

- **Content: List vs Grid content**
  List is when the options are listed in a (generaly) vertical sequence. *Grid* presents the content in a *tile* format, generally in square shape.
- **Map: icons**
  Displaying one map with generic *pin* icon, and others with personalised icons (according to content categories).
- **Map: marker information**
  When tapping/clicking on a pin on a map, the information may be displayed in the bottom of the screen, or as a centred floating banner.

The use of two different subtle prototypes created an opportunity to test other features, such those mentioned above, along with dedicated WHS content.

V. GUIDELINES INTO PROTOTYPES

Two prototypes were created, each one based on one set of guidelines built beforehand (industry and literature-review based). At this stage, considering the need to follow the guidelines as close as possible, the decision was made not to involve users during the design process, but to rely on an expert review approach [2, p. 37], leaving the involvement of users for later, when comparing and evaluating the prototypes.

To enable the comparative A/B test, two prototypes were developed:

- Prototype Red (Figure 4): industry-based guidelines, available at [53].
- Prototype Blue (Figure 5): literature-review based guidelines, available at [54].

The reason for calling the two prototypes “Red” and “Blue” was to set a neutral impression for the users/testers, not revealing their nature (industry or literature-review), neither their chronological development using letters, such as “A” and “B” – which could lead to the impression of “A” being the first version, and “B” a second-and-updated version. The chosen set of colours (red and blue) was also implemented to avoid conflict for possible colour-blind testers.

Figure 4. Prototype Red, with less content on the main menu, bigger tiles for pages and standard map icons.

Figure 5. Prototype Blue, with more items on the main menu, detailed tiles for pages and customised icons for the map.

VI. EVALUATION

In order to compare the two prototypes based on different guidelines, a task-based test and a comparative evaluation survey were implemented. The idea behind this approach is having different individuals performing a series of pre-defined tasks in both prototypes and answering a

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series of questions comparing features and formats presented in both versions.

Questionnaires are a well-known method to collect and summarise evidences [55] [56, p. 100], also helping to collect opinions and input from the users. They are efficient for a wide range of data collection, such as usability, user satisfaction and interface design [57, p. 30].

The questionnaire used in this work had a set of pre-defined answers to be chosen by the users, ideal to statistics, especially on user satisfaction [58]. It also offered open-ended questions to allow the testers to give personal inputs. This method was crucial to compare and analyse both sets of guidelines (industry vs literature-review) against each other and to extract an ideal set of guidelines for apps dealing with open-air world heritage sites.

A. Evaluation process

A questionnaire can be divided into four parts: introduction, participant information, information section and epilogue [57]. In the introduction, it is crucial to give general information about the test, carefully preventing it from producing a biased result. In this case, it explained that the test was meant to compare two different models of interface design. Within this context, the testers had an indication of the upcoming content of the test/questionnaire, but no other details regarding the origins or the differences between the prototypes were provided.

As participant information, the gender role was discarded on purpose as it was irrelevant for this study. The relevant information to understand the profiles were: age, which could be later related to the different groups of visitors; familiarity (or not) with the city of Weimar, showing if the results would change if a tester knows the locations or not; and the behaviour related to the use of apps, especially for travel and touristic activities, and the level of expertise in using them.

The selection of testers/participants aimed to find two different groups: people who knew the city of Weimar beforehand, and people who have never been in the city. The age groups had a wide range spread, going from the early ’20s to late ’40s. The differences brought an interesting perspective on how familiar the users were with the locations, and which features were prefered by individuals of certain group age. For this test, academics, students and professionals from a diverse set of areas of expertise were invited.

It is argued that even a modest number of five participants is enough to perform a usability test [59] [60], getting the necessary feedback to find usability problems when compared with a setting using a larger amount of testers. For the test, 35 participants confirmed the interest in performing the evaluation, with a final attendance of 30 participants.

B. Test settings

After designing the evaluation, an unmonitored / unmoderated setting was selected for the users to perform the tasks in an online evaluation. The unmonitored setting for assessments is not new in computer science [61]. Unmoderated tests can be perfectly applied for testing prototypes [62], and they bring a series of advantages by increasing the measurement precision [63]; no restriction of time [64] [65]; and simultaneous participation [61]. Also, unmonitored tests have a set of advantages in comparison to the monitored ones, which may intrusive to the task performance and time-consuming when having one tester at a time in the observational setting [57, p. 44].

The data collection of the evaluation was implemented by using *Google Forms*, as it is a free tool and covers all the needs relating to the type of questions and sets of data for further analysis.

C. Types of questions

Surveys commonly present two types of questions: open or close-ended. Open-ended questions give more freedom to the participants in answering without any influence, but they require more time and effort from them in creating their own answers and demanding interpretation of the collected data [66]. Close-ended questions are more suitable for quantitative usability data [67].

As the questionnaire has 69 questions in total, it used close-ended questions but with a possibility to an open-ended answer. Different types of questions were used, changing according to the desired data. Most of the questions were multiple-choice, with the option for the tester to add their own open-ended answer. In this way, the participants could always give their own input. Almost all the questions had a screenshot image from the app to contextualise the question.

D. Results

The evaluation questionnaire was divided into seven sections: About you, About the attractions, About the Red Prototype, About the Blue Prototype, Comparing the two versions (Red/Blue), About Weimar, and Final opinion. Among the questions (About the attractions), for example, the testers were asked if they could recognise the UNESCO’s WHS logo after using the prototypes, confirming if they acquired this information by using the prototypes or if they already knew it. From the feedback, it was suggested that using the UNESCO’s WHS logo helps to reinforce its branding, with 59% of the testers who recognised this symbol claiming they learnt if from the prototypes.

The “About Weimar” identified if the testers have been to Weimar beforehand, to verify if the familiarity with the locations and previous knowledge about the WHS site would affect the answers. However, the results were inconclusive in this regard. However, when checking if the prototypes could serve as an incentive for people to travel to

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Weimar, the evaluation suggested that the users who have never been in the location were considering to visit the city after using the app. It allows one to conclude that dedicated apps can be a tool to promote the city.

The core-questions - "About the Red Prototype" and "About the Blue Prototype" and the comparisons - identified the testers' views on each one of the prototypes, but also inquired about exclusive features/pages, such as Routes, Settings and Right-Top-Menu available on the Blue Prototype only. In the end, as the final evaluation of each one of the implemented features, the testers answered a final question regarding which one of the prototypes they would prefer to use, resulting in 83.3% in favour of Blue Prototype (literature-based guidelines), and 16.7% for the Red Prototype (industry-based guidelines).

The exclusive features mentioned in Section IV (the ones not suggested from the found guidelines) were also tested. The results are detailed in Table III, which displays separately each one of the features tested and the guideline that originated it, divided into 'from industry-based', 'from literature-based', 'from evaluation' and the beforementioned ones, that are not from the guidelines.

It is also important to mention that, by making the literature review more inclusive - adding tailored outcomes for specific target groups, such as elderly people and studies on open-air media urban integration using apps – resulted in a more inclusive set of guidelines in general.

As seen, the results were mostly favourable to the literature-based prototype (blue version), confirming the found guidelines suggested by academics, reports, and official documentation for developers. These results can support the idea that, sometimes, the apps offered at the official stores might be closer related to the developers' taste and expertise than to the real needs and requirements of a niche sector.

TABLE III. SUGGESTED GUIDELINES

Guidelines		From Industry -Based	From Lit.- Based	From Evalu-ation
Layout				
1	Place Content in one screen / minimising-avoiding scrolling		X	
2	Consistency between different sections	X	X	
3	Orientation: provide session title		X	
4	Providing a search bar		X	
Navigation				
5	Number of Taps to WHS Information (up to 3)		X	
6	Number of items in the main navigation (up to 5)			X
7	Navigation menu visible	X	X	
8	One level navigation menu		X	
9	Offering visible (tabs) sub-menu navigation			X
10	Self-explanatory menu	X	X	
11	Presence of the Back button		X	
Design				
12	Limited use of colours	X	X	
13	Simple design	X	X	
14	Use of icons	X	X	
15	Space between buttons or other clickable items		X	
16	Use standard icons inside maps			X
Content				
17	Short text		X	
18	Info at start screen		X	
19	Tours / Routes		X	
20	Focus / Only display essential information		X	
21	Use of Aesthetics graphics		X	
22	Considering the surrounding environment		X	
23	Large font size		X	
24	Display the locations in a list format			X
25	Display more details on the locations' preview			X
26	Allow personalisation / configuration		X	
27	Centred pop-up for warnings and messages			X
28	Prevent information loss	X	X	
29	Provide action feedback		X	
30	Clickable buttons with tactile feedback or sound (for Elderly)		X	
31	Provide location-based notification		X	
32	Use of visual clues for visited locations		X	
Media and Features				
33	Photos & Gallery			X
34	Map GPS	X		
WHS Related				
35	Use of the WHS logo			X
36	Provide an "about WHS" info			X
37	Provide carefully curated content			X

VII. CONCLUSION

The main objective of this work was to set guidelines for the future development of apps applied for historical open-air locations, with emphasis on UNESCO World Heritage Sites.

From this analysis, some unique guidelines can be highlighted, such as, the best approach regarding the use of a large amount of text to describe each POI (Point Of Interest) - in this case, offering a short version, with the possibility to read further/expand; no use of audio or video, considering the surrounding noises while walking through the city; the recommendation of implementing thematic routes; and offering the possibility to change interface features such as text-size (especially for elderly groups),

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POI warnings based on GPS and the presence of WHS related content, such as displaying the official WHS logo, curated content and explanation about the reasons the place was listed as WHS.

It can be argued that the found guidelines could be applied not just to dedicated apps to open-air WHS, but also to touristic apps in general. This assumption can be true, as touristic locations also require wayfinding and POI descriptions, alongside with the navigation, design, layout and content recommendations described in this research.

It is important to say that – as it happens in most of the independent projects – this research had a constrain of time and budget for the prototype development and testing. However, in the ideal scenario, the work could continue with the implementation of a commercial app based on the final guidelines and another round of tests with different demographics. Another improvement could be done in regards to inclusion, checking the extension of the elderly-friendly features and extending the user-friendly approach to various disabilities and special needs.

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