

Development of a mobile application to promote tourism in Norte de Santander integrating augmented reality

Desarrollo de una aplicación móvil para promover el turismo en Norte de Santander integrando realidad aumentada

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Abstract: The department of Norte de Santander has faced significant challenges in recent years, with the Covid-19 pandemic heavily impacting the tourism industry. In 2022, it ranked 15th out of 32 departments in the tourism competitiveness index. This project developed a mobile application called Turistear, aiming to promote tourism in the region through a 3D tourist guide with augmented reality. Using the design thinking methodology, focused on solving complex problems through creativity and empathy with the end user, the app gathers information from the main tourist sites, providing 3D representations and relevant information. Unity was used as the core program, integrated with AR Foundation for augmented reality, contributing to the tourism dynamics and cultural exchange in Norte de Santander.

Keywords: tourism, 3D tourist guide, augmented reality

Resumen: El departamento de Norte de Santander ha enfrentado desafíos significativos en los últimos años, con la pandemia de Covid-19 impactando duramente la industria turística. En 2022, ocupó el puesto 15 de 32 departamentos en el índice de competitividad turística. Este proyecto desarrolló una aplicación móvil llamada Turistear, con el objetivo de promover el turismo en la región mediante una guía turística 3D con realidad aumentada. Utilizando la metodología design thinking, centrada en resolver problemas complejos a través de la creatividad y la empatía con el usuario final, la app recopila información de los principales sitios turísticos, con representaciones 3D e información relevante. Unity se utilizó como programa núcleo, integrado con AR Foundation para la realidad aumentada, generando un aporte a la dinámica turística y el intercambio cultural en Norte de Santander.

Palabras clave: turismo, guía turística 3D, realidad aumentada.

1. INTRODUCTION

The department of Norte de Santander has faced significant challenges in recent years, ranking 15th out of 32 departments in the Tourism Competitiveness Index for 2023 [1]. This situation has exacerbated the economic and social crisis in the region, presenting several major challenges for the recovery of regional tourism, which has experienced a significant decline due to the health emergency caused by COVID-19, generating economic and social impacts.

In this context, innovation and technology are becoming important tools to reactivate tourism in Norte de Santander. The advent of the internet has had a significant impact on the tourism sector due to the multiple possibilities it offers for communication [2],[3]. With an internet connection, users can choose where to stay, their final destination, and what activities to do in that geographic location [4]. This trend has transformed the way travel is conceived, both for tourists and businesses [5]. Digitalization has impacted all areas of human activity, playing a crucial role in the development of the tourism sector. These unprecedented changes have led to the integration of various technologies that enhance the consumer experience. Globally, in the hospitality and tourism sectors, digital transformation has allowed the customer experience to become a profitable business, offering a wide range of opportunities [6]. Augmented Reality (AR) is considered a powerful and easy-to-use technology that can play an important role in promoting the region's historical and cultural heritage [7]. According to Vega [8], AR seeks to enhance the way users perceive and interact with real-world environments by adding virtual information. The creation of 3D guides based on AR can not only provide tourists with an immersive experience but also improve the understanding and appreciation of cultural heritage, attract more tourists, and generate additional revenue for the local industry [9]. Mobile technology has become one of the most important trends in the tourism sector. Tourism mobile applications allow travelers to access real-time information, make reservations, receive personalized recommendations, and share their travel experiences on social media while exploring new destinations. According to Bernad [10], the use of smartphones, especially through mobile applications, significantly influences the experience and behavior of people visiting historical or cultural heritage sites. Macías and collaborators [11] establish three principles for sustainable tourism:

Optimize the use of environmental resources as an integral part of tourism development, preserving essential ecological processes and contributing to the conservation of natural resources and biological diversity.

Respect the sociocultural authenticity of host communities, conserving their cultural and architectural assets, as well as their traditional values, and promoting intercultural understanding and tolerance.

Ensure the long-term economic viability of tourism activities, generating equitable socioeconomic benefits for all stakeholders involved, including stable employment opportunities, income generation, and social services for host communities, and contributing to poverty reduction.

In recent years, the most requested applications are those that offer virtual reconstructions, providing a more immersive and enriching experience when interacting with historical and cultural objects. These tools allow visitors to virtually explore attractions before visiting them, effectively plan, and maximize their stay in the area, giving a significant boost to tourism recovery in Norte de Santander.

According to the Ministry of Commerce, Industry, and Tourism (MinCIT) in its report "Departmental Economic Profiles" [12], nearly fifty thousand tourists were registered in the department of Norte de Santander in 2019. These figures were affected in 2020 by the health emergency, with less than nine thousand visits recorded. By 2021, the situation improved slightly, surpassing twenty-five thousand visits. However, in the post-pandemic period, less than seventeen thousand visits were recorded, declining again in 2022.

It is also noted that by 2020, there were 1,335 active tourism businesses, of which only 41% continued throughout 2021, where 52% canceled their Chamber of Commerce registration and 7% were suspended, resulting in 542 active businesses by 2023.

To address the regional need, the project aimed to develop a mobile application that facilitates the deployment of a 3D tourist guide integrating Augmented Reality to promote tourism in the department of Norte de Santander, using the design thinking methodology as an innovative strategy employing digital tools. It is worth noting that in the tourism sector, technology has primarily focused on the promotion and visibility of places and tourist offerings [13]. Therefore, technological tools are considered particularly

important as they allow the historical and cultural heritage of a tourist destination to be showcased, encouraging the flow of visitors to these places.

2. DEVELOPMENT OF THE MOBILE APPLICATION FOR PROMOTING TOURISM IN NORTE DE SANTANDER: TURESTEAR

The selected methodology for the development of this project is Design Thinking. This methodology is described as an approach that places the human being at the center of multidisciplinary and collaborative process development. Its goal is to generate alternatives that lead to the creation of innovative solutions [14]. Moreover, it involves cultivating cognitive skills to examine a situation from various perspectives and follow an innovation process, as indicated by [15]. This process seeks to identify the true needs of the stakeholders. According to Vargas et al. [16], it consists of five phases:

- **Empathize:** The goal is to deeply understand the users involved in the design. This involves observing their actions and behaviors in their natural environment and engaging in meaningful conversations to uncover their needs. Empathy is essential, and questions should be asked to gain a deeper understanding of the situation.
- **Define:** This phase aims to bring clarity and focus to the problem. It builds on the empathy developed in the previous phase to define the project's challenge, taking into account the information gathered about the user and their environment.
- **Ideate:** This is where the creative phase of design begins, and a variety of ideas and concepts are generated. All ideas are welcome, and the combination of rational thinking and imagination is promoted to find innovative solutions.
- **Prototype:** This involves creating tangible representations of the ideas, such as drawings or objects. The goal is to answer key questions and get closer to the final solution. Prototypes can be simple or complex but should have some level of interactivity.
- **Test:** Feedback and opinions on the prototypes are sought from both users and peers. It is an opportunity to refine and improve the solutions, maintaining an open mind to readjust according to the feedback.

2.1. Empathize Phase

In this phase, a qualitative approach was employed, using interviews as the specific instrument. The data collected from these interviews allowed for the identification of user needs when interacting with tourism applications in the specified context.

The interview was conducted with various user profiles to build a tool known as "Persona," understood as a detailed profile that represents a potential user of the application, recognizing their specific needs and interests. This tool is illustrated in Fig. 1.

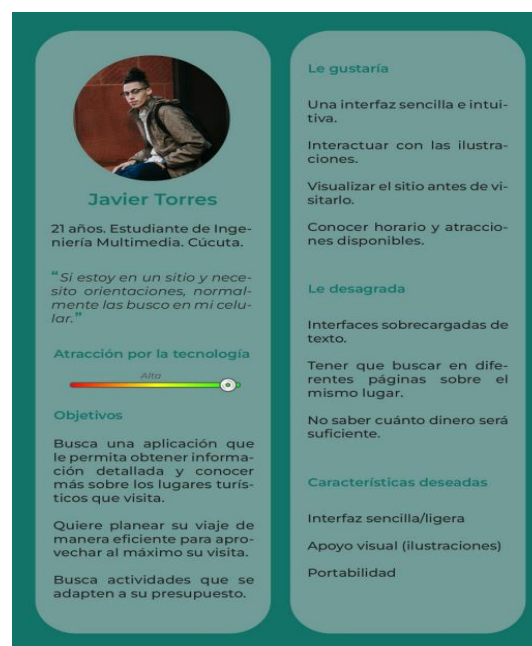


Fig. 1. Persona Tool

Source: Own elaboration.

2.2. Define Phase

2.2.1. Definition of Visual Identity (Logo and Name)

The logo and name are essential in building a brand identity and connecting with the audience. These elements not only visually represent the brand but also convey its values, mission, and vision [17].

The selected name was "turistear," a term that merges the concept of tourism with augmented reality (AR). The logo features the Icterus chrysater bird, or "toche," an emblematic species of the region. It is important to highlight that the bird is depicted in a Low Poly style, foreshadowing the three-dimensional design that users will experience in the application. Low poly is a 3D modeling technique and visual style that involves creating figures with a reduced number of polygons. This technique produces a

stylized and minimalist appearance, characterized by its geometric look [18]. Based on the data defined in the empathize phase, the person's needs and the necessary requirements for designing a functional user interface were established.



Fig. 2. App Logo
 Source: Own elaboration.

2.2.2. Wireframe UI

The wireframe is a crucial phase in design, where it schematizes which widgets (for example, buttons, selection lists, and text fields) compose the interface and what their layout is, but without considering details such as colors, images, or logos [19]. Its goal is to structure information and organize elements logically and coherently, projecting that the user has a fluid and intuitive browsing experience.

In Fig. 3, the wireframe of the main menu of the application is presented, designed in Adobe Illustrator. This menu is a set of cards that display 3D representations of tourist sites, along with their name and location. The application features a dark interface, aligned with current design trends. Additionally, it uses icons from Google's "Material Symbols" set, a standard in design for mobile and web applications.



Fig. 3. Main Menu of the App
 Source: Own elaboration.

Fig. 4 illustrates the wireframe of the AR view. This view allows users to visualize 3D scenarios through their device's camera. The overlaid interface offers various buttons, such as back, capture image, general information, map, and tags.

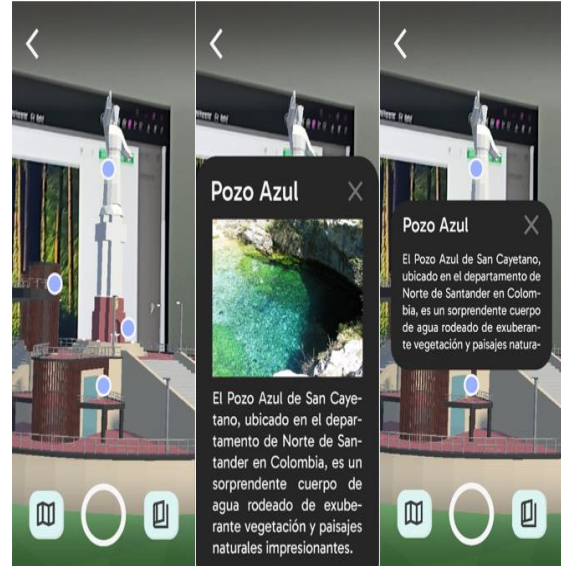


Fig. 4. AR View and UI Element Layout
 Source: Own elaboration.

When selecting "general information," a window covering approximately 70% of the screen is displayed with details and images of the tourist site. Meanwhile, touching a tag presents a popup window with specific information about the place.

2.3. Ideate Phase

In the Ideate phase, scenarios for visualization in the app were prepared. For this process, the use of Blender software was fundamental. This free, open-source program allows for modeling, texturing, and rendering of 3D elements [20]. This made it a key component for the development of this project.

In Fig 5, the Blender interface can be observed with the result of the modeling process of Pozo Azul, San Cayetano. As mentioned previously, the Low Poly style has been chosen, as it is an aesthetic that, when executed correctly, can produce truly appealing and low-resource-consuming results.

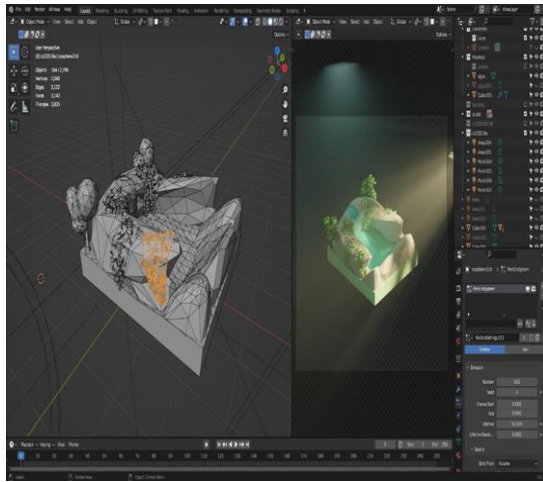


Fig. 5. 3D Modeling of Pozo Azul in Blender.
Source: Own elaboration.

2.4. Prototyping Phase

In the prototyping phase, a first version of the app was built with the aim of materializing the ideas. At this stage of development, the prototype includes a user interface for testing and two functional scenarios with their respective models and information (See Fig. 6). However, the AR functionality has not yet been implemented.

In this phase of development, the assembly of the app begins in the core program, which in this case is the Unity engine, selected for its ability to handle 3D graphics and its ease of compiling applications for Android.

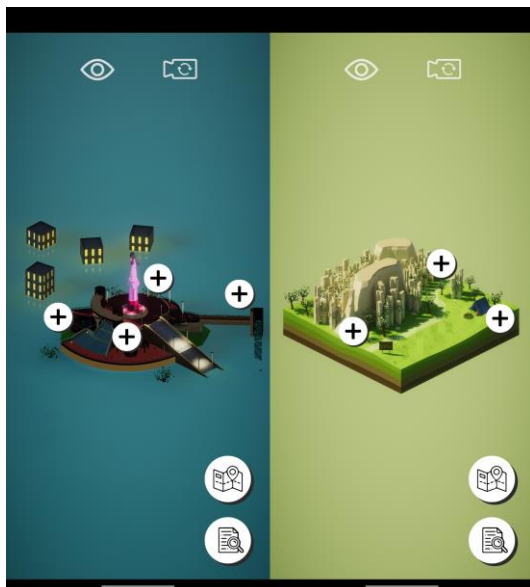


Fig. 6. Functional Scenes: Cristo Rey and Los Estoraques.
Source: Own elaboration.

For the assembly, the process involves importing the available assets to provide them with interactivity through scripts. The functions programmed so far serve to change scenes,

display annotations and pop-up windows, buttons to hide/show content, and reset the camera position, which is controlled through gestures (pan, pinch).

In Fig 7, you can appreciate the different elements that make up the Los Estoraques scene, such as assets, sprites, canvas, lighting, and post-processing effects.



Fig. 7. Los Estoraques Scene.
Source: Own elaboration.

2.5. Testing Phase

During the project testing stage, a process of testing by an expert user of augmented reality was carried out to ensure the quality and functionality of the application aimed at promoting tourism in Norte de Santander.

Likewise, in a second phase of testing, we expect to coordinate with the Secretary of Culture and Tourism of Cúcuta, with the aim of presenting the project and validating it with tourism sector entrepreneurs, according to their assessment of the app's availability, reading formats, content customization, searchability, usability, and ability to share with other users.

3. CONCLUSIONS

The developed project represents an innovative contribution by applying augmented reality to showcase tourist attractions in the Norte de Santander region, on a mobile and user-friendly platform.

The Design Thinking methodology allowed focusing the development on the real needs of tourists, which increases the likelihood of adoption of the application. It is necessary for more actors in the tourism sector in the region to take advantage of these emerging technologies, in collaboration with the academic sector, to enhance their promotion strategies.

Augmented reality adds differential value to the tourist experience; however, it should complement rather than replace real contact between visitors and local communities.

The validation process of the real impact of the developed application on specific indicators of tourism recovery in the region is underway. This will guide future iterations. The project sets an interesting precedent for university-community cooperation to address social issues by leveraging information and communication technologies.

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