Development of an informative web application for the promotion of ecotourism: A case study

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Abstract

INTRODUCTION: En a global context where technology is essential for the search of information and decision-making by tourists, the creation of digital platforms is a key strategy to promote sustainable tourism practices.
OBJECTIVES: We aim to develop an informative web application aimed at promoting ecotourism in Lake Cuipari, using it as a case study.
METHODS: The software development followed the phases established in the Agile methodology Extreme Programming: i) Exploration, ii) Planning, iii) Interactions, iv) Production, and v) Maintenance. To ensure the quality of the software product, we applied black-box testing.
RESULTS: We successfully developed a functional informational web application with two panels, administrative and visitor. The web application allows users to learn about the location of Lake Cuipari, explains access conditions, and provides information about native species in and around the lake. These species are categorized into birds, amphibians, and fish, with academic, scientific, and tourist interest.
CONCLUSION: The informational web application serves as a digital platform that enables the municipality and the local community to promote ecotourism in Lake Cuipari for the sake of its preservation and sustainability. This is achieved through the increased provision of information for potential tourists.

1. Introduction

The COVID-19 pandemic has caused a global crisis that has affected human activities. One of the most impacted sectors is tourism, as it faces the challenge of creating conditions that ensure the health of tourists and provide them with the necessary confidence for a gradual return to activity [1].

To reactivate tourism, it is necessary to conceive innovative ideas and business plans that can meet current needs [2]. Among these are strategies related to ecotourism, also known as landscape tourism or ecological tourism, which focuses on offering tourist activities in natural environments while preserving the environment. This approach becomes relevant in a post-pandemic context, as tourists show a growing interest in participating in outdoor activities [3].

According to the World Tourism Organization, Peru is a globally iconic destination due to its scenic, cultural, and

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gastronomic attractions, being considered a potential sector for economic development. According to the Ministry of Foreign Trade and Tourism, between January and June 2023, 1.1 million international tourists entered the country, surpassing the 200,000 tourists per month threshold [4].

However, in the province of Alto Amazonas, Loreto region, despite the existence of potential natural, cultural, and historical tourist destinations such as Lake Cuipari, the Apangurayacu community, the petroglyphs of Kumpanama, among others; very few are promoted by local authorities and communities [5], leading to a missed opportunity for ecotourism development in this area of the Peruvian Amazon.

As such, this research focuses on the low promotion of ecotourism in Lake Cuipari, located in the district of Teniente Cesar López Rojas, 45 km from the city of Yurimaguas, the capital of the Alto Amazonas province. This is reflected in the low influx of visitors to the lake despite having tourist attractions sought after by national and international tourists [6], such as wildlife observation (birds, amphibians, etc.), canoeing, camping, artisanal fishing, among other activities.

We identified that the low promotion of ecotourism in Lake Cuipari is mainly due to a lack of familiarity with digital dissemination tools. Both the authorities and the residents of the local community have lagged behind in the use of technologies such as web platforms, mobile applications, or social media, limiting the visibility and reach of the tourist offerings [7,8].

The low promotion of this natural resource leads to the loss of economic opportunities for the community and region, limits the generation of local employment, contributes to a lack of environmental awareness among visitors, and results in the absence of incentives for its conservation [9], posing a threat to the sustainability and preservation of the lake.

The purpose of this study is to develop an informative web application aimed at promoting ecotourism in Lake Cuipari as a case study. This tool aims to facilitate its use by both authorities and the local community, enabling the effective promotion of ecotourism through digital channels targeted at potential national and international visitors.

2. Methodology

We applied the agile software development methodology Extreme Programming (XP), given its focus on flexibility and collaboration. XP allows continuous adaptation as new needs are identified and feedback is collected for the development of web applications [10]. Moreover, it encourages constant communication and collaboration among the members of the development team, which is essential for success in a project involving multiple stakeholders [11]. In this regard, we carried out the following phases:

2.1. Exploration

It involved identifying the project requirements based on the needs of the stakeholders, including the authorities of the District Municipality of Teniente César López Rojas, the community surrounding Lake Cuipari, and the authors of this research.

The work meetings were conducted on-site, successfully concluding the exploration phase with the definition of the purpose of the informative web application: Promote ecotourism in Lake Cuipari. Simultaneously, the web application will serve as a digital dissemination medium to increase the visibility and reach of the tourist activities offered at the lake, attracting both national and international tourists.

2.2. Planation

During this phase, we established user stories to understand the functional requirements of the web application. We used technical language that could be understood by the project development team. For each requirement, we assigned a priority of "high," "medium," or "low," allowing flexibility in the production of the web application based on the prioritized needs of stakeholders and testing the system as it is developed. Table 1 shows the registered user stories.

Tabla 1. User stories

Ítem	User	Description	Priority
1		I want to add a map of the location of Lake Cuipari.	High
2		I want to provide directions to reach Lake Cuipari.	High
3		I want to provide information about the characteristics of Lake Cuipari.	High
4	Administrator	I want to provide information about the project that funds the creation of the web application for academic purposes.	Medium
5		I want to record the native species inventoried in Lake Cuipari.	High
6		I want to add photos or videos of the tourist activities at Lake Cuipari.	High
7		I want to get information on how to get to Lake Cuipari.	Low
8	Visitor	I want to know about the native species of Lake Cuipari.	Low
9		I want to be able to access the application from any device.	Medium

Likewise, in this stage, we defined the roles of the project development team, which we describe in Table 2.

Tabla 2. Roles of the development team

Roles	Responsibles
Full Stack Development	Roi Casas
Documentation	Roger Rengifo-Amasifen, Juan Schrader
Administration	José Seijas-Díaz, Karla Martell, Rosa Cueto-Orbe
Validation	Enrique Barbachán-Ruales, Cinthya Torres-Silva

On the other hand, in this phase, we also selected the client-server system architecture, which allows users, such as tourists interested in obtaining information about Lake Cuipari, to connect easily through their web browsers, while the server handles processing requests and providing the necessary resources and data. This architecture facilitates scalability, maintenance, and system updates, in addition to enabling faster and more efficient access to information [12,13], enhancing the user experience and contributing to the success of the ecotourism promotion initiative.

2.3. Interactions

Interaction is a fundamental process that involves continuous and close communication between developers and end-users of the web application. In XP, active collaboration with users is encouraged throughout the development cycle, including the planning, design, coding, and testing phases. User interaction involves obtaining constant feedback on the functionalities of the web application, ensuring that the needs and expectations of users defined in user stories are being met. This allows for agile adjustments and improvements, ensuring that the final product meets the real needs of users.

This led us to define 12 interactions according to the modules and sub-modules to be developed from the administration panel (back end), which will be reflected in the visitor panel (front end). Additionally, the development of the web application was planned for three months of work (Table 3).

Tabla 3. Interactions with the client

Interaction	Module	Submodule	Month
1	Security	Users	1
2		Profiles	
3		Access	
4	Maintenance	Species class	2
5		Species	
6		Species family	
7		Order	
8		Allies	
9		Photo gallery	
10		Project information	
11		Technical team	
12	Visitor Panel (front end)	End user interface	3

2.4. Production

We developed the software in a Ruby on Rails 7.0 working environment, serving as the backend connected to a MySQL database version 8.0. This framework adopts the Model-View-Controller (MVC) design paradigm, where the model handles interaction with the database tables (model = table), and the controller manages data and maintenance through CRUD operations. Additionally, we used Vue.js for the frontend, where forms were created, integrated with the backend through an internal web service interface.

After completing the creation of forms and integration with the backend, we conducted black-box testing to verify the programmed functionalities and ensure their correct availability and security. Subsequently, the system was deployed on a server with 1 GB of RAM and 20 GB of disk space, running on the Ubuntu 22.04 operating system with a Nginx version 1.18.0 proxy server. Additionally, we used Passenger 6.0.18 to run the Ruby on Rails services.

To access the software, we configured the domain lagocuipari.com for the main page, while the administrative application is available at apps.lagocuipari.com, both linked through the server's IP address.

2.5. Maintenance

The maintenance phase reflects the agile development philosophy, emphasizing adaptability and responsiveness to changes. It is a continuous phase that extends throughout the entire software lifecycle and relies on constant user feedback to ensure that the software effectively meets its objectives.

In this stage, we provide support to administrative users to help them understand the functioning of the web application and address their questions and issues. Additionally, we identify and correct any defects that end-users report in the production web application. Finally, we take into account user feedback to make continuous adjustments and improvements to the web application.

3. Results

3.1. Administrator Panel

Based on the XP methodology, we successfully developed an informative web application to promote ecotourism in Lake Cuipari, considering agile and collaborative practices

within the production team. The system includes an administrative panel that allows data and information management through forms, which will be visible on the visitor panel. Figure 1 shows the Login interface of the web application.
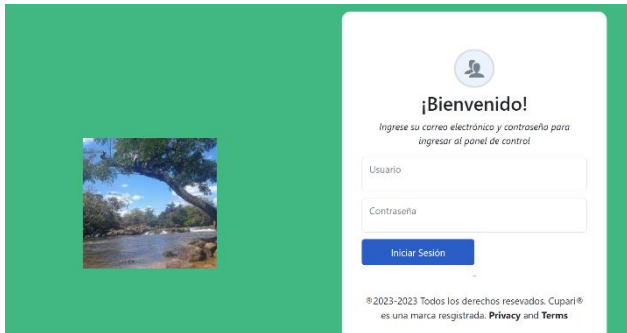

Figure 1. Login interface

Figure 2 highlights the developed modules: Security and Maintenance. In the first module, the submodules for Users, Profiles, and Access are programmed. In the second module, the submodules for Species Class, Species, Species Family, Order, Allies, Photo Gallery, Project Information, and Technical Team are programmed.
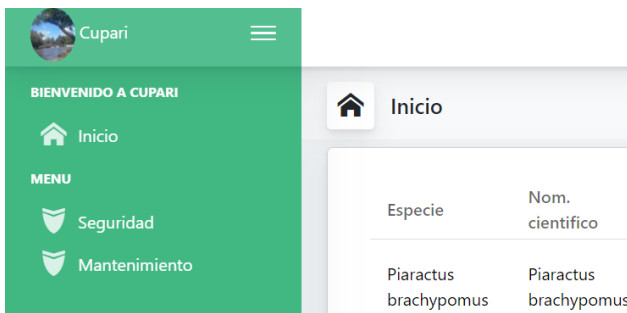

Figure 2. Main modules

Figure 3 displays an example of a form to register a native species inventoried in Lake Cuipari and its surrounding areas. The inventory was conducted by biology specialists and serves as valuable resources to enhance the interest of ecotourist visitors based on the bird, fish, and amphibian species found in the lake.
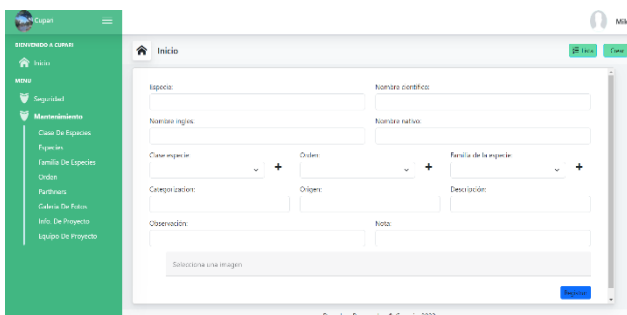

Figure 3. Example from the Species submodule

Figure 4 also showcases the form for the Project Team submodule of the informative web application. In this case,

the submodule aims to provide information about the technical team involved in the management of enhancing Lake Cuipari, fostering potential collaborations with national and international researchers.
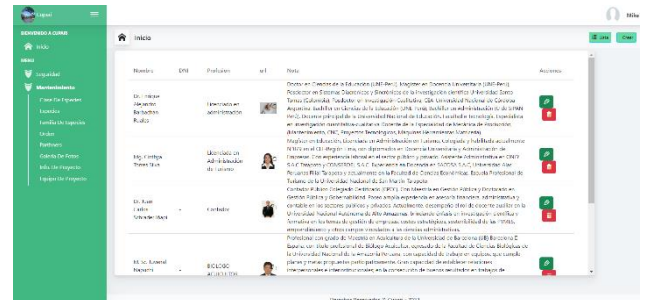

Figure 4. Example from the Project Team submodule

3.1. Visitor Panel

Below, we present the visitor panel based on the programmed modules. In general terms, the web application aims to promote ecotourism in Lake Cuipari by showcasing information about native species and available activities in the area. Figure 5 shows the main interface that a tourist will encounter when accessing the web portal.
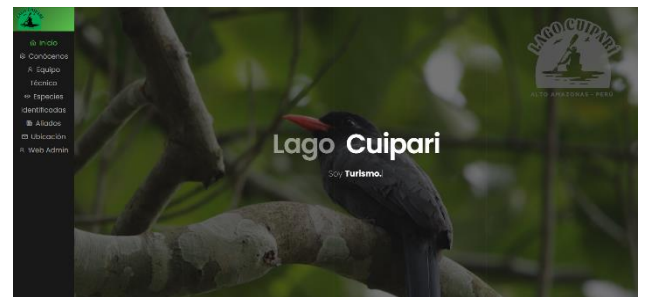

Figure 5. Main interface of the visitor panel

Regarding Figure 6, it displays information about the technical team of the project promoting ecotourism in Lake Cuipari. Users will be able to access information about the professionals responsible for managing the portal and connect with them through their contact links.
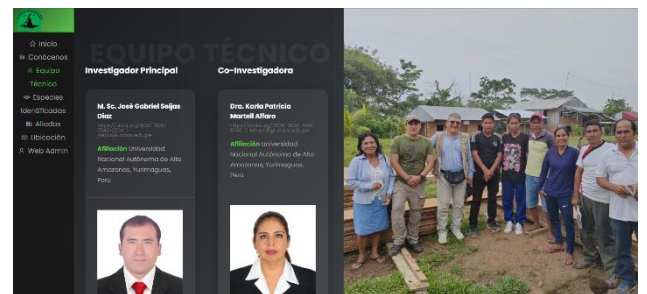

Figure 6. Technical team interface

One of the highlights of the informative web application is to provide data about the inventoried species in Lake Cuipari and its surrounding areas. By disseminating information about birds, we aim to encourage the

possibility for tourists to engage in birdwatching at the lake. Similarly, amphibian species generate interest from both an academic and scientific perspective, in addition to providing tourist attractions (Figure 7).
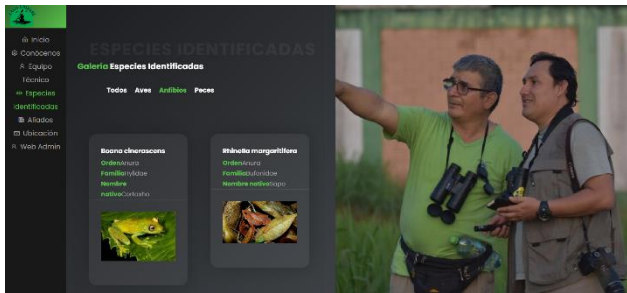

Figure 7. Interface of inventoried species

Furthermore, the informative web application details the routes to access Lake Cuipari, presents a location map, and provides information about weather conditions and available means of transportation, allowing tourists to plan their visits more effectively (Figure 8).

Figure 8. Interface of Lake Cuipari location

It is crucial to emphasize that the information gathered and presented in the web application is the result of a collaborative and integrated effort with the community surrounding Lake Cuipari. The goal of promoting ecotourism is primarily aimed at contributing to the socio-economic development of both the locality and the region.

4. Discussion

Informative web applications are crucial in the current era due to their ability to provide global and instant access to relevant information [14]. These tools facilitate informed decision-making by offering updated and accessible data in various sectors, such as tourism, education, and health. Additionally, they play a key role in promotion and marketing, enabling businesses and destinations to showcase products and services attractively [15].

In the contemporary tourism industry, the diversity of services and products available has seen an increase, offering users a wide range of options ranging from travel packages to hotels and tourist attractions. This exponential growth in offerings, while providing travelers with a variety of alternatives, also poses challenges as the abundance of choices leads users into a difficult situation to identify and select exactly what they need. In this scenario, accurate and accessible information is crucial [16].

Therefore, informative web applications, for example, can act as tools by providing users with updated and detailed data on various available options, thus facilitating informed and personalized decision-making. The growing complexity of the tourism landscape emphasizes the importance of solutions that simplify the search and selection of services, ensuring a more satisfying experience tailored to the individual needs of travelers.

Similarly to the research conducted by Fararni et al. [17], Chai-Arayalert [18], and Nishanbaev [19], the implementation of technological solutions, especially disruptive ones, in the tourism sector is key to meeting the expectations and needs of visitors. This study demonstrates that the development of an extensive informative web application expands the means of communication for the ecotourism offerings provided by Lake Cuipari, which are potentially attractive to national and international tourists seeking to promote environmental sustainability and protect natural resources.

Like any research, this current study has limitations, specifically regarding the web application, as it is only available in one language (spanish), necessitating the addition of english and portuguese options. Additionally, there is a need to integrate digital analytics to understand how many users navigate the website, their geographical origins, and other demographic data. This information will help in better promoting ecotourism at Lake Cuipari. Finally, the web application should be promoted by the government and the local community to ensure it can have a positive impact on regional and international tourism promotion.

Conclusions

We managed to implement an informative web application designed to boost ecotourism at Lake Cuipari. The application was developed efficiently thanks to the agile methodology employed (XP), which facilitated a systematic and collaborative process within the production team.

The launch of this application provides the authorities of the municipality of Teniente Cesar López Rojas and the local community with a digital tool for disseminating information about the various ecotourism activities available at the lake. In a digitized era where tourists actively seek information on the internet to make informed decisions, this application stands as an essential and necessary technological resource.

As the web application solidifies its presence online, it is expected to play a crucial role in the long-term preservation and sustainability of Lake Cuipari. By providing access to detailed information about ecotourism activities, it fosters greater environmental awareness and

promotes a sustainable approach in visitors' interaction with the environment. This initiative not only addresses current tourists' demands but also significantly contributes to the joint effort to preserve the natural beauty and biodiversity of Lake Cuipari.

Acknowledgements

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