



THE ROLE OF ARTIFICIAL INTELLIGENCE (AI) IN PRESERVING HISTORICAL MONUMENTS

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Abstract. This article explores the role of Artificial Intelligence (AI) in preserving historical monuments in their original condition. Historical monuments are important cultural assets, but they face serious risks from environmental factors, time, and human activities. Traditional preservation methods are often not enough to prevent long-term damage. Therefore, modern technologies such as AI are becoming essential in this field.

The study explains how AI can be used to predict structural damage, monitor environmental conditions, analyze images, and support virtual reconstruction. AI-based systems help experts detect problems early, reduce risks, and make better decisions. The article also highlights the potential of using AI in countries rich in cultural heritage, such as Uzbekistan.

Keywords. Artificial Intelligence, Historical Monuments, Cultural Heritage, Preservation, Restoration, Monitoring Systems, 3D Technology, Virtual Reconstruction, Climate Impact, Archaeology

Introduction

Historical monuments are a valuable heritage that reflects the history, culture, and identity of every nation. Preserving them is important not only for today but also for future generations. However, many monuments are under threat due to time, climate change, natural disasters, and human activities. Therefore, using modern technologies, especially artificial intelligence (AI), has become very important in protecting them.

Problems in Preserving Historical Monuments

There are several challenges in preserving historical monuments.

First, building materials naturally deteriorate over time. Moisture, temperature changes, and wind can weaken structures.

Second, human factors can also cause damage. Poor restoration work or excessive tourism may harm the original appearance of monuments.

Third, many monuments do not have regular monitoring systems. Problems are often noticed too late.

These issues show the need for modern solutions like AI.

What is Artificial Intelligence?

Artificial Intelligence (AI) is the ability of computer systems to think, analyze, and make decisions like humans. AI can process large amounts of data quickly, find patterns, and predict future outcomes.



This makes AI very useful in preserving historical monuments.

Predicting Damage with AI

One of the main advantages of AI is prediction. AI systems analyze:

- the age of the monument
- construction materials
- climate conditions
- humidity levels
- previous damage

Based on this data, AI can predict which parts of a monument are likely to deteriorate faster. This helps experts take action before serious damage occurs.

AI-Based Monitoring Systems

AI also helps in real-time monitoring. Sensors installed in monuments collect data such as:

- temperature
- humidity
- structural movement
- crack development

AI analyzes this data continuously and sends alerts if any risk is detected. This allows quick response and better protection.

Image Analysis for Damage Detection

AI can analyze photos and videos of monuments. Special algorithms can:

- detect cracks in walls
- notice color changes
- identify small damages

This method can find problems that are difficult for the human eye to see.

Virtual Reconstruction and Modeling

AI allows the virtual reconstruction of historical monuments. This helps to:

- recreate the original appearance
- understand missing parts
- plan restoration work more accurately

Experts can test ideas digitally without harming the real structure.

Integration with 3D Technologies


AI works well with 3D scanning and 3D printing. It can:

- analyze scanned data
- detect missing elements
- help create accurate replicas

This makes restoration more precise and reliable.

Adapting to Climate Change

Climate change is a serious threat to historical monuments. AI can analyze environmental data and:



predict future risks

suggest protection strategies

For example, it can estimate the impact of heavy rain or extreme heat.

Managing Tourism with AI

Too many visitors can damage monuments. AI can help by:

controlling visitor numbers

planning safe routes

distributing tourist flow

This reduces pressure on sensitive areas.

Opportunities in Uzbekistan

Uzbekistan has many historical cities such as Samarqand, Bukhara, and Khiva. Using AI technologies in these places can greatly improve preservation.

Although some modern methods are already used, AI-based systems are still developing.

Future steps may include:

introducing AI monitoring systems

training specialists

using international experience

Advantages of AI

Using AI provides many benefits:

early detection of problems

faster decision-making

reduced human error

saving time and costs

Therefore, AI is becoming an important tool in heritage preservation.

Conclusion


Preserving historical monuments is a complex and responsible task. Combining traditional methods with modern technologies like AI makes this process more effective.

AI helps monitor monuments, predict damage, and support scientific restoration. This ensures that cultural heritage can be preserved in its original state for many years.

In the future, AI will play an even bigger role in protecting historical monuments.

References

1. UNESCO. World Heritage and Artificial Intelligence. Paris, 2021.
2. ICOMOS. Guidelines for the Conservation of Cultural Heritage. 2017.
3. ICCROM. Modern Approaches to Heritage Conservation. Rome, 2020.
4. Russell, S., & Norvig, P. Artificial Intelligence: A Modern Approach. Pearson Education, 2021.
5. Scientific articles on Artificial Intelligence (Google Scholar database).
6. European Space Agency (ESA). Satellite Monitoring for Cultural Heritage. 2019.

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7. NASA. Remote Sensing Applications in Archaeology. 2018.
 8. Materials of the Cultural Heritage Agency of Uzbekistan.
 9. Research papers in archaeology and heritage conservation.

