

Original Research Article

UaiGuia: Enhancing tourist experiences in São João del-Rei, Brazil, through personalized route creation and cultural immersion

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ABSTRACT

Digital transformation is becoming increasingly essential for developing the global economy. Within this advancement framework lies the tourism industry, where the growing demand from travelers for new experiences drives the search for increasingly technological solutions. Among the many tourism segments are religious, natural, gastronomic, and cultural tourism. These, in turn, seek to offer travelers personalized options based on individual preferences and specific interests. Given the significant growth of Brazilian tourism in recent years, it seems coherent to enhance new technologies that can invigorate the sector. In this regard, this research proposes the development of a mobile application designed to assist users in creating personalized routes in the city of São João del-Rei (Brazil). The study employed design science research with software engineering methods to achieve the desired outcome. The result is the creation of the mobile application called UaiGuia, which provides a distinct approach to exploring the rich culture and tourist attractions in the city of São João del-Rei. The app's main characteristic is allowing tourists to create routes based on their interests according to the local features. Moreover, access to cultural events, festivals, and other attractions via the application enhances the stay in the city even further, supporting a better immersion in the richness of the region's heritage.

Keywords: tourism; digital transformation; design science research; application

1. Introduction

This paper presents a novel mobile app to promote a better tourism experience in São João del Rei, Minas Gerais, Brazil. Mass tourism is recognized as favorable to exploring new opportunities around the world. In Brazil, it has been a relevant source of job creation since the 1970s, contributing to the country's economic growth^[1]. Nevertheless, when it comes to Brazil and most parts of the world, the understanding of the contributions made by the sector is undoubtedly broader. Thus, in the biodiversity and cultural heritage of the

ARTICLE INFO

Received: 10 February 2023 | Accepted: 21 March 2023 | Available online: 16 April 2023

CITATION

Gonçalves FP, Carvalho DBF, de Faria VF, et al. UaiGuia: Enhancing tourist experiences in São João del-Rei, Brazil, through personalized route creation and cultural immersion. *Smart Tourism* 2023; 4(1): 2556. doi: 10.54517/st.v4i1.2556

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numerous communities spread throughout the country lies not only the generation of employment and income but, above all, the valorization and preservation of cultural identity and natural beauty.

Nonetheless, like in other sectors of the economy, the digital revolution has brought to the forefront the inevitability of transformations brought about by technology. As a result, the discussion on smart cities has evolved in relevance since the 1990s^[2]. Not indifferent to this scenario, the tourism sector has also sought to adapt and integrate technology into its practices, providing more enriching and connected tourist experiences and recognizing digital channels as a vital source of information for travelers choosing attractions and destinations^[3].

In this context of thriving transformation, information systems (ISs) perform not simply data processing but predominantly consider human, organizational, and technological aspects^[4], which is crucial to providing more ennobling and connected tourist experiences^[2]. As a result, these elements influence system interactions with the environment in which they are implemented and must be addressed in an integrated manner to promote effective changes.

In accordance with the aforementioned, digital cities involve new ways of dealing with the environment, economy, and social interaction. This way, the apparent fragility of digital transformation in Brazilian tourism is observed, impacting the competitiveness of the sector in the country^[5]. There is also a gap regarding the integration of technology into the sector. Yet, even in the face of segmental technological limitations, in the first nine months of 2022, Brazilian tourism recorded a growth of 36.9% compared to the same period of the previous year^[6].

Thus, faced with facts revealing the urgent need for technological modernization of the tourism industry, the present research, based on the studies of Siqueira^[3], Carvalho et al.^[7], and Meta^[8], proposes a mobile application for tourist routes in the city of São João del-Rei, Minas Gerais. It attempts to combine the richness of Minas Gerais tourism with the ongoing technological advancement of smart cities, improving the tourist experience and promoting digital transformation in the sector. The application also intends to provide travelers with the choice of places they wish to visit, as well as the possibility of creating itineraries based on this selection, which aims to include this historic city on the route of smart destinations.

In order to present the research performed, this article is structured into sections. In addition to this introduction (section 1), the theoretical foundations (section 2) that support the proposal for the development of applications for the tourism sector are presented. Additionally, the methodological procedures (section 3) are explained so that, subsequently, the results analysis (section 4) is presented by the outlined objectives, and the discussion (section 5) elements sustain this development. Finally, the conclusions (section 6) are drawn, and the references used throughout this research are duly listed.

2. Literature review

Digital transformation is a result of the technological evolution of society, consisting of a constant integration between digital technology and business areas to change operations and value propositions to customers, making procedures more efficient and effective. However, digital transformation is not only about technology but also about a structural change in how organizations carry out their activities. It is a continuous process of improvement in operations and the creation of additional value for customers^[9].

Regarding the discussion about digital cities, its global relevance began in the 1990s, with a focus on the implementation of public policies to provide efficient digital infrastructure in all spaces. In this scenario of social and digital inclusion, promoted by public and private investment, governments and companies started to experience more diligent routines in their work processes. In Brazil, digital cities began to be addressed in

the 2000s with the significant advancement of digital inclusion, led by the participation of digital information and communication technologies (ICTs)^[2,10,11].

The change in access to the digital world and the high flow of data in urban areas led digital cities to be seen as smart cities^[10], revealing not only an improvement in digital infrastructure but also a better utilization of available resources, aiming at economic advancement and social welfare^[5]. In this context, ISs have become essential decision-support tools, considering, in addition to the technological factor, people and processes^[12]. As a result, when scrutinizing the structure of ISs, Laudon and Laudon^[13] differentiated them into three dimensions: organizations, people, and information technology (**Table 1**).

Table 1. Dimensions of IS.

| Dimension | Main aspects |
|------------------|--|
| Organization | Structure (hierarchy), organizational processes, history, culture, conflict resolution, functional specializations, and internal stakeholder groups. |
| Human | Competent people, training, professional attitudes and management behavior. |
| Technology | Computational hardware, software, data management technology, network and telecommunications technology. |

Conceptually, the tourism industry is characterized by not fitting into a formal production environment and by not having a structure common to other industries. As it is a segment affluent in the concentration of intangible assets (cultural attractions), measuring the relationships of interaction and interdependence of its variables represents an additional challenge for researchers and managers^[14,15].

Tourism goods can be categorized as material (e.g., seas, beaches, rural landscapes), immaterial (e.g., art, folklore, prestige), free (e.g., air and climate), and appropriable (e.g., art collections, sports fields), providing satisfaction to physiological, spiritual, cultural, and moral demands. The current tourism industry is composed of organizations from the public and private sectors and even the local community. The synergistic process among these areas aims to offer a tourism product that meets the needs of its target audience, considering the development of local attractions, tourism hubs, and even entire regions^[14,15].

Due to the diversity of this sector, problems such as a lack of information about what is actually offered to tourists (i.e., tourist attractions, accommodations, and health and/or emergency services) are commonly observed^[3]. Still, the use of technological platforms, which aim to dynamically integrate the entities inherent to tourism activity and ICTs, appears to be a possible solution to the problems related to the collection, creation, and exchange of information that can be used to enrich tourism experiences in real-time^[16–18].

Given that 79% of Brazilian tourists seeking leisure and rest trips already use platforms (Booking, Decolar, Trivago, and Hurb) to assist in the destination selection process^[8], the present research aims to develop a mobile application to enhance the tourist experience in the city of São João del-Rei, Minas Gerais. Furthermore, in line with the aspects that constitute the rigor of this research, the methodological procedures establish solid pillars for the conduct of the present investigation.

3. Methods

This research employs design science research (DSR) to frame the research and software engineering methods to develop the proposed mobile app, which aims to enhance the tourism experience. Research adopting design science (DS) not only concerns itself with exploring, describing, or explaining the problem, but also with unfolding frameworks that contribute to better human performance, whether in society or organizations. Thus, prescribing the solution or designing a system generates knowledge with relevance and

rigor^[19,20]. Therefore, due to the limitations of traditional scientific methods in constructing software, frameworks, and technological systems, the approach used in this study follows the precepts of DSR. This methodology aims to structure the development of artifacts as a means to produce epistemological scientific knowledge^[21].

Regarding technological structures, these are objects designed to solve problems, not necessarily physical objects, but encompassing the entire computational environment^[21]. With this in mind, the construction of an artifact in cycles (**Figure 1**), using DSR as a basis, aims to ensure design, rigor, and relevance in its conception^[20].

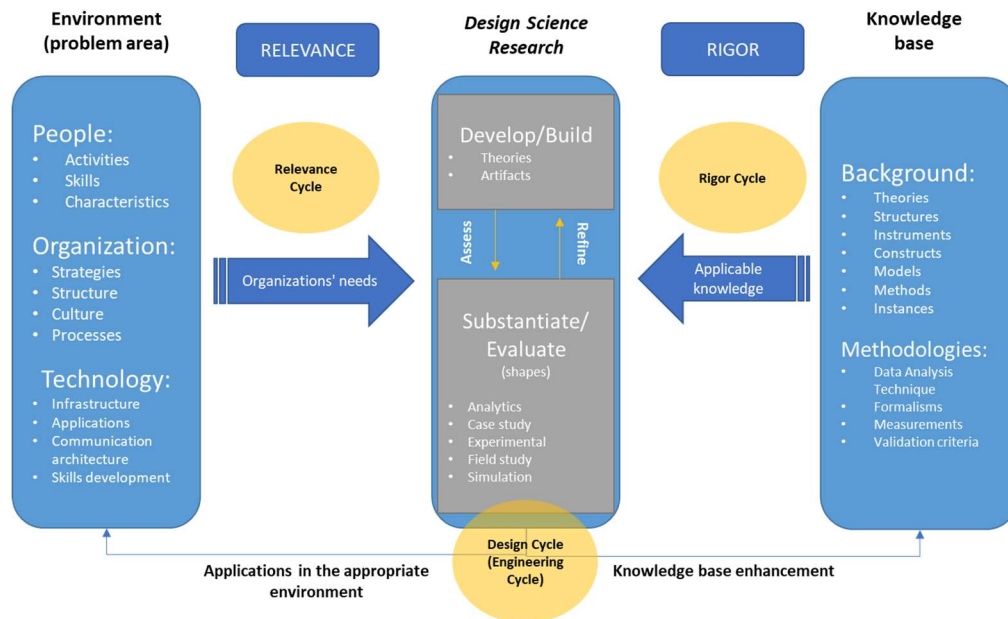


Figure 1. Design science research method^[20] considered by this research.

In terms of the process of building a solution, DSR's success depends on the researchers' ability to select relevant social-technical concerns (the relevance cycle) besides suitable procedures. So, the efficient use of the theoretical foundations of research and scientific knowledge ensures method rigor (the rigor cycle). In line with the other cycles, the engineering of the artifact (the design cycle) is responsible, among other things, for validating the solution and moderating the relationship between the other cycles, ensuring that the process is repeated as many times as necessary^[20].

So, the artifact is created according to modern software development practices grounded in the works of Halpin and Morgan^[22] and Larman^[23]. It intends a logical and intuitive representation that aims to ensure the solution's maintainability, understanding, robustness, and quality and allows for projects closer to the real world, which consequently offers a better user experience. This procedure focuses on objects and their interactions and permits greater adaptability to changes in software solution development^[23].

In this context, the DSR process presented by Hevner et al.^[20] consists of the development of four interdependent stages: requirement gathering, analysis, design, and implementation. This includes identifying and examining the requirements of the system to be developed, moving through the investigation of objects, classes, and relationships, evolving to the transition from the analysis model to the design model, in which the implementation details of the system are defined, writing the source code, and performing tests to produce a functional system.

Additionally, the simulation of the application's use will rely on the proof-of-concept (PoC) method

combined with the creation of a persona, allowing, in a practical way, to demonstrate the feasibility of the idea or theory in question. The PoC plays a crucial role in the development of an operational prototype, representing a fundamental stage in verifying the effectiveness and usefulness of the concept in a real context. This simulation aims to bring a typical user to life and advocates for the creation of fictitious scenarios to assess the practical usability of systems, products, or services, intending to identify possible operational problems throughout their lifecycle^[24].

4. Result

Over the last six decades, tourism has become one of the most important economic sectors in the world^[25]. More recently, during the COVID-19 crisis, the pandemic directly impacted the habits and routines of individuals and organizations. In this context, digital information and communication technologies played a fundamental role in meeting the demands of individuals and optimizing organizational processes and services^[26]. However, fundamentally, this industry still needs more technological development to meet the new needs of increasingly connected consumers.

It is worth noting that São João del-Rei is a colonial town in Minas Gerais, Brazil, renowned for its UNESCO-listed historic center showcasing exquisite 18th and 19th century Brazilian colonial baroque architecture. A hub of cultural tourism, it offers visitors a chance to immerse themselves in the region's rich heritage through its cobblestoned streets lined with preserved buildings, museums exhibiting sacred art and local history, lively traditional festivals, unique cuisine highlighting dishes like pão de queijo, and locally produced handicrafts. The surrounding natural landscapes provide opportunities for eco-tourism activities like hiking and caving, complementing the town's appeal as a destination for those seeking to experience the authentic colonial charm and cultural traditions of Minas Gerais. The Holy Week holiday is the most famous event, attracting hundreds of thousands of visitors^[3].

Besides, considering the increasing demand for tourism services^[8], it seems logical and coherent to develop technologies that contribute to the continuous growth of historical state tourism. Following the digital transformation trend, UaiGuia emerges as a mobile application that provides tourists with a unique and personalized travel experience, enabling users to define their itineraries based on their interests, i.e., route planning when traveling via multiple places. Furthermore, this information technology enables the segmentation of tourism types (e.g., religious, gastronomic, natural, and cultural tourism) and access to events previously registered in the system.

The app modeling went through the stages of modern software development, employing the use case diagram (**Figure 2**) to highlight the main system functionalities. A domain class diagram (**Figure 3**) provides a graphical representation of the main entities of the proposed application and their relationships. Finally, the prototype is presented by its concrete user interface, built by implementing the application. The design of the application screens prioritized the tourist's usability, focusing on navigation and visualization of information about their route, locations, and events registered in the application.

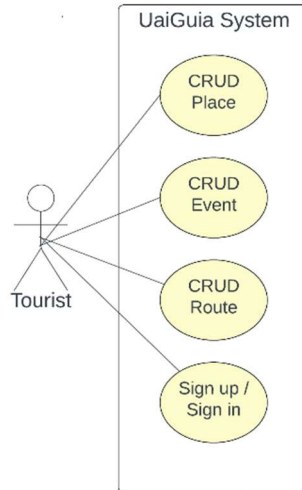


Figure 2. Use case diagram.

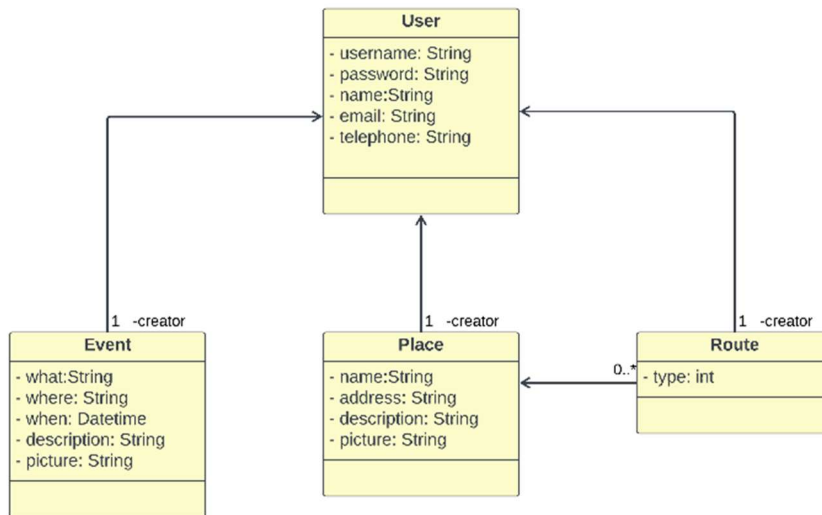


Figure 3. Domain class diagram.

In addition, it is worth mentioning the creation of personas^[24], which helped to reflect on the user’s needs and functionalities required, allowing the creation of specific situations for using the application. For instance, the persona of Ana Moraes was characterized as follows: Ana Moraes is a 32-year-old history teacher. Ana is planning a trip to visit the historical cities of Minas Gerais (Brazil), and the second city, after Ouro Preto, she will visit is São João del-Rei. Her main interest is to explore the churches and significant religious monuments in the area. She seeks a rich cultural experience, wishing to absorb each church’s history and appreciate its architecture and artistic details. Ana values accurate information about the churches’ opening hours, suggestions for optimized routes to visit multiple sites in one day, and a bit about the history of the buildings. She expects to experience the religious aspect and the cultural and historical connection the churches offer.

As a result of this dynamic, the app was implemented using Flutter, Firebase, and the Google Geolocation API. Flutter is a multi-platform app development framework created by Google that uses the Dart programming language to build high-performance user interfaces. Officially known as Cloud Firestore, Firebase offers a flexible and scalable NoSQL database service. Its operation is based on storing data in documents, which are organized into collections. Firebase establishes solid integration with Flutter, which provides backend-as-a Service (BaaS) services. This synergy provides functionalities such as user authentication, cloud storage, a real-time database, and push notifications. The cohesion between Flutter and

Firestore optimizes the development process, allowing the focus to be on creating user experiences while Firebase manages essential backend aspects.

Here are some screenshots of the app that was created. Among the developed screens are the initial page for registration and entry (**Figure 4**) and the login page, where the user enters their credentials to exploit the application's functionalities (**Figure 5**).



Figure 4. Start screen.



Figure 5. Login page.

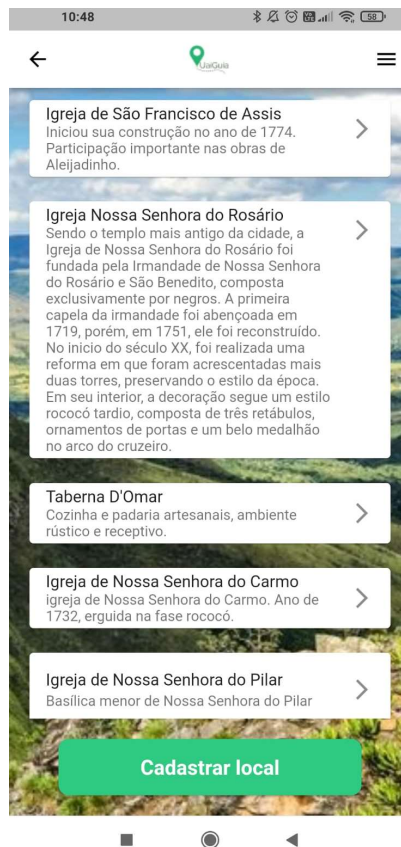


Figure 6. List of places.

The sign-up/in use case (**Figure 2**) is accessible through the “Cadastra-se” and “Entrar” buttons of the app's open screen (**Figures 4 and 5**), respectively. The other CRUD uses cases, which stand for the regular operations create, read, update, and delete performed on the main system entities (i.e., places, events, and routes—**Figure 3**), which were implemented consistently with the app look and feel. For example, users can see a list of events or places (**Figure 6**) as well as input new tourist event information (**Figure 7**). Since route creation is more complex, it has a specific procedure.

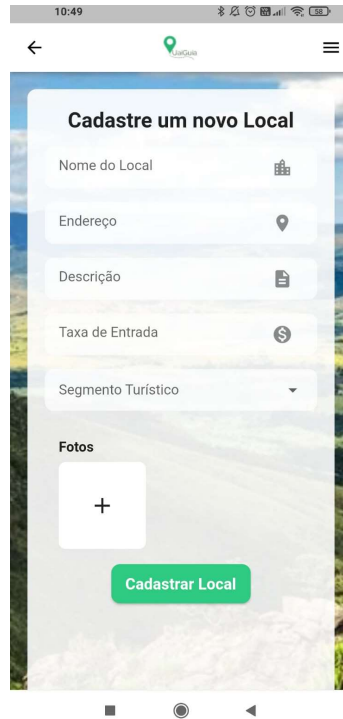
A screenshot of a mobile application interface for registering a new location. The screen is titled "Cadastra um novo Local". It features several input fields: "Nome do Local" with a building icon, "Endereço" with a location pin icon, "Descrição" with a document icon, and "Taxa de Entrada" with a dollar sign icon. Below these is a dropdown menu for "Segmento Turístico". A "Fotos" section contains a large white square with a plus sign for adding images. At the bottom, there is a green button labeled "Cadastrar Local". The background is a scenic landscape image.

Figure 7. Registering a new place.

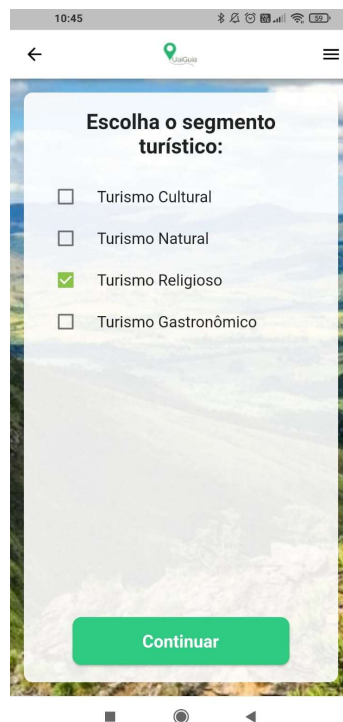
A screenshot of a mobile application interface for selecting a tourism segment. The screen is titled "Escolha o segmento turístico:". It lists four options with checkboxes: "Turismo Cultural", "Turismo Natural", "Turismo Religioso" (which is checked with a green checkmark), and "Turismo Gastronômico". At the bottom, there is a green button labeled "Continuar". The background is a scenic landscape image.

Figure 8. Starting a new route by selecting the tourism segment.

The pages displaying tourist segment places (**Figure 8**) and a summary of the chosen route with the selected locations (**Figure 9**) were developed to assist in the visualization and selection of places the tourist intends to visit. Upon selecting the tourist route visualization (**Figure 10**), Google Maps immediately displays the chosen direction, tourist locations, travel time, and path to be taken (**Figure 11**).

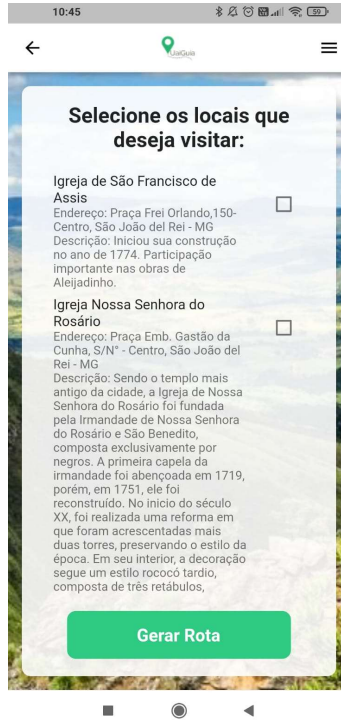


Figure 9. A route is created by checking places to visit.

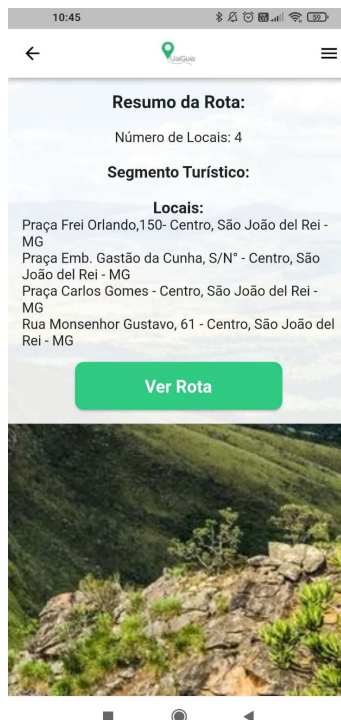


Figure 10. Route summary text visualization.

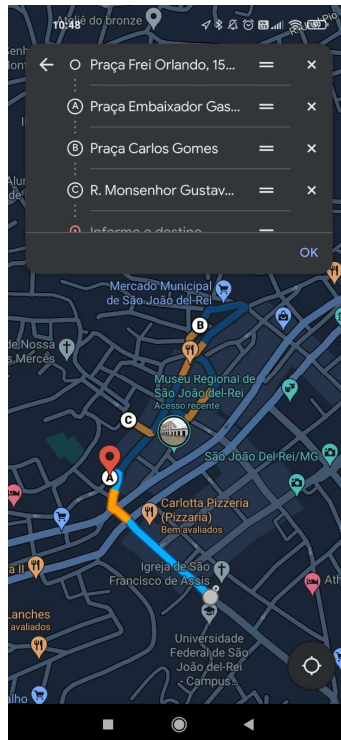


Figure 11. Route summary map visualization.

The presentation of these results aims to provide the reader with an understanding of the steps taken to achieve the central objective of proposing the development of a mobile application focused on tourist routes in the city of São João del-Rei, Minas Gerais, and providing travelers with the choice of locations to visit and the possibility of creating itineraries.

5. Discussion

Aware of the importance of tourism in the global economy, business leaders and academics^[3,7,8] invest their resources and efforts in developing technologies to meet the new demands of the sector. It is noteworthy, then, that not only the present research but also the study by Carvalho et al.^[7] focused on the development of a mobile application promoting tourism in the city of São João del-Rei (Brazil). The difference is that Carvalho et al.^[7] targeted a specific audience of tourists and enthusiasts of the religious festival of Holy Week with their proposal.

Besides, similar to the findings of this research, Siqueira's^[3] effort also emphasizes the importance of digital applications in the users' decision-making process in historical destinations (Diamantina and Ouro Preto). It adds to the pressing need for alignment between companies, tourist destinations, and digital mechanisms of information technology. Meanwhile, the study conducted by Meta^[8] presents multiple data points regarding Brazilian tourists, indicating an increasingly constant use of digital channels in researching and choosing tourist destinations. In synergy with this study, it underscores the importance of technological tools and platforms for enhancing travelers' experiences.

Thus, the present study is likely to encompass the key elements for developing the mobile application UaiGuia in its structure. This application aims to enhance the tourist experience of visitors in the city of São João del-Rei and boost the local tourism industry by offering personalized functionalities for exploring the region's rich culture. UaiGuia takes into account the changes in human and technological aspects, introducing a new system into the current environment to contribute to the continuous growth of historical state tourism.

6. Conclusion

Within all the concepts that underpin the field of information systems research, it is possible to affirm that the creation of the mobile application, UaiGuia, provided a distinct approach to exploring the rich culture and tourist attractions in the city of São João del-Rei, MG. Furthermore, it is believed that UaiGuia's main characteristic is to offer tourists the opportunity to create their own routes in a personalized manner based on their interests, ensuring that each visitor can explore the city according to their own choices and preferences. Moreover, access to cultural events, festivals, and other attractions via the application enhances the stay in the city even further. It provides a complete immersion in the richness of the region's heritage.

Regarding the inherent rigor in conducting the methodological steps, efforts were made in the design and development of the application, which involved the use of advanced concepts in software engineering with an emphasis on object-oriented architecture and a literature review to enhance understanding of the elements that comprise the tourism sector. This research also employed design science research in the construction of a technological artifact that aims to solve practical problems and generate scientific knowledge.

Nevertheless, this research is limited by the small number of studies analyzed. However, these were satisfactory for identifying the presented aspects. Thus, the addition of new features such as the evaluation and comment system, the checking system for the existence of locations and events, the incorporation of pre-defined routes, the inclusion of accommodation options, and the possibility of user system usability evaluation (feedback) are suggestions for future research.

Author contributions

Conceptualization, FPG and DBFC; methodology, DBFC; software, FPG; validation, FPG, DBFC, VFdF, MCV, ECF and FC; formal analysis, FPG, DBFC and MCV; investigation, FPG and VFdF; writing—original draft preparation, FPG and DBFC; writing—review and editing, VFdF, DBFC, MCV, ECF and FC; supervision, DBFC and FC; project administration, DBFC. All authors have read and agreed to the published version of the manuscript.

Acknowledgments

We are grateful to the residents of São João del-Rei for their collaboration and feedback. Special thanks to o colleagues from the Universidade Federal de São João del-Rei and FUMEC for their contributions. Lastly, we appreciate the unwavering support of our families, friends, and colleagues.

Conflict of interest

The authors declare no conflict of interest.

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