Research Article

Open Access Journal of Medicine and Healthcare

ISSN: 3068-7527

OPENPUB GLOBAL PUBLISHERS

Received: 21-03-2025 **Accepted:** 31-03-2025 **Published:** 07-04-2025

Volume 1 | Issue 1

Reviving History Digitally: Utilizing Artificial Intelligence Technologies in Reconstructing The Past

Ahmed Shaker Alalaq*

Iraq\University of Kufa

***Corresponding author:** Ahmed Shaker Alalaq, Iraq\University of Kufa.

Citation: Alalaq AS (2025) Reviving History Digitally: Utilizing Artificial Intelligence Technologies in Reconstructing The Past. Open Access Journal of Medicine and Healthcare, Research Article 1(1): 01-09.

Abstract

Reconstructing historical cities using AI and augmented reality technology represents a significant step in preserving humanity's cultural and architectural heritage. This technology enables us to accurately visualize and redesign ancient cities, helping to revive their history and promote cultural awareness. Augmented reality technology is one of the powerful outcomes of the recent revolution in artificial intelligence. Through it, researchers and historians can retrieve the history of ancient cities that have faded into obscurity. In our research, we highlighted several important points related to this technology, foremost among them a definition of augmented reality. We then discussed the key steps and methods through which this AI-supported technology can help historians visualize ancient cities.

Keywords: Augmented Reality, Artificial Intelligence, Ancient Cities, History, Archaeolog

1. Introduction

Historic cities represent a unique cultural and civilizational heritage that reflects the identity of nations and their developmental stages throughout history. However, many of these cities have suffered partial or complete destruction due to natural or human factors, leading to the loss of a significant portion of this heritage. With the tremendous advancements in artificial intelligence (AI) and augmented reality (AR) technologies, the possibility of virtually reconstructing these cities has become a tangible reality, offering current and future generations an interactive and innovative way to explore their cultural heritage.

Importance of the Study

1. This study derives its significance from several key aspects:
2. Preservation of Cultural Heritage: AI and AR technologies contribute to documenting and reconstructing endangered or lost historical landmarks, ensuring the continuity of cultural heritage for future generations.
3. Enhancement of Cultural Tourism: Augmented reality applications can bring historic cities back to life in a way that attracts tourists and enhances their understanding and appreciation of the historical and cultural value of these sites.
4. Advancement of Scientific Research: These technologies open new horizons for researchers in archaeology, history, and architecture to test scientific hypotheses related to the design and construction of historic cities.
5. Education and Public Awareness: Virtual reconstruction models provide an innovative educational tool that helps spread awareness about the importance of cultural heritage and strengthens national identity.
6. Development of New Restoration Methodologies: AI models can be utilized in planning actual restoration processes for historic sites with greater precision and lower costs.
7. Interdisciplinary Integration: This study encourages collaboration among various disciplines such as computer science, archaeology, history, architecture, and visual arts.

Scope of the Study

The study is defined by the following limitations:

- Thematic Scope: It focuses on AI and AR applications in reconstructing historic cities without delving into other technologies except where relevant.
- Technical Scope: It examines currently available algorithms and technologies while anticipating near-future developments.
- Geographical Scope: The study applies its analysis to selected historic cities from different civilizations and periods to assess the effectiveness of the proposed technologies.
- Temporal Scope: It covers technological advancements in this field over the past decade, with an emphasis on the latest innovations.
- Methodological Scope: The study adopts a multi-faceted methodology that combines theoretical analysis and practical application of AI and AR technologies.

Research Problem

The central research question of this study is: How can AI and AR technologies be employed to reconstruct historic cities while ensuring historical accuracy, scientific value, and interactive appeal?

Several sub-questions arise from this main inquiry:

1. What are the most suitable AI algorithms for analyzing and reconstructing historical landmarks based on available data?
2. How can the challenge of insufficient accurate historical data for some lost cities be addressed?
3. What criteria for historical accuracy and scientific reliability should be adopted in virtual reconstruction projects?
4. How can a balance be achieved between historical accuracy and interactivity in AR applications?
5. What are the anticipated social, cultural, and economic impacts of applying these technologies to tourism, education, and scientific research?
6. How can a sustainable model be developed for managing virtual reconstruction projects of historic cities?

This study aims to address these research challenges through a rigorous scientific methodology that integrates theoretical and practical aspects, drawing on leading global experiences in the field while exploring promising future prospects for the integration of cultural heritage and advanced technology.

2. What Are Augmented Reality and Virtual Reality?

Augmented reality (AR) is a digital medium that allows users to integrate virtual context into the physical environment in a multi-dimensional, interactive manner. AR programs obtain information about the surrounding environment through cameras and sensors. The implementation of artificial intelligence (AI) enhances the AR experience by enabling deep neural networks to replace traditional computer vision methods and adding new features such as object detection, text analysis, and scene annotation.

How Does AI Transform Augmented Reality?

Historically, AR programs have used traditional computer vision techniques called “Simultaneous Localization and Mapping” (SLAM). SLAM algorithms compare visual features between camera frames to map and track the environment. However, modern AR applications rely on deep learning to provide more advanced functionality [1].

AI, AR, and virtual reality (VR) technologies open new and exciting horizons for exploring history. AI uses complex algorithms to analyze data, make predictions, and simulate possible scenarios, while AR adds digital information to our physical world, and VR immerses us in a fully virtual environment. In archaeology, AI is used to reconstruct and simulate ancient environments, landscapes, sites, artifacts, and monuments, thereby challenging traditional notions of historical knowledge and providing new perspectives on the past.

By combining these technologies, we can reconstruct and experience the rich fabric of ancient cities and lost civilizations. One of the most exciting AI applications in archaeology is the virtual reconstruction of ancient cities. AI algorithms can analyze archaeological remains, architectural fragments, and historical texts to form an idea of what these cities might have looked like. For example, with current and future AI tools, we may be able to create a digital model of ancient cities like Rome, Pompeii, Petra, and others, offering a comprehensive view of the

city's architectural marvels at their peak [2].

A category of AI algorithms known as "generative AI" can create new content, including texts, images, and videos, by analyzing data and patterns learned. Unlike traditional AI systems, which mainly focus on classification, prediction, and decision-making, generative AI models are trained to recognize the underlying structure and attributes of input data. This enables the models to produce unique and authentic outputs. These models can learn to imitate the original data's structure, content, and production style by training on large datasets, resulting in the creation of original works that resemble the training data [3].

Generative AI can utilize archaeological data, historical narratives, and remaining structures to create virtual replicas of these great lost cities. Imagine wandering through bustling streets, exploring majestic temples, and witnessing the grandeur of these ancient civilizations [4].

AI excels at creating detailed 3D models of historical structures, capturing every intricate detail from the grandeur of towering arches to the fine decorations of ornamental carvings. These virtual replicas enable precise planning for restoration efforts, allowing architects and engineers to navigate the 3D model virtually, identify structural weaknesses, and plan repairs with unmatched accuracy. Moreover, these models serve as valuable historical records, preserving the essence of structures for future generations in case of irreparable damage [5].

The AI-enhanced revolution of new technologies has achieved remarkable results in reimagining ancient historical cities. Augmented reality (AR) has facilitated a realistic environment for interpreting artifacts using 3D modeling and vision-based techniques. Cultural organizations such as the Museum of London, the Dutch Architecture Museum, and the Powerhouse Museum in Sydney are currently leveraging AR to provide a user-focused experience. AR is a technology that integrates real-time live views with computer-generated images, creating an enhanced real-time experience of reality. This emerging technology adds a new dimension to sensory perception, vision, and hearing in the real world while augmenting human senses and improving the ability to visualize complex objects in challenging environments [6].

It is useful to consider augmented reality, mixed reality, and virtual reality as interconnected fields within the broader realm of extended reality. For instance, the line between AR and mixed reality is often so blurred that the terms can be used interchangeably in most contexts [7].

AI and AR technologies can achieve many things together that are impossible to accomplish separately. Although they are entirely different technologies, their areas of overlap offer a rich array of opportunities, particularly in the field of augmented intelligence. We live in a world of big data, and the volume of data is growing rapidly. While human intelligence can be impressive, it has its limits. Numerous studies have shown that virtual reality technology can deliver powerful educational and training experiences through VR headsets. While there is less data on AR and mixed reality, early indications suggest they can be as impactful as VR, if not more so. Expanding our learning environment is just one potential use of augmented intelligence, with nearly limitless opportunities to integrate these advancements with AR technology to enhance intelligence. Reality will never be the same again [8].

1.1. Steps for Augmented Reality in Reconstructing Ancient Archaeological Sites

Reconstructing archaeological cities using artificial intelligence (AI) is a complex process that combines several advanced techniques to analyze historical, engineering, and archaeological data to digitally or even physically reimagine these sites. This process is based on a series of technical steps:

1. Collecting and Analyzing Historical and Archaeological Data:
    - Textual Data and Historical Sources: Available information is gathered from ancient texts, including writings of historians, archaeological records, and historical books that discuss the site. Natural Language Processing (NLP) techniques are used to extract important details, such as building dimensions, materials used, and descriptions of features.
    - Visual Data: Photographs, drawings, and historical maps of the site are collected. Image Recognition techniques can also be employed to extract important architectural features.
    - Archaeological Data: Analyses are based on information extracted from excavations, such as remnants of foundations or walls, to understand the layout of the city and its architectural structure. AI assists in analyzing this data and suggesting possible designs.

Explanation of Collecting and Analyzing Historical and

Archaeological Data

A variety of modern techniques, especially those related to artificial intelligence, are used to analyze vast amounts of data collected from various sources to achieve a deeper understanding of ancient civilizations and the details of their lives.

1. Textual Data and Historical Sources:

- Collection: All written material about the site or region is gathered, from ancient books and manuscripts to recent archaeological records.
- Analysis: Modern techniques known as Natural Language Processing (NLP) are used to understand texts written in different languages and extract precise information such as:
  - **Dimensions:** Size and height of buildings.
  - **Materials:** Materials used in construction (stone, brick, wood).
  - **Description:** Details about decorations, engravings, and any distinctive elements.

2. Visual Data:

- **Collection:** All images, drawings, and old maps related to the site are collected.
- **Analysis:** Image Recognition techniques are used to analyze these images and extract information such as:
  - **Architectural Features:** Types of arches, columns, and windows.
  - **Changes:** Comparing old images with modern ones to observe changes that have occurred at the site.

3- Archaeological Data:

- **Collection:** During excavation processes, samples of soil, building remnants, and objects used by people are collected.
- **Analysis:** These samples are analyzed in laboratories to understand:
  - **Layout**: How the city was built and how the streets intersected.
  - **Architectural Structure:** The materials used in construction and how the buildings were interconnected.
- **Artificial Intelligence:** AI assists in analyzing this complex data and suggesting 3D models of buildings and cities, helping us visualize how they looked in the past.

Why Is This Process Important?

- **Higher Accuracy:** These technologies help avoid human errors and analyze vast amounts of data quickly.
- **Deeper Understanding:** They provide us with a deeper understanding of ancient civilizations, how they lived, and how they built their cities.
- **Heritage Protection:** They help us preserve and document archaeological sites more effectively.

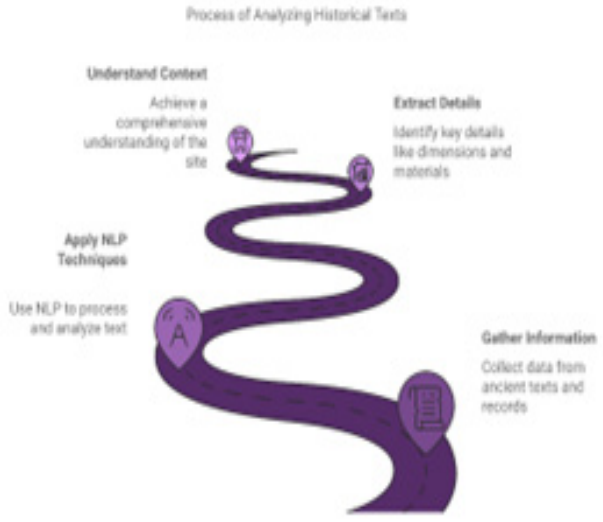


Figure 1: Mechanism for analyzing historical texts

2- 3D Model Design

- After collecting data, artificial intelligence (AI) and computer-aided design (CAD) techniques are employed to create 3D models of the city. Deep learning algorithms are used to generate accurate models based on the available information.
- If the data is incomplete, AI can fill in the gaps using techniques such as “image completion” or “model

completion" based on similar architectural patterns from the same era or region.

Explaining 3D Model Design Using AI Once historical and archaeological data is collected and analyzed, the next vital stage is designing 3D models of the ancient city. What are 3D Models? They are precise digital representations of something in the real world; in this case, an ancient city. These models provide a clear and comprehensive view of the city, as if we are looking at it from every angle.

How Are These Models Created?

1. **AI and Computer-Aided Design (CAD):**
    - AI: Plays a crucial role in transforming raw data (such as images and measurements) into 3D models. It uses techniques called "deep learning" to analyze the data and identify patterns and relationships among different elements.
    - CAD: A suite of software that allows engineers and designers to create and modify 3D models. This software is used to transform the prototypes generated by AI into accurate final models.
2. **Deep Learning Algorithms:**
    - These algorithms can "learn" from large amounts of data. In the case of model design, they learn to recognize various architectural elements (such as columns, arches, and windows), their dimensions, and their arrangement within buildings.
    - Based on this learning, the algorithms can generate highly accurate 3D models that correspond to the available historical data.
3. **Completing Missing Data:**
    - Often, historical data is incomplete. There may be missing parts of buildings or insufficient information about certain areas.
    - Here, AI comes into play again. It uses techniques like "image completion" or "model completion" to infer the missing parts based on existing architectural patterns in other parts of the city or in other cities from the same era.

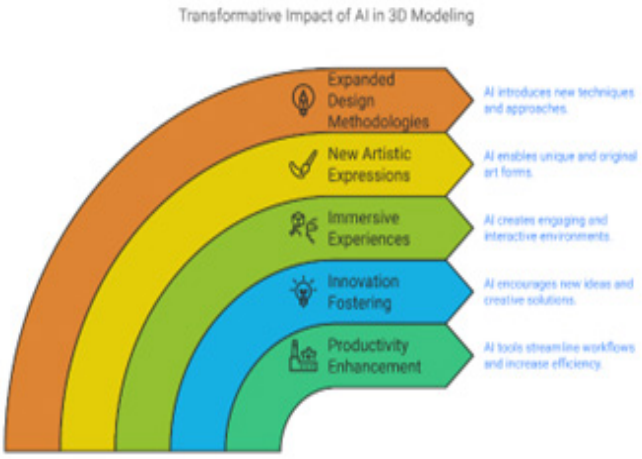
Why Do We Need These Models?

- Visualization: They help us visualize how the city looked in the past.
- Analysis: We can analyze the models to understand the city's layout, the materials used in construction, and the changes that have occurred over time.
- Education: These models can be used in museums and educational institutions to explain history to the public.
- Heritage Preservation: They assist in efforts to preserve and document archaeological sites.

3. Simulating the Natural Environment:

- AI helps simulate ancient geographic and climatic conditions by analyzing the surrounding terrain and remaining artifacts, which aids in estimating how the city interacted with its environment.
- It can also simulate the impact of environmental factors, such as wind and rain, on buildings, contributing to the accuracy of the reconstruction process.

Explaining Natural Environment Simulation Using AI in Archaeology Imagine wanting to understand how an ancient city looked thousands of years ago. Simply building models of the buildings isn't enough; we must also understand how these buildings interacted with their surrounding environment. This is where AI comes in.



How Does This Work?

- **Analyzing Terrain and Climate:**
    - Terrain: By using old maps and satellite imagery, AI can reconstruct the terrain as it was in the past. Was the city located on a hill?

Was it surrounded by rivers? This information is crucial for understanding the city's layout and the distribution of buildings.

- Climate: Through analyzing tree rings, sediment layers, and current climate data, AI can estimate the climate in the past. Was the city hot and dry, or cold and wet? This helps in understanding the types of materials used in construction and how buildings were affected by weather conditions.

- **Simulating Environmental Conditions:**
  - Wind and Rain: AI can simulate the effects of wind and rain on buildings. For instance, how did wind influence roof design? How did rain contribute to the erosion of stones?
  - Earthquakes and Floods: Natural disasters that may have impacted the city in the past can also be simulated to understand how buildings were constructed to withstand these hazards.

Why Is This Important?

- Accuracy in Reconstruction: It aids in creating more accurate 3D models of the city, considering the environmental factors that influenced its design and construction.
- Understanding Causes of Destruction: It helps in understanding the reasons behind the city's destruction, whether due to natural or human factors.
- Preservation Planning: This information can be used to better plan preservation efforts, taking environmental factors into account.

By using this technology, we can transport ourselves to the past and see how life unfolded in those ancient cities.

4. Analysis of Ancient Materials and Construction Techniques:

- AI is used to analyze materials used in construction through techniques such as spectral analysis to examine archaeological samples and identify original materials.
- It can also simulate traditional construction processes and large structures using the tools and techniques available in the past to understand ancient building methods.

Explaining Analysis of Ancient Materials and Construction Techniques Using AI Simply put, this technology helps us learn how our ancestors built their homes and temples using the materials and tools that were available to them at that time.

How Does This Work?

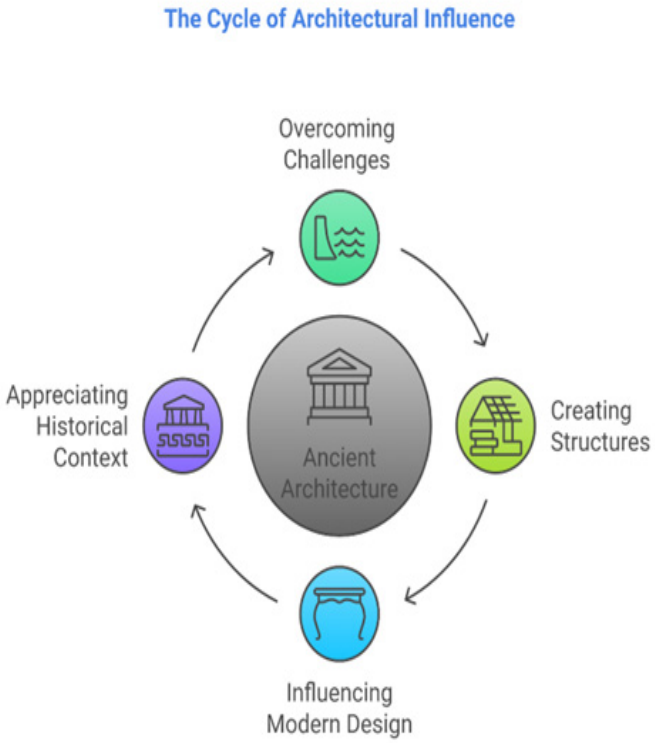
1. **Material Analysis:**
   - Spectral Analysis: Imagine you want to identify the type of stone used to build a pyramid. By using spectral analysis, a beam of light can be directed at a small sample of the stone. This will cause the stone to emit light with specific characteristics that reveal its chemical composition.
   - AI: AI plays a crucial role in analyzing this complex data. It can compare the results obtained from spectral analysis with a vast database of different materials, accurately determining the type of stone.
   - Other Materials: This technique can also be used to analyze wood, clay, and metals used in construction.
2. **Simulating Construction Processes:**
   - Traditional Tools: Using the information gathered about the materials used and the techniques available in the past, simulation models of construction processes can be created.
   - Large Structures: The construction of massive structures like pyramids and temples can be simulated to understand the challenges faced

by ancient builders and how they accomplished these monumental engineering feats.

Why Is This Important?

- Understanding Ancient Techniques: It helps us comprehend the advanced techniques that were used in the past, which may have been lost over time.
- Preserving Antiquities: It aids in the restoration of archaeological sites, as the information obtained about materials can be used to select suitable materials for restoration.

Developing New Building Materials: Studying materials used in the past can lead to the development of new, more durable building materials that can better withstand environmental factors



Representation and Interactive Experience:

- After creating the digital model, virtual reality (VR) and augmented reality (AR) technologies are used to create an interactive experience that allows users to "visit" the ancient city as it was in the past.
- AI can enhance this experience by adding details such as sounds, changing lighting, and even virtually representing the ancient inhabitants.

Explaining Visual Representation and Interactive Experience in Archaeology Simply put, this technology allows us to "travel through time" and visit ancient cities as they once were, rather than just looking at pictures or reading about them.

How Does This Technology Work?

1. **Virtual Reality (VR):**
    - **Full Immersion:** Using VR headsets, users can enter a virtual world that displays the ancient city in three dimensions.
    - **Interaction:** Users can navigate through the city, view buildings from different angles, and even enter some structures.
    - **AI:** AI is employed to add more realism to the experience. For example, it can generate the sounds of the city, such as voices, animals, and wind.
2. **Augmented Reality (AR):**
    - **Merging Worlds:** Instead of complete immersion in a virtual world, AR adds virtual elements to the real world.
    - **Applications:** A smartphone app can display a 3D model of the ancient city over its actual location. For instance, pointing your phone at the ruins of an ancient temple will show the 3D model of the temple as it appeared in the past.
3. **Enhancing the Experience:**
    - **Fine Details:** AI can add intricate details such as:
        - **Lighting:** Changing the lighting based on the time of day and seasons.
        - **Sounds:** Different sounds depending on the location (e.g., the sound of flowing water near a river).
        - **Characters:** Virtual characters representing the ancient city's inhabitants can interact with users and provide information about their daily lives.

Why Is This Technology Important?

- Education: It makes learning about history more enjoyable and interactive, especially for children and

young adults.

- Tourism: This technology can be used in museums and archaeological sites to attract more visitors and provide a unique experience.
- Cultural Heritage Preservation: It helps raise awareness about the importance of preserving cultural heritage.

6- Scientific Verification and Review

- It is essential to review the accuracy of the model with experts in history, ancient architecture, and archaeology. AI assists in analyzing expert feedback and suggesting improvements to the model.
- Machine learning techniques can also be used to compare the model with new archaeological discoveries and update it based on recent data.

Explaining the Process of Scientific Verification and Review in Archaeology Using AI Simply put, this stage ensures that the 3D models we create are accurate and reliable, reflecting historical reality as closely as possible. After a 3D model of an ancient city or archaeological building is created using AI, it is not considered final. Instead, it undergoes a rigorous process of review and scrutiny to ensure its validity.

How Is the Review Process Conducted?

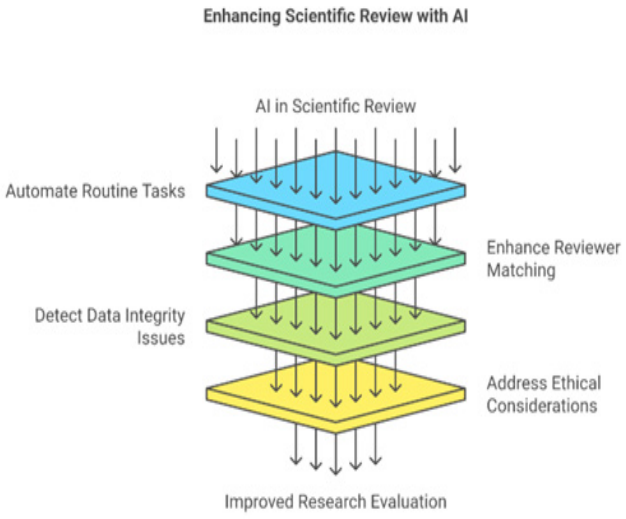
1. **Expert Review:**
    - Specialized Experts: Experts in various fields such as ancient history, architecture, and archaeology are invited to review the model.
    - Thorough Analysis: Experts analyze the model in detail, comparing it to available historical information and archaeological findings.
    - Feedback and Suggestions: Experts provide their feedback and suggestions on any potential errors or aspects that need improvement.
2. **Role of AI in the Review:**
    - Comment Analysis: AI is used to analyze expert comments and identify common patterns.
    - Continuous Improvement: Based on the analysis of comments, AI can suggest modifications to the model and continuously improve it.
3. **Comparing the Model with New Discoveries:**
    - Machine Learning: Machine learning techniques are employed to compare the model with new archaeological discoveries.
    - Ongoing Updates: If new information contradicts the model, it is updated to align with this new data.

Why Is This Process Important?

- **Accuracy and Reliability:** This process ensures that the model reflects historical reality as accurately as possible.
- **Scientific Trust:** It increases scientific confidence in the model, making it a reliable reference for researchers and the public.
- **Continuous Development:** It allows for the ongoing development of the model based on new information and discoveries.

Simply put, this process ensures that the models we use to understand the past are reliable scientific tools.

Example: Imagine a 3D model of an ancient city showing that one of the buildings was used as a granary. However, a later discovery of an inscription on the building's wall indicates it was actually a temple. In this case, the model must be updated to reflect this new information.



Conclusión

Augmented Reality (AR) is a technology that integrates digital elements with the real world, offering visitors a more immersive experience. In the realm of rediscovering ancient cities, AR plays a crucial role in preserving and presenting cultural heritage

in a more interactive manner. With augmented reality, users can explore ancient cities without causing any damage to historical buildings. AR-based applications allow visitors to see how structures appeared in the past or how the city thrived during its golden ages, creating an engaging experience. Moreover, AR can be utilized in history education, enabling students to explore ancient cities through educational applications. These tools provide students with insights into past lifestyles, fostering a more interactive learning experience. Ultimately, augmented reality significantly contributes to the preservation and presentation of cultural heritage. By employing this technology, users can navigate ancient cities without harming historical sites, ensuring an immersive visit. Additionally, AR educational applications can offer students a more engaging learning experience. Therefore, governments and cultural organizations should leverage this technology to preserve and share cultural heritage with the public.

References

1. Alalaq AS (2024) Reconstruction of Historical Cities Using AI Technology (Augmented Reality). https://research.aimultiple.com/ar-ai/

2. Jitendra Jain (JJ) (2023) Rediscovering Ancient Cities and Lost Civilizations Using AI, AR, and VR.https://hotelemarketer.com/2023/06/10/rediscovering-ancient-cities-and-lost-civilizations-using-ai-ar-and-vr/

3. World Archaeology (2024) Artificial intelligence rethinks the past: How computers are reconstructing Etruscan and Roman landscapes. https://the-past.com/feature/artificial-intelligence-rethinks-the-past-how-computers-are-reconstructing-etruscan-and-roman-landscapes/

4. Divyansh Sawant (2024) Unearthing the Past: Generative AI and the Reconstruction of Lost History. https://medium.com/@divyanshsawant/unearthing-the-past-generative-ai-and-the-reconstruction-of-lost-history-83bb4251c45b

5. Attri Blogs (2024) How AI Can Preserve Historic Architecture Structure. https://attri.ai/blog/how-ai-can-preserve-historic-architecture-structure

6. Ramtohul A, Khedo KK (2024) Augmented reality systems in the cultural heritage domains: A systematic review. Digital Applications in Archaeology and Cultural Heritage, 32: e00317. https://doi.org/10.1016/j.daach.2024.e00317.

7. Alalaq Ahmed (2024) "Augmented Reality and Its Relationship to Artificial Intelligence in Historical Studies", Mendeley Data 1. doi: 10.17632/kzc5bt9578.1.

8. Digitalreality (2022) Artificial Intelligence and Augmented Reality. https://digitalreality.ieee.org/publications/artificial-intelligence-and-augmented-reality

9. Alalaq AS (2024) AI tools assisting in the proofreading and scientific review of research papers. ScienceOpen Preprints. DOI: 10.14293/PR2199.001358.v1

10. Alalaq AS (2024) Reconstruction of Historical Cities Using AI Technology (Augmented Reality). Available at SSRN 5040088. https://ssrn.com/abstract=5040088 or http://dx.doi.org/10.2139/ssrn.5040088

11. Alalaq A (2024) Inteligência Artificial e sua Relação com as Humanidades. In SciELO Preprints. https://doi.org/10.1590/SciELOPreprints.10389

12. Alalaq Ahmed (2025) The Role of Artificial Intelligence in Restoring Ancient Texts and Analyzing Historical Documents. 10.13140/RG.2.2.27438.42565

13. Alalaq AS (2024) AI tools assisting in the proofreading and scientific review of research papers. ScienceOpen Preprints.

14. Alalaq AS (2025) Artificial Intelligence and Rhetorical Pattern Analysis: A Study of Ruhollah Khomeini›s Speech on the Palestinian Issue. Authorea Preprints.

15. Alalaq AS (2025) AI-Enhanced Digital Databases. J Sen Net Data Comm 5: 01-08.

16. Alalaq AS (2024) Reconstruction of Historical Cities Using AI Technology (Augmented Reality). Available at SSRN 5040088.

17. Wahhab HSA, Almudhafar SM, Alalaq AS, Almayahi B (2023) Social Environment and its Effects on Domestic Violence. Revista De Gestão Social E Ambiental 17. e03536. https://doi.org/10.24857/rgsa.v17n7-006

Copyright: ©2025** Alalaq AS. **This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.