South American Publishing

SAP Land and Architecture. 2025; 4:184
doi: 10.56294/la2025184

REVISIÓN

Technological innovation for cultural tourism: Virtual assistant at the Las Lajas Shrine, Colombia

Innovación tecnológica para el turismo cultural: Asistente virtual en el Santuario de Las Lajas, Colombia

Raúl Andrés Villada Melo[1] ✉, Juan Camilo Caicedo Peña[1] ✉, Jorge Alveiro Rivera Rosero[1]

[1]Universidad CESMAG, Facultad de Ingeniería, Ingeniería de sistemas. Pasto- Nariño, Colombia.

Cite as
Villada Melo RA, Caicedo Peña JC, Rivera Rosero JA. Technological innovation for cultural tourism: Virtual assistant at the Las Lajas Shrine, Colombia. SAP Land and Architecture. 2025; 4:184. https://doi.org/10.56294/la2025184

Publication History
Submitted: 21-05-2024
Revised: 23-10-2024
Accepted: 03-07-2025
Published: 04-07-2025

ABSTRACT

The research focused on improving the tourist experience at the Santuario de las Lajas, located in Ipiales, Colombia, through the use of artificial intelligence applied to image recognition via WhatsApp. The project was part of the artificial intelligence research line, specifically in the sub-line of artificial vision, by implementing a virtual assistant capable of identifying artistic representations of the sanctuary and providing contextualised information to visitors. The sanctuary, recognised as one of the seven wonders of Colombia, lacked significant educational and guidance information for tourists, which created a cultural disconnect and limited appreciation of the heritage site. The proposed virtual assistant used machine learning and natural language processing algorithms to provide accurate and rapid responses through simple interaction via the WhatsApp platform. The study was carried out through surveys, interviews, and data analysis applied to a representative sample of visitors between 2023 and 2024. The results showed improvements in user satisfaction, greater accuracy in visual recognition, and a decrease in response times. The project also had a positive impact on the promotion of sustainable tourism, the strengthening of regional tourism, and the conservation of cultural heritage. In conclusion, the research highlighted the importance of integrating emerging technologies for social and cultural purposes, positioning the virtual assistant as a replicable model in other historical spaces and as an important step forward in the digitisation of heritage.

Keywords: Artificial Intelligence; Artificial Vision; Cultural Heritage; Image Recognition; Sustainable Tourism.

RESUMEN

La investigación se enfocó en mejorar la experiencia turística en el Santuario de las Lajas, ubicado en Ipiales, Colombia, mediante el uso de inteligencia artificial aplicada al reconocimiento de imágenes a través de WhatsApp. El proyecto se inscribió en la línea de investigación de inteligencia artificial, específicamente en la sublínea de visión artificial, al implementar un asistente virtual capaz de identificar representaciones artísticas del santuario y brindar información contextualizada a los visitantes. El santuario, reconocido como una de las siete maravillas de Colombia, presentaba una carencia significativa de información didáctica y orientativa para los turistas, lo que generaba una desconexión cultural y limitaba la apreciación del patrimonio. El asistente virtual propuesto utilizó algoritmos de aprendizaje automático y procesamiento de lenguaje natural para ofrecer respuestas precisas y rápidas mediante una interacción sencilla a través de la plataforma WhatsApp. El estudio se llevó a cabo mediante encuestas, entrevistas y análisis de datos aplicados a una muestra representativa de visitantes entre 2023 y 2024. Los resultados evidenciaron mejoras en la satisfacción del usuario, mayor precisión en el reconocimiento visual y una disminución en los tiempos de respuesta. Asimismo, el proyecto tuvo un impacto positivo en la promoción del turismo sostenible, el fortalecimiento del turismo regional y la conservación del patrimonio cultural. En conclusión, la investigación destacó la relevancia de integrar tecnologías emergentes con fines sociales y culturales, posicionando al asistente virtual como un modelo replicable en otros espacios históricos y como un avance importante en la digitalización del patrimonio.

Palabras clave: Inteligencia Artificial; Visión Artificial; Patrimonio Cultural; Reconocimiento De Imágenes; Turismo Sostenible.

© 2025; The Authors. This Open access article is distributed under the Creative Commons Attribution 4.0 license (https://creativecommons.org/licenses/by/4.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

INTRODUCTION

The research focuses on the tourist experience in the Sanctuary of Las Lajas through an image recognition system utilizing WhatsApp.

Line of Research

The research falls within the realm of Artificial Intelligence. Which is the simulation of human intelligence by machines, the application of the aforementioned line of research becomes an essential component in the project's framework by implementing a virtual assistant with image recognition through WhatsApp.[1,2]

The present research falls under the Artificial Vision subline, specifically in its application to a virtual assistant for the WhatsApp messaging platform. This assistant will be tasked with recognizing images of the artistic manifestations of the Sanctuary of Las Lajas. The importance of this subline lies in the fact that artificial vision enables the processing, analysis, and understanding of images, and in turn, interprets the visual environment like humans This means that the virtual assistant can process and respond to the captured images, providing visitors with detailed and contextualized information.[3,4,5]

The Las Lajas Sanctuary, situated 7 km from the municipality of Ipiales, is regarded as one of the most impressive sanctuaries in the world and serves as a symbol of the region's cultural and spiritual richness. The sanctuary has been recognized worldwide for housing one of the most beautiful churches in the world. In 2007, it was distinguished as one of Colombia's seven wonders,[6,7] solidifying its position as a highly sought-after tourist destination. Its impressive architecture and deep-rooted historical tradition not only make it a key point of interest in the country, but also attract visitors from all over the world. Despite its undisputed relevance, an impact on the tourist experience has been identified, marked by the lack of access to detailed and contextual information about the sanctuary and its representations. Available information tends to rely heavily on family sources or friends.[8,9,10]

Visitors to Las Lajas Sanctuary may experience difficulty accessing historical and cultural information, which can reflect a limited understanding of the meaning behind the artistic representations present at the site, thereby depriving them of the rich historical context they contain. Likewise, the lack of guidance on other elements to explore at the sanctuary limits tourists' experience, preventing them from taking full advantage of their visit and immersing themselves inthe essence of the site.

The substantial lack of information at Las Lajas Sanctuary is primarily attributed to the limited availability of educational resources and the sparse presence of informational points at the site. The absence of personnel designated exclusively to provide historical details to visitors, combined with the irregular availability of information, contributes to a lack of information, causing tourists to feel disconnected and hindering their ability to fully appreciate the meaning and significance of the sanctuary and its artistic elements.

Failure to address the lack of information poses a risk that the rich historical and tourist tradition associated with artistic expressions at Las Lajas Sanctuary will fade over time. Both local and foreign visitors may miss the opportunity to appreciate the profound cultural richness that this place offers, thereby diminishing its recognition and relevance as a unique and indispensable destination. This neglect would not only negatively affect the individual tourist experience but also impact the overall experience of the destination. However, it would also weaken the very essence of the sanctuary as a fundamental historical and spiritual point of interest in Colombia. The urgency of addressing this issue underscores the importance of preserving and enriching the connection between visitors and the valuable cultural heritage of Las Lajas Sanctuary.

This project explored the interaction between technology and cultural heritage by developing a virtual assistant for WhatsApp with image recognition capabilities, specifically for the Sanctuary of Las Lajas. Focusing on chatbots that process images, this innovation not only enhances the visitor's experience but also opens up new avenues for the digitization of heritage. With this application in the Sanctuary of Las Lajas, a model was developed that will serve as a foundation for the future implementation of technology in museums, historical sites, and other cultural institutions—achieving a position as a fundamental tool for the conservation, protection, and promotion of cultural heritage at a global level.

The project stood out not only for its ability to promote cultural understanding through technology but also for its impact on the field of artificial intelligence. These innovations will represent critical technological advances, aiding in the development of real-time image processing methods. This innovative proposal had a profoundly positive impact on visitors to the Las Lajas Sanctuary, making it a valuable resource for museums, cultural institutions, and tourist communities worldwide.

In addition to its technical importance, the project sought to achieve significant social and cultural relevance. By providing an educational and enriching digital experience, the virtual assistant enabled visitors to explore heritage interactively, fostering a deeper appreciation of cultural diversity. Likewise, the convergence of technology and cultural heritage serves as an example of how technology can play a crucial role in protecting and preserving humanity's cultural assets, making them accessible to future generations. In this sense, it became a fundamental ally in the preservation and understanding of our culture's origins.

Ultimately, this project served as a testament to the power of technological innovation combined with a passion for preserving our cultural heritage, while enhancing the way visitors engage with the past.

The project was conducted at the Las Lajas Sanctuary in Ipiales, Colombia, a historic and religious site of great interest to visitors. Similarly, the present research proposed to develop, implement, and evaluate a virtual assistant that provides detailed information about the sanctuary and its artistic representations through WhatsApp to visitors who request it. The study period covered the annual cycle from September 2023 to December 2024. Additionally, the target population consisted of individuals who visited the sanctuary during that period, and a representative sample of randomly selected visitors was used to collect data and assess the effectiveness of the virtual assistant; however, the primary focus was on the visitor experience. To conduct the study, surveys, online interviews, and quantitative data analysis were employed. Similarly, image recognition tools were utilized to develop the

technology used in the virtual assistant on WhatsApp.

Additionally, in terms of institutional support, CESMAG University plays a crucial role by providing high-quality learning materials that facilitate the exploration of the Temple of Las Lajas, and having the availability of technical resources such as computers, software, and Internet connectivity necessary for the development of the proposed system and equally, achieving the goal of minimizing costs through the use of open source software and personal resources for the development of the virtual assistant.

DEVELOPMENT

Background

Technological advances have elevated artificial intelligence (AI) to a new level, enabling it to perform even complex procedures, such as image interpretation. The present theoretical framework analyzes how artificial intelligence algorithms have modified the ability of machines to understand and analyze images, such as:

International

The authors, López-Cabrera et al.[1], with their article, "Critical review on the identification of COVID-19 from chest x-ray images using artificial intelligence techniques." They reveal that since the emergence of the COVID-19 pandemic, the scientific community has coalesced to minimize its impact. Early detection of diseases, as well as assessment of their progression, is a crucial task that requires the timely use of medical procedures. In this effort, the use of pulmonary medical imaging provides valuable information that professionals utilize. Thus, it can be seen that the successful implementation and use of artificial intelligence techniques have been achieved, which serve as a reference for the benefit of this project, particularly in image identification.

The authors, Gallego Gómez et al.[2], with their article, "Artificial intelligence and sustainable development of tourism." They focus their research on the application of artificial intelligence in the tourism sector to significantly enhance the consumer experience through the work of various organizations aimed at promoting social innovation. In other words, AI applied to tourism with sustainable usability, according to the EAE Business School. In this context, with the above-mentioned points in mind, this reference provides knowledge for implementing these concepts within the research, aiming to enhance the visitor experience and promote sustainable tourism.

The authors, Flores-Sotelo[3], with their article, "Artificial Intelligence in Public Management in Times of Covid-19." They demonstrate that the application of artificial intelligence has surpassed academic approaches and has significantly exceeded its benefits in advancing public administration. This study was conducted to analyze the application of artificial intelligence in public administration during the COVID-19 pandemic, focusing on the importance of capability and assessing the significant impact and great potential that artificial intelligence brings. This can support the implementation of the virtual assistant in the sanctuary, demonstrating how artificial intelligence has not only proven effective in public administration but can also be innovatively applied to enhance the tourism experience and cultural information management.

Authors, Moreno-Izquierdo[4] with their article, "Reinventing tourism in the key of artificial intelligence." They point out that the tourism industry is facing the so-called great fourth industrial revolution, led by artificial intelligence and some transformative technologies along the way. In other words, Moreno-Izquierdo's research supports the idea that artificial intelligence is essential for driving significant transformations in tourism. Concerning the project for the Sanctuary of Las Lajas, this is presented as a concrete contribution, offering a guide for an improved tourism experience through the integration of advanced technologies.

Author, Geisler, R in their article, "Artificial intelligence in the travel & tourism industry adoption and impact," They assess the current level of adoption and show the potential impact of artificial intelligence systems in the tourism industry. Focusing on the adoption and impact of AI in the tourism industry, this article examines how AI has been used to enhance cultural tourism experiences, i.e., a foundation for future research.

National

The author, I. Lizarazo[5] with his article, "Urban land cover and land use classification using satellite imagery and supervised artificial intelligence algorithms." They present the productivity and potential of two artificial intelligence algorithms: retrieval (artificial neural network) and alternative solutions for classifying digital remote sensing images, compared to statistical algorithms. This background highlights the effectiveness of artificial intelligence-based solutions in image interpretation, directly supporting the implementation of a virtual assistant with image recognition capabilities in the sanctuary. The present project benefited from the productivity demonstrated by artificial intelligence algorithms in image analysis and classification, thus contributing to a more enriching and technologically advanced tourism experience.

The authors, R. A. Manjarrés-Betancur et al.[6] a and Monica María Echeverri-Torres, with their article, "Academic virtual assistant using cognitive natural language processing technologies." They succeed in implementing a virtual academic assistant prototype that utilizes cognitive technologies, such as chatbots (i.e., artificial intelligence software designed to perform various tasks independently and without human assistance), to enhance the experience. And attention span in the educational process of students at the Instituto Politécnico Jaime Isas Cadavid in Colombia. By highlighting the successful use of chatbots and artificial intelligence technologies to enhance the experience and attention capacity in the educational environment, this background supports the feasibility and effectiveness of this virtual assistant proposal in enriching the tourism experience. The application of cognitive technologies, such as natural language processing, can be adapted to this tourist context, enhancing the interaction between visitors and the cultural heritage of the Santuario de las Lajas.

The author, Fierro[7], with his article, "Artificial intelligence in Colombia." They teach how data collection has enabled significant

advances in technology, especially in the field of artificial intelligence. However, Colombia has not yet adopted a binding legal and ethical framework to directly guide the deployment of artificial intelligence in the public sector. The above highlights the critical need to consider legal and ethical aspects when implementing artificial intelligence technologies. Although the focus of the research is on enhancing the tourism experience and providing detailed sanctuary information, this article highlights the importance of addressing ethical and legal issues to ensure the responsible implementation of artificial intelligence in a tourism and cultural context.

The author, S. C. Arcos, with his report, "Report on the Sanctuary of Nuestra Señora de Las Lajas." They reveal how Colombia has great potential in this segment thanks to the wealth of unique experiences accessible to those who practice the Catholic faith. Only in our country can we venerate Our Lady in a church built hundreds of years ago, in the middle of the abyss. Thus, it underscores Colombia's unique potential in tourism, especially in experiences related to the Catholic faith. This report highlights the uniqueness of the sanctuary, built hundreds of years ago in an unparalleled location, and highlights the wealth of spiritual and cultural experiences it offers. Integrating this report into the present project lends meaning by recognizing and respecting the unique significance of the Sanctuary of Las Lajas within the Colombian context. The research not only seeks to enrich the experience but also contributes to highlighting and preserving the sanctuary's historical and spiritual richness.

The author, Rodriguez[8], with his article, "Delimitation of local tourist destinations for statistical purposes based on supply criteria." They present the results of a research problem of growing importance in the field of tourism. Since we are talking about providing a treatment in tourism at the local level for decision-making, this highlights the growing importance of addressing research problems in the field of tourism, especially in decision making at the regional level, thus, by integrating supply criteria and considering local relevance, the ongoing research, seeks to take advantage of these statistics to have a report on the average visitor attendance of the Sanctuary of Las Lajas.

Regional

The author, J. Camilo, with his article, "Evaluation of drought in the department of Nariño through the standardized precipitation evapotranspiration index (SPEI) using artificial intelligence." They teach that drought is an extreme and natural climatic event that is increasingly prolonged, occurs more frequently, and intensifies due to climate change. Therefore, in recent years, research on drought has been encouraged to describe, understand, reduce, and mitigate the adverse effects. This study aims to explore the capabilities of artificial intelligence in analyzing climate data and its potential to provide valuable insights for sustainable tourism management. Leveraging the artificial intelligence capabilities discussed in this article could significantly contribute to the project's adaptability.

The authors, David[9], with their article, "Artificial Intelligence as a Utility for Systems Auditing," allow themselves to describe in general terms one of the different ways in which AI can serve as a systems testing tool, to provide an example of how AI helps in various fields, other than systems engineering and other fields. When considering AI as a systems testing tool, it is possible to highlight the relevance of applying advanced technologies in the implementation and evaluation of the virtual assistant with image recognition. This not only strengthens the technological foundation of the project but also highlights how artificial intelligence can be leveraged to enhance the functionality, efficiency, and safety of the project.

The authors, Figueroa et al.[10] with their article, "Competitive analysis of the religious tourism sector in the municipality of Ipiales." This focuses on the competitiveness of religious tourism in the commune of Ipiales. This enables us to assess the potential of the commune to enhance the existing tourism industry, as it has become one of the key drivers of economic, environmental, and social development in various regions of the country. By providing detailed and contextual information about the sanctuary, the research will directly benefit from it, thus supporting the idea that the project not only enriches the tourist experience at the Las Lajas Sanctuary but also contributes to the economic and social well-being of the region through the effective promotion of religious tourism.

The author, Luz Bettylu, with her contribution "Much is missing for the tourist." It is feasible to recognize that, for any project focused on tourism, it is necessary to know the opinions of tourists who have visited this place; therefore, these surveys and views are essential to consider in the development of the project for the Sanctuary of Las Lajas.

Theoretical research assumptions

Artificial intelligence

Artificial intelligence (AI) is a combination of algorithms designed to create machines with human-like characteristics. This technology is still distant and mysterious, but it has been present in everyday life for several years.[13,14]

Types of artificial intelligence

Computer scientists Stuart Russell and Peter Norvig distinguish several types of artificial intelligence:[15,16,17]

- The system thinks like humans: it automates activities such as decision-making, problem-solving, and learning. An example is artificial neural networks.
- Systems that act like humans: These are computers that perform human-like tasks. This is the case with robots.
- Rational thinking system: They aim to mimic logical and rational human thinking, which involves investigating how to equip machines with the ability to perceive, reason, and act appropriately. This group includes expert systems.
- The system works properly: Ideally, those that attempt to mimic human behavior, e.g., intelligent agents, should do so reasonably.

Application of artificial intelligence

Currently, there are many practical applications of artificial intelligence systems. Some of the most popular examples:

Speech recognition

Also known as automatic speech recognition (ASR), desktop speech recognition, or speech-to-text, this function utilizes natural language processing (NLP) to process speech and convert it into a text format.[18,19]

Customer Service

Virtual online employees replace humans in the customer service process. They frequently answer asked questions on various topics (e.g., shipping) or offer personalized advice, cross-sell products, or provide size recommendations to users, thereby changing the way we interact and collaborate with customers on websites and social networks.[20]

Artificial vision

This artificial intelligence technology enables computers and systems to extract meaningful information from digital images, videos, and other visual data.[21] Considering the above, this branch of artificial intelligence falls within the scope of this research, as it arises from the need to mimic the intelligent behavior of living organisms in image processing. The ability to detect, classify, segment, or process objects from images is just one of the many examples in which artificial vision can intervene.[22,23]

To carry out the tasks mentioned above, this field focuses on one of its main elements: collecting adequate information for this purpose. This task is called description and is something that people do all the time, and is an essential step in the knowledge extraction process.

Description allows presenting information using fewer details than what was initially provided, leaving only those attributes or characteristics that enable the identification of an entity, such as an object.

Recommendation engine

By analyzing data on past consumer behavior, artificial intelligence algorithms can help identify trends to develop more effective cross-selling strategies.[24,25]

Neural networks

A neural network is a simple model that simulates how the human brain processes information: it works by simultaneously connecting a large number of interconnected processors that look like an abstraction of neurons.[26,27]

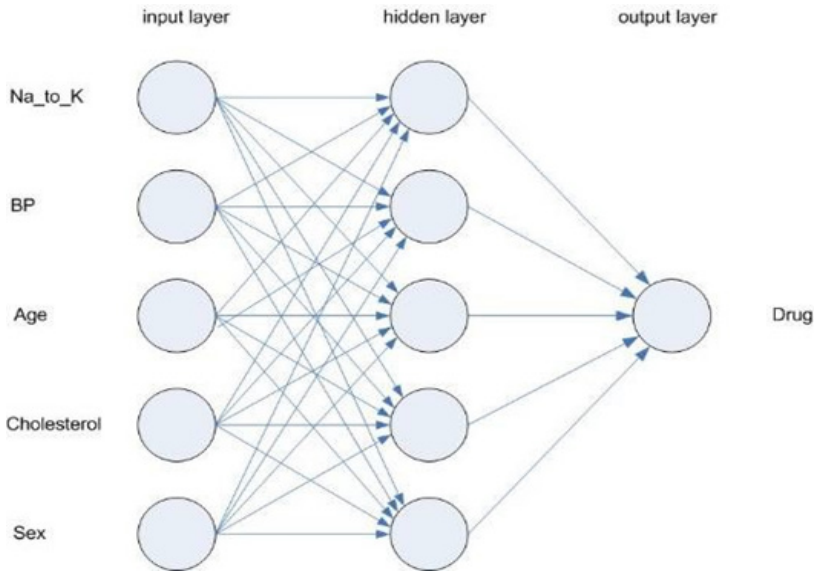

Figure 1. Structure of a neural network

Source: https://blog.facialix.com/curso-para-construir-tu-propia-red-neuronal-desde-cero-con-python/

The processing units are organized in layers. Typically, a neural network is segmented into three parts:

- An input layer with modules representing the input fields.
- One or more hidden layers.
- An output layer with one or more units representing the target field.

The devices are connected using different connection strengths (or weights). Input data are presented in the first layer, and values are passed from each neuron to each neuron in the next layer. Finally, the results are sent from the output layer.

Machine learning

Machine learning is an artificial intelligence topic that utilizes algorithms to enable computers to identify patterns in large datasets and make predictions (predictive analytics). This training program allows computers to perform specific tasks independently without programming.

Various machine learning algorithms

Machine learning algorithms can be divided into three categories, of which the first two are the most common:[29,30]

- Supervised learning: These algorithms are pre-trained on a system of labels associated with data, allowing them to make decisions or predictions. An example is a spam sensor, which categorizes emails as spam or not based on patterns learned from an email's history (sender, text-image ratio, keywords in the subject, etc.).
- Unsupervised learning: These algorithms have no prior knowledge. They confront the chaos of the data to find patterns that somehow organize it. For example, in marketing, they are used to extract patterns from social network data and create highly targeted advertising campaigns.
- Reinforcement learning: Its purpose is to make the algorithm learn from experience. This means it can make the best decisions in a variety of situations through trial and error, where correct choices are rewarded. It is currently used for face recognition, medical diagnosis, or DNA sequence classification.

Deep learning

Deep learning is a type of machine learning that is essentially a neural network with three or more layers. These neural networks attempt to mimic the behavior of the human brain, allowing it to "learn" from large amounts of data. While a single-layer neural network can already make rough predictions, additional hidden layers help optimize and improve accuracy.[31,32]

How deep learning works

Deep learning neural networks, also known as artificial neural networks, attempt to mimic the human brain through a combination of inputs, weights, and biases. These elements work together to accurately identify, classify, and describe objects in your data.[33]

Deep neural networks comprise multiple layers of interconnected nodes, where each layer builds upon the previous one to refine and optimize predictions or classifications. This computational movement through the network is referred to as direct propagation. The input and output layers of a deep neural network are referred to as visualization layers. The input layer is where the deep learning model obtains the data to be processed, and the output layer is where the final prediction or classification is performed.

Natural language processing

Natural language processing (NLP) is a branch of artificial intelligence that examines how machines interact with humans in natural languages, such as Spanish, English, and Chinese.

Components of natural language processing

Some elements of natural language processing are presented below. Not all the analyses described apply to every NLP task; it depends on the application's purpose.

- Morphological or lexical analysis: involves the internal analysis of the words that make up a sentence to derive lemmas, inflectional features, and complex lexical items. This is important for basic information: syntactic categories and linguistic meanings.[34]
- Syntactic analysis: involves analyzing the sentence structure according to the grammatical model used (logical or statistical).
- Semantic analysis: Provides interpretation of sentences after eliminating morphological-syntactic ambiguities.
- Pragmatic analysis: Includes analysis of the context of use in the final interpretation. This includes interpreting figurative language (metaphor and irony) as knowledge about the concrete world necessary to understand a specialized text.

Software engineering

Software engineering is the set of computational activities dedicated to creating, designing, implementing, and maintaining software.

Software itself is a set of instructions or programs that tell the computer what to do. It is independent of the hardware and allows the computer to be programmed. There are three main types:[35]

- System software: provides basic functions such as the operating system, disk management, services, hardware management, and other operational needs.
- Programming software: provides developers with tools such as text editors, compilers, linkers, debuggers, and other tools to create code.
- Application software (also known as an application or app): helps users perform specific tasks. Office packages, data management software, media players, and security programs are just a few examples. The term "application" also refers to web and mobile applications, such as those used to shop on Amazon.com, chat on Facebook, or post photos on Instagram.

Programming languages

A programming language is a way to communicate with your computer, tablet, or smartphone and instruct it on what you want to do. There are two main types of languages: low-level and high-level. The difference lies in whether you are close to or far away from our device. This proximity implies your control over the device, board, or controller. Here, you will find various programming languages, including C, C++, Java, PHP, Python, C#, ASP, and others.[36]

Python

Python is a programming language widely used in web applications, software development, data analysis, and machine learning (ML). Developers use Python because it is efficient, easy to learn, and can run on multiple platforms. Python software is free to download, integrates well with any system, and speeds development.[37]

Programming languages for chatbot development

- Chatbot in Python: Python will be included in this study because it is an open-source language widely used in data science, machine learning, web development, applications, scripting automation, financial technology, and more.
- Chatbot with Java: Java is an object-oriented programming language, one of the most widely used languages by companies when creating WEB and mobile applications.
- Chatbots in Lisp: The Lisp language, created by John McCarthy in 1956, was intended for symbolic data processing in the context of creating artificial intelligence programs and solving complex problems.
- Chatbot with Clojure: Clojure is a programming language developed based on Lisp, so it is considered a dialect of Lisp. Created for functional programming, Clojure relies on mathematical functions to guarantee immutability and immutable data structures.
- Chatbot with Ruby: The Ruby language is interpreted using a series of flexible and powerfully typed models. It was developed in Japan in 1995 for use as a programming language.

Chatbot

A chatbot is a computer program that utilizes artificial intelligence (AI) and natural language processing (NLP) to comprehend customer questions and respond to them automatically, mimicking human conversation.

How chatbots work

Today's AI-powered chatbots use natural language understanding (NLU) to determine users' needs. They then use advanced artificial intelligence tools to determine what the user is trying to accomplish. These technologies rely on machine learning and deep learning (elements of artificial intelligence with some nuances) to develop a more detailed knowledge base of questions and answers based on user interactions. This improves their ability to predict user needs and respond accurately over time.[38]

Mass media

Also known as mass media or broadcast media, they allow us to reach a wider audience. The mass media have the characteristics of educating, informing, and entertaining the target audience.

And entertain the target audience. The main channels include newspapers, radio, television, and the Internet.[39]

Types of media

- Newspaper/Journalism: Considered one of the first mass media. They are media outlets that provide news, articles, and reports, allowing people to stay informed about the most critical events in their area. In these media, advertisements can be placed between each message.
- Television is a mass medium characterized by the production and distribution of video content and entertainment news. Advertising content is presented through commercial offers between individual programs or through product placement within the content.
- Radio: This medium allows the broadcasting of audio content using frequency waves. Product positioning is achieved through audio announcements between or during each program.
- Email: This is a medium that allows you to send and receive messages regardless of text size.

To use email as a medium, you must have an email marketing service provider because these platforms allow you to create templates and send them to contact databases that can contain millions of users.

- Blog: These are articles published on the Internet that may contain advertising. Blogs utilize search engine optimization (SEO) techniques to rank high in search engine results through the strategic use of keywords and other tactics.
- Instant Messaging: These platforms, such as WhatsApp or Telegram, can be used to send short text messages in bulk through mailing lists, channels, or groups. This type of media can be accompanied by video content and downloadable documents, so the medium for this research will be instant messaging:
- WhatsApp: WhatsApp is an instant messaging service that uses the Internet to send short text or picture messages. WhatsApp acts as a medium through chatbots that allow users to search customized databases and initiate conversations between them.

- Social networks: These are digital platforms that include user communities where information and advertising can be exchanged. Social networks allow companies to have a communication channel with their customers.

Agile method: SCRUM

Scrum is an agile project management methodology that helps teams to structure and manage work through a set of values, principles, and practices. For the above and others, the research method used will be Scrum. Learn from experience, stay organized when solving problems, and reflect on both your victories and defeats to continually improve.[40]

Scrum Protocols or Events

Below is a list of all the major protocols that a Scrum team can participate in:[41]

- Organize collection: This activity, sometimes referred to as backlog cleanup, is the responsibility of the product owner. A product owner's primary task is to execute the product according to their vision and stay ahead of the market and customers.
- Sprint Planning: During this meeting, the entire development team plans the work to be done (scope) in the current sprint. A Scrum Master leads this meeting, and during the meeting, the team defines the goal of the sprint.
- Sprint: A sprint is the actual period in which the Scrum team works together to complete the increment. A sprint typically lasts two weeks, although some teams report that it is easier to allocate two weeks to a sprint.
- Report that it is easier to allocate four weeks to the scope or a month to allocate valuable increments.
- Daily Scrum or Quick Meeting: This is a very short daily meeting that is always held at the same time (usually in the morning) and in the same place to make things easier. Many teams try to finish the game in 15 minutes, but this is just a guideline.
- Sprint Review: At the end of the sprint, the team meets informally to review the demo or verify development. The development team shows internal parties the elements of the pending work that are now "completed."
- Sprint retrospective: A sprint retrospective is a meeting where the team gathers to record and review what worked and what did not work about the sprint, the project, the people or relationships, the tools, and even some protocols.

Study variables

In the context of the project dedicated to the Sanctuary of Las Lajas, which utilizes WhatsApp for comprehensive data collection, essential variables of the process are established to facilitate the interpretation and understanding of the images and the visitor's experience. The variables identified for this project are the following:

- Independent variable:
  - Image recognition tool applied in WhatsApp.
- Dependent variables:
  - User satisfaction.
  - Visual recognition accuracy
  - Response time

Nominal definition of variables

Within the scope of the project dedicated to the Sanctuary of Las Lajas, via WhatsApp, we identified nominal variables essential to categorize the interactions and evaluate the user experience. The following nominally defined variables are necessary to organize and understand user interactions with a virtual assistant:

- Image recognition tool applied in WhatsApp: This tool uses advanced image recognition algorithms to identify and analyze images related to the Sanctuary of Las Lajas.
- Visual recognition accuracy: This variable represents the virtual assistant's ability to accurately recognize images in the church of the Santuario de las Lajas.
- Response time: Indicates the average time it takes for the virtual assistant to respond to user queries via WhatsApp.
- User satisfaction: This variable represents the user's overall satisfaction with the virtual assistant experience.

Operational definition of the variables

For the Santuario de Las Lajas virtual assistant project, operational performance variables were identified to evaluate and demonstrate various aspects of the system. These variables that are defined for statistical analysis include:

- Image recognition tool applied in WhatsApp: Users capture images of the sanctuary using their mobile devices and send them via WhatsApp to a specific project number. Using image recognition algorithms, the tool analyzes these images for features such as architecture, sculptures, and religious art. It then generates personalized responses with detailed information about the recognized elements.
- Visual recognition accuracy is measured by an accuracy index, where higher values indicate greater accuracy in recognizing visual objects.
- Response time: The unit of measurement is seconds, used to rate the system's efficiency based on its speed of operation.
- User satisfaction: User satisfaction is measured by a survey in which participating users rate their experience on a scale of 0 to 10, with 10 being the highest satisfaction score.

Formulation of hypotheses

Research hypothesis

The project enhances the tourist experience at the Sanctuary of Las Lajas by implementing a virtual assistant with image recognition capabilities via WhatsApp, fostering a genuine connection between visitors and the site's valuable heritage.

Null hypothesis

The project does not enhance the tourist experience at the Santuario de las Lajas by implementing a virtual assistant with image recognition via WhatsApp, thereby failing to foster an authentic connection between visitors and the valuable heritage of the place.

Alternative hypothesis

The project utilizes ICT to enhance the tourist experience in the Sanctuary of Las Lajas through the implementation of a virtual assistant with image recognition capabilities via WhatsApp, fostering a genuine connection between visitors and the valuable heritage of the site.

CONCLUSIONS

This research demonstrated how the integration of artificial intelligence, specifically through an image recognition system via WhatsApp, can significantly transform the tourist experience at the Sanctuary of Las Lajas. Through the development, implementation, and evaluation of a virtual assistant, it was possible to offer visitors an interactive tool that provides contextualized and detailed information about the artistic representations of the sanctuary, thereby overcoming the historical limitation of access to cultural data at the site.

The project not only enhanced visitors' understanding of the cultural heritage but also established a precedent for future technological applications in historical and tourist settings. In addition, it effectively explored the synergy between computer vision, natural language processing, and instant messaging, which reinforces the value of artificial intelligence as a tool for the conservation, promotion, and education of cultural heritage.

From a technical, social, and cultural perspective, the virtual assistant proved to be an innovative, scalable, and low-cost solution that can be replicated in similar contexts. The proposal also opens new possibilities in the field of sustainable and digital tourism, contributing not only to the enrichment of the visitor's experience but also to the strengthening of regional tourism and the revaluation of local heritage. In short, this project demonstrates that the ethical and strategic application of emerging technologies can have a profoundly positive impact on society and contribute to preserving our history for future generations.

REFERENCES

1. López-Cabrera JD, Armando J, Orozco Morales R, Pérez Díaz M. Revisión crítica sobre la identificación de COVID-19 a partir de imágenes de rayos x de tórax usando técnicas de inteligencia artificial. Rev Cubana Transform Digit. 2020;1(3):67–99. https://rctd.uic.cu/rctd/article/view/103

2. Gallego Gómez C, Vaquero Frías L. Inteligencia artificial y desarrollo sostenible del turismo. Esic Market. 2022;53(3):e281. https://doi.org/10.7200/esicm.53.281

3. Flores-Sotelo M. Inteligencia artificial en la gestión pública en tiempos de Covid-19. Rev Cienc Soc. 2022. https://www.semanticscholar.org/paper/Inteligencia-artificial-en-la-gesti%C3%B3n-p%C3%BAblica-en-de-Maita-Cruz/e15364d79f9cc70fd12a4c220e0c24af1640c87e

4. Moreno-Izquierdo L. Reinvención del turismo en clave de inteligencia artificial. n.d. https://documentos.fedea.net/pubs/ap/2022/ap2022-19.pdf

5. Lizarazo. Clasificación de la cobertura y del uso del suelo urbano usando imágenes de satélite y algoritmos supervisados de inteligencia artificial. UD y la geomática. 2023;(2):4–18. https://revistas.udistrital.edu.co/index.php/udgeo/article/view/3669

6. Manjarrés-Betancur RA, Echeverri-Torres MM. Asistente virtual académico utilizando tecnologías cognitivas de procesamiento de lenguaje natural. Rev Politecnica. 2020;16(31):85–95. https://doi.org/10.33571/rpolitec.v16n31a7

7. Fierro G. La inteligencia artificial en Colombia. Repositorio Institucional Séneca. 2020. https://repositorio.uniandes.edu.co/entities/publication/cd8af197-d8fe-45d8-a64e-a605626e3270

8. Rodríguez YR. Delimitación de destinos turísticos locales con fines estadísticos a partir de criterios de oferta. 2017. https://www.semanticscholar.org/paper/Delimitaci%C3%B3n-de-destinos-tur%C3%ADsticos-locales-con-a-Rodr%C3%ADguez/6bbf88f6f7800099c38d10a19b837ed48567fa74

9. Alexander, David. La Inteligencia Artificial como utilidad para la Auditoría de Sistemas. Uan.edu.co. 2021. http://repositorio.uan.edu.co/handle/123456789/6628

10. Elia Romera Figueroa, Eunice Pérez Sánchez, Maricela E, Marino O. Análisis competitivo del sector turístico religioso en el municipio de Ipiales – año 2021. Travesía Emprendedora. 2023;7(1):41–49. https://doi.org/10.31948/travesiaemprendedora.vol7-1.art6

11. Delrieux C, Pawelko EE, Arcusin L, Raponi M. Procesamiento de imágenes en tiempo real utilizando tecnología embebida. 2017. https://www.semanticscholar.org/paper/Procesamiento-de-im%C3%A1genes-en-tiempo-real-utilizando-Delrieux-Pawelko/b63e01827f85b7e9b21d40276768313f947d191f

12. IBM. ¿Qué es el software de código abierto? 2019. https://www.ibm.com/mx-es/topics/open-source

13. Turijobs. "¿Cuál es el impacto de la tecnología en el sector turístico y hostelero? - Turiconsejos," Turiconsejos, Nov. 25. 2019. https://www.turijobs.com/blog/cual-es-el-impacto-de-la-tecnologia-en-el-sector-turistico-y-hostelero/

14. marinamaldonadophoto. "Una joya arquitectonica," Tripadvisor. 2019. https://www.tripadvisor.co/ShowUserReviews-g678216-d677903-r654432983-Las_Lajas_Sanctuary-Ipiales_Narino_Department.html

15. "¿Cómo llegar?," Laslajas.org, 2023. https://laslajas.org/visitenos/como-llegar (accessed Nov. 19, 2023).

16. Iberdrola. ¿Qué es la Inteligencia Artificial? 2023. https://www.iberdrola.com/innovacion/que-es-inteligencia-artificial

17. IBM. ¿Qué es la Inteligencia Artificial (IA)? 2013. https://www.ibm.com/mx-es/topics/artificial-intelligence

18. admin@xeridia.com. La Visión Artificial y el procesamiento de imágenes. Xeridia. 2019. https://www.xeridia.com/blog/la-vision-artificial-y-el-procesamiento-de-imagenes

19. Iberdrola. 'Machine Learning': definición, tipos y aplicaciones prácticas. 2023. https://www.iberdrola.com/innovacion/machine-learning-aprendizaje-automatico

20. IBM. ¿Qué es Deep Learning? 2015. https://www.ibm.com/es-es/topics/deep-learning

21. Moreno A. Procesamiento del lenguaje natural ¿qué es? Instituto de Ingeniería del Conocimiento. 2017. https://www.iic.uam.es/inteligencia/que-es-procesamiento-del-lenguaje-natural/

22. IBM. ¿Qué es el desarrollo de software? 2020. https://www.ibm.com/es-es/topics/software-development

23. Desarrollar Inclusión. ¿Qué es un lenguaje de programación? 2017. https://desarrollarinclusion.cilsa.org/tecnologia-inclusiva/que-es-un-lenguaje-de-programacion/

24. Planeta Chatbot. 5 lenguajes de programación para el desarrollo de chatbots. 2022. https://planetachatbot.com/lenguajes-programacion-desarrollo-de-chatbots/

25. IBM. ¿Qué es un chatbot? 2023. https://www.ibm.com/es-es/topics/chatbots

26. SendPulse. Qué son Medios Masivos: Tipos, Funciones, Ejemplos. 2021. https://sendpulse.com/latam/support/glossary/mass-media

27. Qualtrics. ¿Qué Es Net Promoter Score? (Actualizado En 2020). 2020. https://www.qualtrics.com/es-la/gestion-de-la-experiencia/cliente/net-promoter-score/

28. Ballina Ríos F. PARADIGMAS Y PERSPECTIVAS TEÓRICO-METODOLÓGICAS EN EL ESTUDIO DE LA ADMINISTRACIÓN. https://www.uv.mx/iiesca/files/2013/01/paradigmas2004-2.pdf

29. Concepto. Método Científico - Concepto, pasos, características y ejemplos. 2013. https://concepto.de/metodo-cientifico/

30. Rueda JP. Las espectaculares imágenes del Santuario de Las Lajas, en Nariño. El Tiempo. 2022. https://www.eltiempo.com/colombia/el-santuario-de-las-lajas-destino-para-el-turismo-en-narino-643292

31. admin. Santuario de las Lajas, Nariño. Expotur. 2019. https://expotur-eco.com/santuario-de-las-lajas/

32. Verónica D. Técnicas e instrumentos de recolección de datos en investigación. TEPEXI Boletín Científico de la Escuela

Superior Tepeji del Río. 2022. https://www.semanticscholar.org/paper/T%C3%A9cnicas-e-instrumentos-de-recolecci%C3%B3n-de-datos-en-Mart%C3%ADnez/3f51134e35e844070ad57fb5038185e1eebb7d33

33. Díaz-Bravo L, Torruco-García U, Martínez-Hernández M, Varela-Ruiz M. La entrevista, recurso flexible y dinámico. Investig Educ Med. 2013;2(7):162–7. https://www.scielo.org.mx/scielo.php?script=sci_arttext&pid=S2007-50572013000300009

34. González Y. El método hermenéutico aplicado en el análisis de documentos periodísticos, un camino para la investigación filosófica en el nivel medio superior. 2017. https://www.semanticscholar.org/paper/El-m%C3%A9todo-hermen%C3%A9utico-aplicado-en-el-an%C3%A1lisis-de-Gonz%C3%A1lez/f97e4085be9043ff3b0f2897915b71689017b146

35. BuilderBot. Get started with BuilderBot. 2024. https://www.builderbot.app/en

36. Haya P. La metodología CRISP-DM en ciencia de datos. Instituto de Ingeniería del Conocimiento. 2021. https://www.iic.uam.es/innovacion/metodologia-crisp-dm-ciencia-de-datos/

37. Universidad Nacional de San Martín. https://ri.unsam.edu.ar/bitstream/123456789/2324/1/TFPP%20EEYN%202023%20BC.pdf

38. Candela G, María R, Sáez Fernández D. Asistente virtual para un sistema de información. 2020. https://rua.ua.es/dspace/bitstream/10045/101934/1/Asistente_virtual_para_un_sistema_de_informacion_GUIJARRO_MARCO_PABLO.pdf

39. CORDIS | European Commission. Cómo las tecnologías digitales pueden desempeñar un papel fundamental en la conservación del patrimonio cultural europeo. 2019. https://cordis.europa.eu/article/id/413473-how-digital-technologies-can-play-a-vital-role-for-the-preservation-of-cultural-heritage/es

40. Cultivating Culture. The Importance of Cultural Heritage. 2013. https://cultivatingculture.com/2013/04/05/the-importance-of-cultural-heritage/

41. ResearchGate. Fig.1. El ciclo del patrimonio (traducido de: Thurley 2005). 2020. https://www.researchgate.net/figure/El-ciclo-del-patrimonio-traducido-de-Thurley-2005_fig5_345761872.

FINANCING

None.

CONFLICT OF INTEREST

None.

AUTHORSHIP CONTRIBUTION

Conceptualization: Raúl Andrés Villada Melo, Juan Camilo Caicedo Peña, Jorge Alveiro Rivera Rosero.
Data curation: Raúl Andrés Villada Melo, Juan Camilo Caicedo Peña, Jorge Alveiro Rivera Rosero.
Formal analysis: Raúl Andrés Villada Melo, Juan Camilo Caicedo Peña, Jorge Alveiro Rivera Rosero.
Research: Raúl Andrés Villada Melo, Juan Camilo Caicedo Peña, Jorge Alveiro Rivera Rosero.
Methodology: Raúl Andrés Villada Melo, Juan Camilo Caicedo Peña, Jorge Alveiro Rivera Rosero.
Project Management: Raúl Andrés Villada Melo, Juan Camilo Caicedo Peña, Jorge Alveiro Rivera Rosero.
Resources: Raúl Andrés Villada Melo, Juan Camilo Caicedo Peña, Jorge Alveiro Rivera Rosero.
Software: Raúl Andrés Villada Melo, Juan Camilo Caicedo Peña, Jorge Alveiro Rivera Rosero.
Supervision: Raúl Andrés Villada Melo, Juan Camilo Caicedo Peña, Jorge Alveiro Rivera Rosero.
Validation: Raúl Andrés Villada Melo, Juan Camilo Caicedo Peña, Jorge Alveiro Rivera Rosero.
Visualization: Raúl Andrés Villada Melo, Juan Camilo Caicedo Peña, Jorge Alveiro Rivera Rosero.
Writing - original draft: Raúl Andrés Villada Melo, Juan Camilo Caicedo Peña, Jorge Alveiro Rivera Rosero.
Writing - proofreading and editing: Raúl Andrés Villada Melo, Juan Camilo Caicedo Peña, Jorge Alveiro Rivera Rosero.