Classification of cultural heritage digitalization cases

I. Cultural heritage preservation
(A) Digitalization of tangible cultural heritage
1. Digital acquisition and documentation:
Acquiring high-precision 3D spatial information of cultural relics, buildings and sites through technologies such as 3D laser scanning, multi-view 3D reconstruction
2. Data processing and reconstruction:
Restoring the original form of damaged cultural heritage using AI or manual modeling.
3. Digital storage and management:
Establishing digital archives for cultural heritage.
4. Research and analysis:
Algorithm-based analysis of artifact age, style or degradation trends (for example, identifying mural diseases).
5. Conservation and monitoring:
Real-time monitoring of environmental factors (temperature, humidity, vibration) on cultural relics using digital monitoring systems.
6. Image and text acquisition and mining:
Utilizing digital technologies to gather image and textual information from ancient texts, followed by indexing, content organization, and knowledge mining.

(B) Digitalization of intangible cultural heritage
1. Digital research and preservation:
Audio-visual recording, motion capture, multi-modal collection and data research using digital technologies.
2. Data processing and storage:
Digital archiving, metadata annotation, etc.
3. Virtual representation and dissemination:
Creating immersive experiences of intangible cultural heritage scenarios using Digital Twin, virtual reality or augmented

reality.

4. Living inheritance and education:

Facilitating traditional artisanship learning with AI assistance and enhancing interactive experiences through motion-sensing games, holographic projection, etc.

5. Innovative application and industrialization:

Supporting intangible cultural heritage artistic creation using generative AI such as AIGC.

II. Archaeology

(A) Archaeological survey and prospection

1. Remote sensing:

Using satellite imagery, UAV aerial photography and LiDAR scanning to detect surface features (for example, hidden ancient sites, burial clusters).

2. Geophysical prospection:

Assisting non-destructive exploration with digital equipment such as magnetometers, ground penetrating radar and resistivity imaging.

3. GIS spatial analysis:

Integrating geographic data to analyze site distribution patterns (for example, spatial modeling of the Liangzhu Dam System).

(B) Archaeological excavation

1. 3D recording and modeling:

Documenting excavation sites and artifact contexts through multi-view 3D reconstruction and 3D laser scanning, generating real-time 3D models of trenches, strata and relics.

2. Digital field recording:

Managing unearthed object information (material, composition, location, age, etc) using structured databases.

3. Real-time monitoring:

Using sensors to monitor environmental conditions (temperature, humidity and vibration) during excavation to prevent damage to cultural relics.

(C) Artifacts and relics

1. High-precision artifact modeling:
Using macro photography, CT scanning (for example, internal casting trace analysis on bronze artifacts) and structured light scanning for detailed artifact data.
2. Virtual restoration and reconstruction:
Assisting fragment splicing of broken artifacts using AI algorithms.
2. Material and age analysis:
Digital data integration and visualization using techniques such as x-ray fluorescence and carbon-14 dating.

(D) Archaeological research and analysis
1. Big data and AI applications:
Machine learning to identify artifact decorative styles; natural language processing to analyze ancient documents or inscriptions.
2. Digital twins and simulation:
Constructing dynamic evolution models of sites; virtual experiments to reconstruct ancient techniques.

(E) Digital storage and management
1. Archaeological databases:
Establishing standardized databases (for example, China Archaeology Network), integrating excavation reports, artifact data and image materials.
2. Blockchain-based authentication:
Ensuring immutability of archaeological data (for example, excavation records of important cultural relics).
3. Cloud platform sharing:
Enabling cross-institutional collaborative research (for example, global digital archive of petroglyphs).

III. Exhibition and utilization
(A) Digital exhibition and display
Including physical exhibitions with digital enhancement and fully digital exhibitions.

1. Virtual reality technologies:
VR, AR, mixed reality, etc.
2. Immersive display technologies:
VR, AR, holographic projection, etc.
3. Interactive experience installations:
Touchscreens, motion-sensing interaction, dynamic displays combining projection and sensing technologies (for example, social media interactive walls displaying real-time visitor comments/photos).
4. Digital artifact display technology:
High-precision 3D scanned artifacts supporting 360° rotation, layered viewing, etc.
5. Dynamic visualization:
Using data visualization charts to present archaeological discoveries, cultural dissemination routes, geographical changes, etc.

(B) Digital management
1. Visitor behavior analysis:
Using Wi-Fi probes and cameras for traffic hot spot statistics, optimizing exhibition routes, and AI analysis of visitor dwell time and interaction preferences.
2. Digital ticketing and security:
Implementing facial recognition for ticketing and intelligent surveillance systems for anomaly alerts.

(C) Digital services
1. Digital service platforms:
For example, Dunhuang's Digital Library Cave database platform.
2. Knowledge service platforms:
Platforms leveraging AI and large language models to provide specialized knowledge services for the preservation and inheritance of cultural heritage.
3. Smart guiding:
Mobile apps or mini-programs providing personalized route recommendations and audio explanation, etc.

4. Digital dissemination and education:
Cloud exhibition platforms, remote education platforms, digital cultural and creative derivative development, etc.
5. Activation and use of cultural relics:
Digital cultural relics stage performances, digital cultural derivatives and cultural creative products, etc.