

## A Framework for an Interactive Public Art Platform: Revitalizing Graphic Heritage of Luoyang City Gates

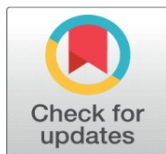
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## ABSTRACT

This study proposes a three-stage framework "symbolic decoding - digital translation - public co-creation" to revitalize graphic heritage through an interactive public art platform. Using the graphic heritage of Luoyang's ancient city gate as a case study, the research was conducted through literature review, expert interviews, platform prototype development, and initial user validation. Results demonstrate that the TUMEN (Cultural Memory Gate Generator) platform effectively transforms historical architectural symbols into interactive cultural experiences. Data from 157 valid responses demonstrates the platform's positive impact on aesthetic perception, understanding of cultural symbolism, and interactive engagement. The study validates the theoretical and practical applicability of the framework and provides a replicable strategy for cultural communication in both digital and physical public spaces. This research establishes a new bridge between the preservation of cultural heritage authenticity and its creative reinterpretation, offering important implications for public art, cultural education, and the construction of urban memory.

**Keywords:** Public Art, Graphic Heritage, Interactive Platform, Co-Creation, Cultural Heritage Communication, Urban Memory, Visual Narratives

## 1. INTRODUCTION

Against the backdrop of rapid globalization and digitalization, public art has gradually become a crucial medium for cultural dissemination and the construction of urban identity [Della Lucia and Trunfio \(2018\)](#). Contemporary cities face the dual challenges of cultural homogenization and the gradual loss of local cultural values. Preserving and revitalizing local cultural assets has become a crucial issue that demands urgent attention [UNESCO \(2001\)](#). Among various forms of cultural heritage, "graphic heritage" (the visual, symbolic, and stylistic elements embedded in historical architecture, decoration, and design) plays an irreplaceable role in the construction of collective memory and the strengthening of cultural identity [Harland et al. \(2019\)](#), [Gombrich \(1984\)](#).

However, despite its significance, graphic heritage is often confined to archives, static exhibitions, or specialized academic fields, limiting its accessibility and interactivity to the contemporary public. In contrast, public art, with its openness, interactivity, and site-specific nature, can transform heritage into a participatory cultural experience [Cartier and Willis \(2008\)](#). Furthermore, the rapid development of digital platforms, particularly online interactive systems for public co-creation, has opened up new possibilities for the dissemination of heritage, transforming the public from passive recipients to participants and reconstructors of cultural content [Giaccardi \(2012\)](#).

Against this backdrop, the question of how to integrate graphic heritage, public art, and interactive digital platforms to enhance the engagement and impact of heritage communication has become a pressing issue. To address this challenge, this article proposes a three-stage public art framework model. Using the graphic heritage of Luoyang's ancient city gates as an example, this paper constructs and initially validates the platform, aiming to explore pathways for reinterpreting cultural symbols in digital environments.

## 2. RESEARCH OBJECTIVES

This study aims to construct and verify an interactive public art platform model based on the logic of graphic heritage symbol translation, emphasizing the integration of the entire process from visual element extraction to public co-creation, and enhancing the depth of cultural heritage dissemination and public participation.

### Specific objectives include:

**Framework construction:** To formulate a visual-encoding and re-interpretation framework applicable to multiple types of cultural heritage;

**Prototype development:** To develop an interactive platform prototype centered on the graphic repertoire of Luoyang's city gates and verify modes of public participation in digital co-creation;

**Exploring communication paths:** To explore deployable design pathways for both virtual and physical spaces, thereby expanding the boundaries of cultural-heritage dissemination.

## 3. LITERATURE REVIEW

### 3.1. PUBLIC ART AS CULTURAL ENGAGEMENT AND URBAN MEMORY

The role of public art in contemporary cities has transcended aesthetic decoration, becoming a crucial medium for inspiring collective identity and fostering cultural interaction [Mersmann et al. \(2024\)](#). Highly interactive art forms, in particular, emphasize the public's right to recreate within specific spaces, shifting art spaces from a "display" perspective to a "participatory" one [Giaccardi \(2012\)](#). This shift provides a theoretical foundation for transforming the way cultural heritage is disseminated.

Related research has shown that public art, through its community-building and participatory processes, can enhance a sense of place and encourage public reflection on historical elements that have been overlooked or lost in urban development [Lossau and Stevens \(2014\)](#). This suggests that, within the dual context of urban renewal and cultural heritage, public art is not only an aesthetic practice but also a crucial channel for cultural reproduction. This study applies this theoretical perspective to the practice of interpreting the graphic heritage of Luoyang's ancient city gates, aiming to explore how public participation can promote the regeneration of historical and cultural symbols.

### 3.2. GRAPHIC HERITAGE: THE INTERSECTION OF ARCHITECTURAL SYMBOLISM AND VISUAL CULTURE

"Graphic heritage" refers to the collection of elements that carry historical and cultural values in visual forms, such as architecture, patterns, and decorative symbols [Harland and Xu \(2021\)](#). In social memory theory, cultural memory is continuously constructed at the collective level through visual symbols, images, and rituals [Halbwachs \(1992\)](#). Therefore, graphic heritage is not only a carrier of historical information but also a "visual language" of cultural identity.

In ancient Chinese architecture, the proportions of city gates, roof forms, and color schemes all carry specific political and cultural symbolism. For example, the hipped roof and gabled roof are not only structural features but also implicitly convey hierarchy and status. The stability and recognizability of these visual symbols make them crucial vehicles for the public to quickly identify cultural information.

Visual culture theory further argues that the meaning of an image derives not only from its appearance but also from its function and context within social cognition and cultural production [Mirzoeff \(2015\)](#). This theoretical framework provides the foundation for this study, making graphic heritage not only an object of study but also a dynamic participant in the process of cultural dissemination.

### 3.3. DIGITAL PLATFORMS AND MECHANISMS FOR HERITAGE CO-CREATION

Driven by information technology, digital platforms have become a crucial channel for disseminating cultural heritage. [Katifori et al. \(2020\)](#) emphasize that the interactivity and customizability of digital environments provide unprecedented opportunities for public participation in heritage interpretation. [Mantzou et al. \(2023\)](#) note that the introduction of co-creation mechanisms can enhance public participation and a sense of belonging, bringing cultural expression closer to individual experience.

In the context of public art, digital platforms provide flexible and open experimental venues for the contemporary reinterpretation of heritage. They not only transcend the limitations of physical space but also enable the display of virtually generated cultural works in physical public spaces, fostering a model of interactive and complementary online and offline communication. This study explores the feasibility of this "digital - physical" dual-track communication approach using the case study of the Luoyang Ancient City Gate graphic heritage.

### 3.4. RESEARCH GAP AND POTENTIAL FOR INTEGRATION

While existing research has explored the roles of public art, graphic heritage, and digital platforms in cultural communication, theoretical models that systematically integrate these three remain relatively scarce. In the context of Chinese culture, research on how to effectively transform visual cultural symbols into interactive artistic experiences is particularly weak. Most studies focus on single-domain or single-media applications, lacking comprehensive methodological support across disciplines and media.

This study aims to fill this gap by proposing and validating an interactive framework centered on the pathway of "symbolic decoding - digital translation - public co-creation." This framework not only focuses on the authenticity and recognizability of heritage but also emphasizes the public's creative participation and emotional connection in the cultural regeneration process, thereby exploring strategies for revitalizing traditional visual heritage in the digital age.

## 4. RESEARCH METHODOLOGY

This study adopts a qualitative-led exploratory research strategy, combining the development of a platform prototype with user feedback verification to implement the feasibility of the three-stage interactive model of "graphic heritage + public art + digital platform" in practice.

### 4.1. LITERATURE SUMMARIZATION AND VISUAL VARIABLE EXTRACTION

This study first, through a systematic literature review and collation of historical image archives, identified key visual variables that influence the cultural cognition and aesthetic perception of city gates. These include roof form, the ratio of width to column height, the shape and number of doorways, and the color scheme. These variables, which have clear hierarchical symbolic meanings in architectural history and visual culture research, were encoded as interactive components of the platform.

In city gate architecture, roofs serve both structural and social functions; hip-roofed and gable and hip-roofed are the most representative forms, and the number of eaves (single-eaved vs. double-eaved) also visually conveys corresponding social status. Accordingly, the platform maps roofs into four optional components: single-eaved hip-roofed, double-eaved hip-roofed, single-eaved gable and hip-roofed, and double-eaved gable and hip-roofed. These are coded A1–A4 for easy access and recording on the platform.

**Table 1**

**Table 1 Roof form Variable Definition and Platform Mapping**

Variable	Reference Images	Platform Mapping	Visible parameters	Coding
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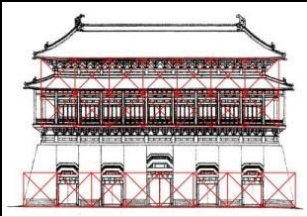


Hip-roofed (single-eaved)			Shape: Hip-roofed, Number of eaves: 1	A1=Single-eaved Hip-roofed
Hip-roofed (double-eaved)			Shape: Hip-roofed, number of eaves: 2	A2=Double-eaved Hip-roofed
Gable and hip-roofed (single-eave)			Shape: Gable and hip-roofed, number of eaves: 1	A3 = Single eaves Gable and hip-roofed
Gable and hip-roofed (double-eaved)			Shape: Gable and hip-roofed, number of eaves: 2	A4=Double eaves Gable and hip-roofed

Source: Author (2025)

The ratio of frontage (number of bays) to column height jointly determines the vertical and horizontal tension of the city gate's facade, providing a crucial clue to the sense of hierarchy and visual order. Standards such as the "Yingzaofashi" clearly define the relationship between the two, with variations observed over time: the Tang Dynasty saw a tendency toward horizontal expansion and low proportions, while the Song and Yuan dynasties saw a trend toward vertical expansion and increased column height. Within the platform, proportion is achieved through the number of bays and levels of the building's components.

Table 2

Table 2 Variable Definition and Platform Mapping for Width-to-Column-Height Ratio				
Variable	Reference Images	Platform Mapping (House Components)	Visible parameters	Coding
Tang Dynasty city gate			Number of bays: 9; Number of floors: 1	B9F1
			Number of bays: 9; Number of floors: 2	B9F2
Northern Song Dynasty city gate			Number of bays: 7; Number of floors: 1	B7F1

			Number of bays: 7; Number of floors: 2	B7F2
Yuan Dynasty city gate			Number of bays: 5; Number of floors: 1	B5F1
			Number of bays: 5; Number of floors: 2	B5F2









**Note:** B represents the number of bays, and F represents the number of floors. These numbers are specific values. This study considers bays and floors as core parameters for roof components, used for platform component selection and user combination recording.

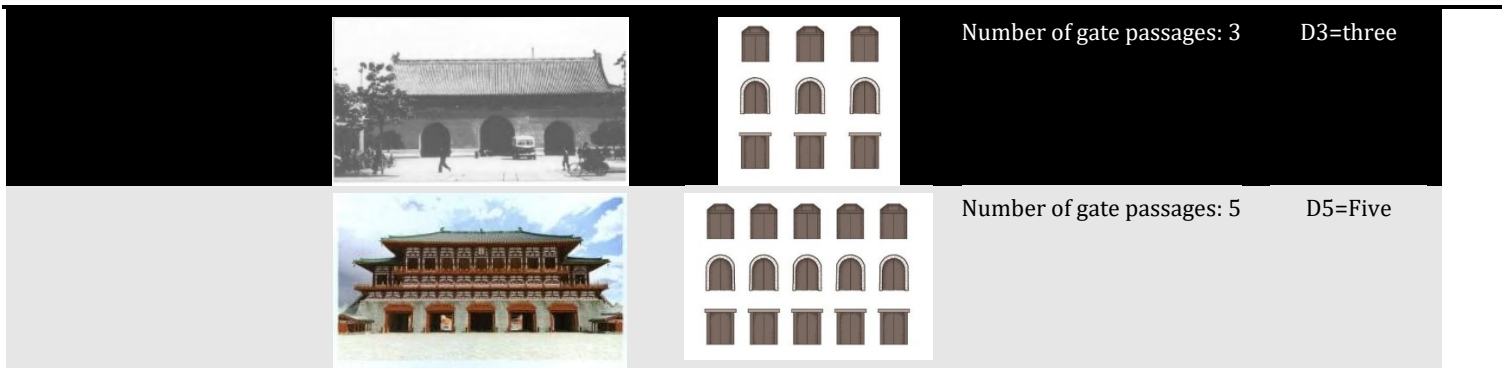
**Source:** Author (2025)

The layout of gate opening and gate passages embodies ritual and traffic order: structural forms gradually evolve from lintels to arches; the number of one, three, or five passages clearly reflects allocation of use and hierarchy (the central gate was reserved for the emperor, the side gates for officials and civilians). The platform uses C-codes for doorways (trapezoidal, arched, or square) and D-codes for passages (1, 3, or 5), allowing for free combination to convey ritualistic meaning.

**Table 3**

**Table 3 Doorway and Passage Variable Definitions and Platform Mapping**

Variable	Reference Images	Platform Mapping	Visible parameters	Coding
Gate opening shape			Trapezoid	C1=trapezoidal
			Arch	C2=Arch
			Square	C3=Square
Number of gate passages			Number of gate passages: 1	D1 = one



Source: Author (2025)

Color is the most intuitive way to encode hierarchy: Tang and Song dynasty imperial architecture often featured a "red pillars, red doors, and yellow glazed tiles" pattern, with walls often constructed of gray brick or white. Based on this, the platform constructs combinations of primary colors (pillars, walls, and doors), roof colors (yellow glazed tiles, black tiles), and city wall colors (white, gray, and brown) to support the visual selection of cultural symbols.

Table 4

Table 4 Color System Variable Definition and Platform Mapping				
Variable	Reference Images	Platform Mapping	Visible parameters	Coding
Main color			Column color, wall color, door color	M=Red columns/white walls/red doors combination
Roof color			Roof tile and ridge color	RY = Yellow Glaze; RG #NAME?
Wall color			Wall color	CW=white; CG=gray; CB=brown

Source: Author (2025)

These four variables do not exist in isolation; rather, they interact within historical architecture, collectively shaping the city gate's sense of hierarchy and cultural identity. To this end, this study integrates them into a component library and embeds them into an interactive platform, allowing users to freely combine them to digitally recreate cultural imagery.

## 4.2. EXPERT INTERVIEWS AND THEMATIC ANALYSIS

Based on the variable extraction process, this study conducted purposive sampling and invited eight experts in the fields of architectural history, urban heritage preservation, visual communication, color systems, and public art curation to participate in semi-structured interviews to gain professional insights into the cultural value and transformation paths of city gates [Table 5](#). The interviews covered core topics such as "cultural memory recall," "form and symbol recognition," and "public participation variables." The data collection process included audio recording, verbatim transcription, and cross-verification.

**Table 5**

Table 5 Expert Interview Sample Overview					
No.	Field	Job title/position	Representative organizations/units	Years of experience	Interview method
E01	Public Art Design	Senior Art Curator	Urban Art Promotion Center	15 years	Offline
E02	Architecture and Urban Renewal Design	Partner of an architectural firm	An architectural firm	18 years	On-line
E03	Urban Landscape and Visual Communication	Professor/ Urban Landscape Consultant	Urban Space Vision Research Institute	25 years	Offline
E04	Interpretation of Historical Architectural Culture	Researchers	Dingdingmen Ruins Museum	12 years	On-line
E05	Research on Color and Modeling Language	Color system expert	Art and Color Research Association	20 years	On-line
E06	Urban public space art	Design Director	Cultural and Creative Companies	14 years	Offline
E07	Research on the history of Chinese and Western aesthetics and aesthetic principles, research on art philosophy and art theory	Doctoral Supervisor/ Expert Consultant	Chinese Society of Aesthetics/Shanghai Society of Aesthetics	22 years	Offline
E08	Urban heritage protection	Professor/Doctoral Supervisor	School of Urban Planning of a comprehensive university	20 years	On-line

**Note:** To protect the privacy of the respondents, the professional titles and affiliations in the table has been desensitized, but their professional identity labels are still retained.

**Source:** Author (2025)

To ensure a systematic qualitative analysis, the research team used NVivo 12 Plus to conduct a three-level coding process, completing open, axial, and selective coding. During the open coding phase, the interview texts were annotated sentence by sentence, resulting in 78 initial tags. These tags were then clustered and contextualized into 16 mid-level categories [Table 7](#). Ultimately, four core themes were identified, explaining the transformation mechanism from "graphic heritage to cultural cognition to public expression" [Table 8](#).

**Table 6**

Table 6 Open Coding Example			
Excerpt from the original statement	Encoded Label	Frequency	
"The overlapping eaves of the double-eaved hip roof make the roof appear even larger, creating a sense of oppression at first glance. This is the architectural embodiment of power" (E02)	Roof volume + symbol of power	23	
"Using parametric design to transform the proportions of bracket sets into modern devices, preserving the DNA while breaking through the formal boundaries" (E06)	Component parameterization + form regeneration	27	
"The gradual changes in the height-to-width ratio of the city gate piers not only reflect the evolution of technical skills, but also reflect carefully calculated political considerations" (E03)	Proportional changes + political expression	41	
"Yellow glazed tiles are an absolute symbol of imperial status; this is an institutionalized color privilege" (E05)	Color Specificity + Hierarchy	38	
"The material division system of bracket sets can be completely transformed into parametric design units" (E03)	Construction logic + digital translation	22	
"Young people think of city gates as arched, semicircular gates on top, but they don't realize that during their heyday, city gates wer	Graphic symbol failure + cultural disconnection	35	
"Directly replicating city gate components in a commercial plaza is essentially symbolic appropriation" (E06)	Mechanical reproduction + field disembedding	22	
"[E04 repeatedly used hand gestures to simulate the warping curve of the roof during the demonstration]" (recording notes)	Gesture simulation + spatial memory evoked	27	

"Allowing viewers to use AR to adjust the number of door nails and the color of the building allows them to better understand the impact of the architectural system on class at the time than a static exhibition would." (E03)	Immersive interaction + Enhanced system awareness	19
"The change in the number of doorways is a developmental need for urban expansion, and more importantly, it is physical evidence of the identity system" (E04)	Doorway changes + identity system mapping	17

Source: Author (2025)

Table 7

Table 7 Axial Categories Summary				
Category Name	Contains concepts (keywords)	Typical relationship path	Experts involved	Remark
Reappearance of ritual space	Axial symmetry / Number of gates / Level of city walls	Structural Features → Spatial Rituals → Power Representation	E02, E08	Closely linked to the planning of the city's central axis
Color symbology	Red Pillars and Red Walls / Glaze Level / Golden Despotism	Color Combination → Visual Hierarchy → Identity	E05, E07	High integration of structure and decoration
Graphic Cognitive Gap	Graphic symbol failure / Chiwen meaning / Young people's poor cognition	Graphic style → Cultural suspension → Cultural distance	E03, E04	It is the premise of the phenomenon of "context stripping in design"
Translation technology path	Parametric design / Material classification system / Digital imitation	Traditional form → Digital language → Modular adaptation	E03, E06	A collection of opinions from public art designers
Module expression potential	Graphic Reconstruction/ Proportional Unit/ Rhythmic Structure	Component deconstruction → Visual unit → Contemporary design language	E01, E06	Forming a technical bond with "parametric architecture"
Field disembedding risk	Graphic collage / Positional disjunction / Display symbolism	Spatial stripping → Emotional rupture → Meaning dissolution	E04, E08	Frequently observed in negative cases
Non-verbal memory channels	Gesture reproduction / Graphic imitation / Spatial immersion	Body movement → Memory anchor → Spatial identity	E01, E06	Combined with immersive display
Proportional Power Rhetoric	Pier height-to-width ratio / Strict proportions / Gradual enclosure on three sides	Mathematical form → Volumetric oppression → Visual sense of power	E08, E03	It represents a core expression of political architectural aesthetics
Material symbolism	Glazed Tile / Chiwen Ridge Beast / Craft Difficulty	Material Grade → Technological Development → Gazing up at Majesty	E05, E07	Often intersects with color categories
Graphics system closed	Roof shape / Gate shape / Door and window / Decoration patterns	High knowledge threshold → Difficulty in memory → Symbolic barrier	E02, E04	One of the obstacles to public participation
Visual power axis	City gate → Main building → Central axis → Distant view composition	Deep Space → Emotional Progression → Ritual Symbolism	E03, E08	Overlapping with "Ritual Space Reproduction"
Dynamic participation mechanism	AR control / Simulation comparison / Immersive experience	Modern methods → Participatory interaction → Improved understanding	E01, E06	It is the experience factor that young users pay attention to
Graphic aesthetics are detached from reality	Decorative stacking / Graphic collage / Simulated texture	Rough transplant → Visual retro → Floating meaning	E04, E06	Joint review with "field disembedding" forms an anti-category
Institutional semantic lag	Roof shape / Number of brackets / Ceremonial structure	Complex norms → Lack of institutional translation → Cognitive gap	E05, E02	There is a causal relationship with cognitive dissonance
Environmental Visual-Emotional Resonance	Symmetrical Space / Repetitive Structure	Spatial environment → Mind shock → Emotional arousal	E06, E03	Interdisciplinary (Psychology/Arts) Focus
Media technology convergence	Light Mapping / Material Updates	Media Update → Cultural Reproduction → Expression Upgrade	E01, E07	Forming a technical intersection with the "translation path"

Source: Author (2025)

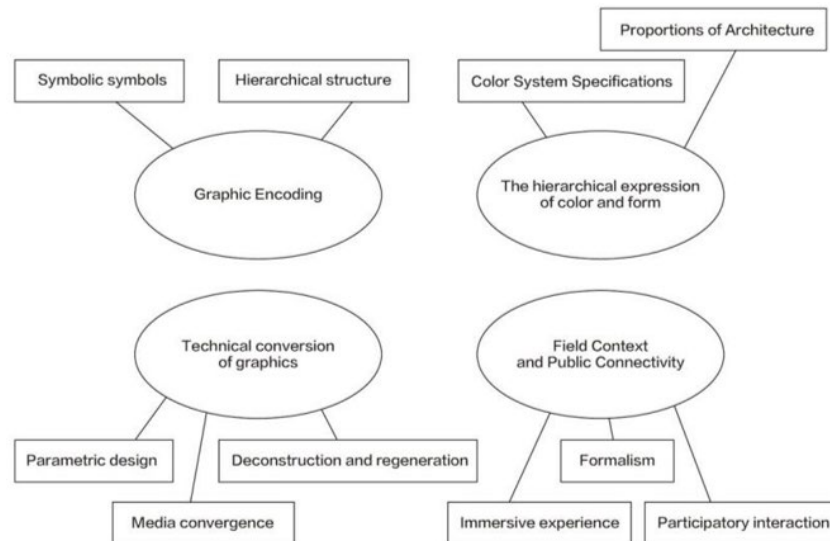
**Table 8**

Table 8 Selective Coding Framework				
No.	Core Themes	Concept aggregation source (axis category)	Conceptual Inductive Logic	Functional Positioning
1	Graphical Coding of Ritual Space	Reproduction of ritual space / axis power field / institutional semantic lag	The graphic structure of the city gate → the spatial expression of ritual hierarchy → visualization of the system	Core meaning: Institutional expression materialized through space
2	Hierarchical expression of color and form	Color symbolism / proportional power rhetoric / material symbolism / emotional-proportional resonance	Proportion and color as visual rules → stimulate psychological oppression → convey power hierarchy	Perceptual Mechanisms: Symbolization from Aesthetics to Symbolism
3	Technical translation mechanism of graphics	Modular expression / parametric path / media convergence / non-verbal memory channel	Deconstruct traditional components into modules → digital media translation → reconstruct urban public expression	Operational mechanism: A conversion model from translation to experience
4	Field context and public connectivity	Graphic cognitive gap / Field disembedding risk / Graphic system closedness / Dynamic participation mechanism	Graphics out of context are risky → difficult for the public to understand → need to be re-embedded through participatory interaction	Reception mechanism: The process of constructing recognition and memory

Source: Author (2025)

To facilitate intuitive understanding of the relationships between the themes, the framework table was visually simplified, retaining the core themes and their key subcategories, and a thematic map was created. This map clearly illustrates the logical path from "graphic heritage elements" to "public connection mechanisms," providing a comprehensive reference for subsequent platform design and strategy formulation.

**Figure 1**



**Figure 1** Theme Map

Source: Author (2025)

### 4.3. PROTOTYPE PLATFORM DEVELOPMENT AND FUNCTION DESIGN

Based on literature review and expert interviews, this study developed an interactive prototype platform, TUMEN: Cultural Memory Gate Generator. This platform implements the digital translation of cultural symbols through a logical process of "component selection → real-time preview → naming and exporting → data recording." Users can freely combine components from the component library and receive instant visual presentation and cultural cues. The system also records their operation paths and selection preferences.

#### 4.4. INITIAL PLATFORM VERIFICATION AND SUBSEQUENT USER FEEDBACK PLAN

To assess the platform's suitability for public interaction and cultural communication, this study introduced a brief questionnaire during the image generation phase, collecting feedback on three key areas: aesthetic perception, cultural symbolism, and interactive experience. User behavior data was also recorded simultaneously. Because validation is an exploratory phase, this chapter only describes the validation framework and process; detailed results will be presented in the Research Results section.

### 5. RESEARCH RESULTS

#### 5.1. OBJECTIVE 1: FRAMEWORK CONSTRUCTION RESULTS

Through preliminary expert interviews and coding analysis, four key themes have been clearly identified: ritual space, hierarchical color, graphic translation, and public connection mechanisms. These themes not only summarize the cultural characteristics of Luoyang's ancient city gates but also serve as a design basis for platform components, systematically embodying them in aspects such as interface interaction, modular composition, and cultural cues. For example, visual variables such as roof form, structural proportions, doorway layout, and color schemes are incorporated. These elements not only reflect the cultural meaning of traditional architecture but also provide clear structural guidance and meaningful feedback to users when constructing graphics.

To more intuitively illustrate the application path of the framework in platform design, the study further developed a "Graphic Heritage Regeneration Model" [Figure 2](#), summarizing the platform's operational processes and data flows within the three-phase logic of "symbolic decoding - digital translation - public co-creation." This model clearly illustrates the translation path from traditional component knowledge to interactive experience, providing theoretical support for the systematic construction of heritage dissemination mechanisms.

Figure 2

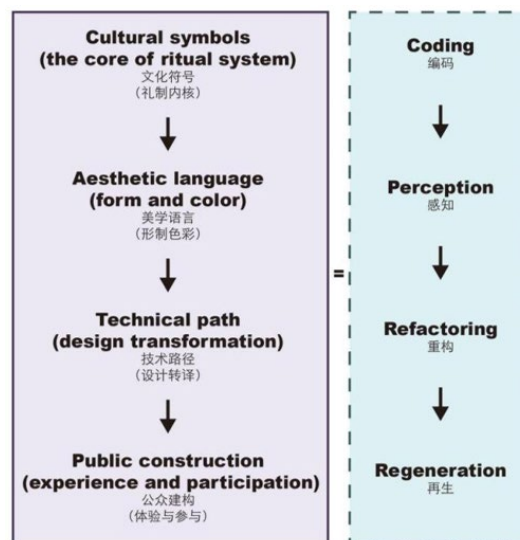


Figure 2 Graphic Heritage Regeneration Model

Source: Author (2025)

#### 5.2. OBJECTIVE 2: PROTOTYPE PLATFORM IMPLEMENTATION AND INTERACTION MECHANISM CONSTRUCTION

After constructing a framework and refining core themes, this study translated the theoretical findings into actionable digital tools, developing an interactive prototype platform—TUMEN: Cultural Memory Gate Generator. This platform aims to facilitate the public re-creation of Luoyang's ancient city gate graphic heritage through modular component assembly.

Figure 3

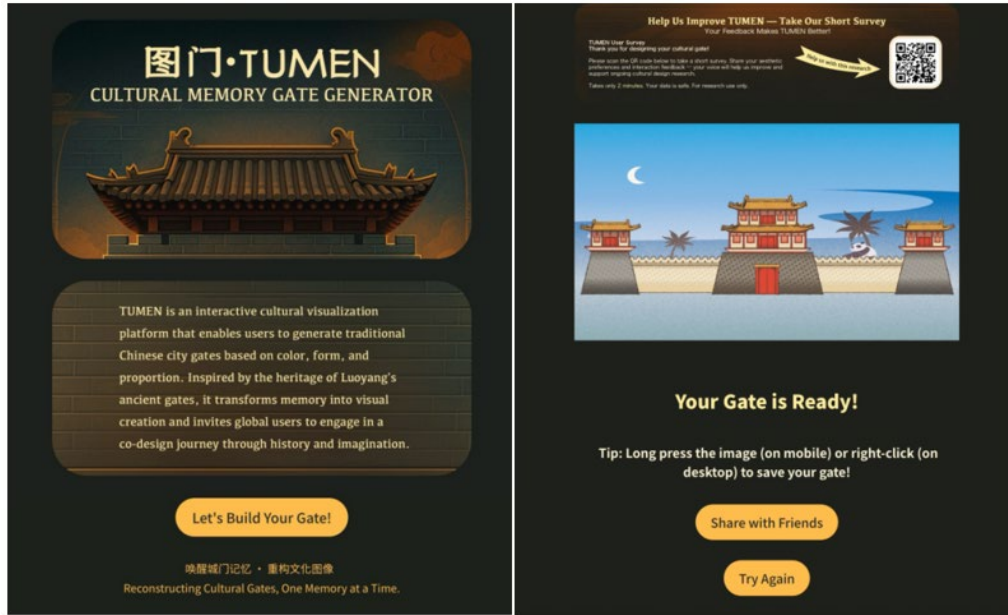


Figure 3 Platform Operation Interface Home Page and User-Generated Results Page

Source: Author (2025)

The TUMEN platform utilizes a top-down, partitioned interface, allowing users to freely select and replace components from a library of components (Roof of the Gatehouse, Facade and Structure of the Gatehouse, Gate Podium, Gate Opening, Gate Base, Que-Gate Towers, hereafter referred to as Que). The system uses layer-based stitching to provide instant previews, allowing users to return to modify and export results at any time. The operation path is "Component Selection → Instant Preview → Name and Export → Data Recording." The backend simultaneously records the selection sequence and duration of the selected component, providing data support for subsequent preference analysis and platform optimization [Figure 4](#), [Figure 5](#) and [Figure 6](#).

Figure 4



Figure 4 Platform Interface Layout and Functional Divisions

Source: Author (2025)

Figure 5



Figure 5 Schematic Diagram of the Platform Image Generation Process  
Source: Author (2025)

Figure 6

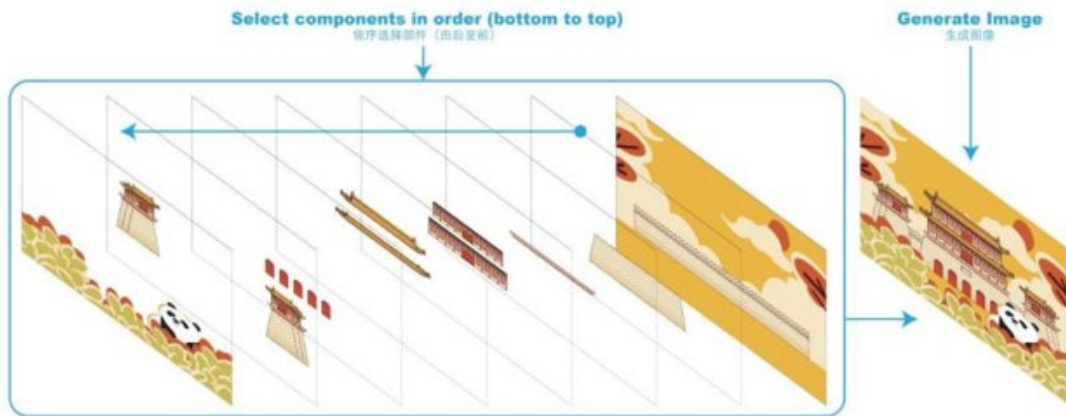


Figure 6 Image Stitching Structure and Layer Order  
Source: Author (2025)

To enhance component identification and cultural understanding, the platform adds naming labels to roof components (such as "Hip-roofed" and "Gable and hip-roofed") and uses icons for image comparison to help distinguish between forms. Users can customize names for complete works, and the system will display the names above the gate opening, enhancing personalized expression and a sense of belonging [Figure 7](#).

**Figure 7**



**Figure 7** Roof Component Naming Example

Source: Author (2025)

The gate podium's component library covers three categories: shape, proportion, and color. These are derived from historical imagery of Luoyang's Dingding Gate and Yingtian Gate and expert interviews [Table 9](#), [Table 10](#) and [Table 11](#). This library not only ensures the cultural authenticity of the shapes but also provides users with visual creative resources.

**Table 9**

Table 9 Shape Component Library			
Roof of the Gatehouse			
Facade and Structure of the Gatehouse			
Gate Podium			
Gate Base			
Gate Opening			
Que			

Source: Author (2025)

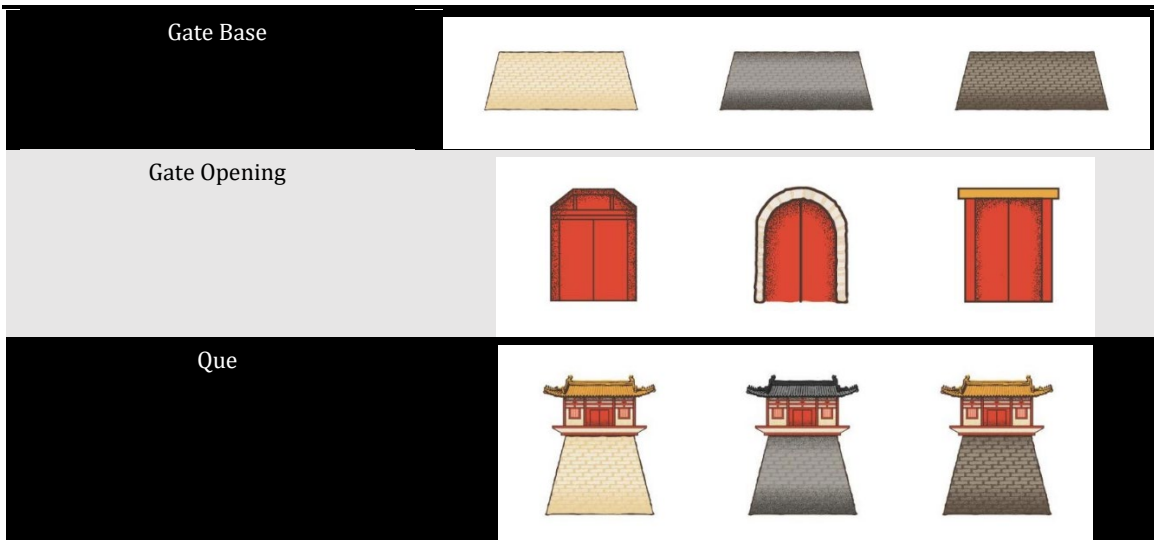
**Table 10**

Table 10 Scale Parameter Library			
Roof of the Gatehouse			
Facade and Structure of the Gatehouse			
Gate Podium			
Gate Base			
Gate Opening			

Source: Author (2025)

**Table 11**




Table 11 Color Combination Library	
Roof of the Gatehouse	
Facade and Structure of the Gatehouse	
Gate Podium	



Source: Author (2025)

In terms of presentation, the platform has brought together a diverse range of user-generated works [Table 12](#) . These works not only demonstrate the creativity of free combination but also visually retain the symbolic characteristics of traditional architecture. To further demonstrate the relationship between platform functionality and user experience, this study compiled a table corresponding to the platform's main functions and user experience dimensions [Table 13](#) . This table clearly demonstrates how functional design enhances public engagement in terms of operational freedom, visual feedback, cultural cognition, and social communication, providing a context for subsequent verification of the results.

**Table 12**

Table 12 User-Generated Works Samples					
Gate Base	Facade and Structure of the Gatehouse	Roof of the Gatehouse	Gate Passages and Gate Opening	Que	Result image
Ivory white base	Nine-bay, two-storey	Gable and hip-roofed (double-eaved)	Five-passaged Gate, Trapezoidal Gate Opening	Triple Que	
Gray base	Five-bay, two-storey	Gable and hip-roofed (double-eaved)	Three-passaged Gate, Arched Gate Opening	Single Que	
Brown base	Five-bay, single-storey	Hip-roofed (single-eave)	Single-passaged Gate, Arched Gate Opening	Double Que	

Gray base	Five-bay, two-storey	Gable and hip-roofed (double-eaved)	Three-passaged Gate, Arched Gate Opening	Single Que	
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Source: Author (2025)

**Table 13**

**Table 13 Comparison of the Platform's Main Functions and User Experience Dimensions**

Platform Features	Specific description	User experience dimension	Corresponding value
Modular component selection	Provide free selection and combination of roof of Gatehouse, Facade and Structure of Gatehouse, Gate Podium, Gate Opening, Gate Base, Que and other components	Operational freedom	Enhance the diversity and personalization of creation
Live Preview	Instantly display the combination effect, support zoom and viewing angle adjustment	Visual feedback	Enhance the intuitiveness and immersion of operation
Cultural knowledge	Learn about cultural heritage through component selection	Knowledge accessibility	Enhance cultural learning and cognition
Personalized naming	Users can name their works based on creativity or cultural associations	Create a sense of participation	Strengthening personal engagement and cultural expression
Export and share your work	Generate image files and support sharing on social platforms	Social Contagion	Expand cultural influence and public participation
User behavior records	Backstage records the order of component selection, duration of stay, and structure of the work	Data analyzability	Support follow-up research and platform optimization

Source: Author (2025)

### 5.3. OBJECTIVE 3: EXPLORATION AND PRELIMINARY VERIFICATION OF TRANSMISSION PATHS

During the initial testing phase, the platform collected 157 valid responses, primarily evaluating users across three dimensions: aesthetic perception, understanding of cultural symbolism, and interactive experience. The results showed that 82.5% of users found the platform's images visually appealing, 87.1% said the platform helped them more easily identify city gate cultural symbols, and 79.4% found the platform easy to use and the feedback effective [Table 14](#).

**Table 14**

**Table 14 Key Indicators from Preliminary User Feedback**

Evaluation Dimensions	Core Issues	Recognition rate (%)	Illustrate
Aesthetic perception	The images generated by the platform are visually appealing	82.5	Users generally recognize the design quality of the platform's visual presentation
Cultural symbolic understanding	The platform helps me more easily identify the main cultural symbols of Luoyang's ancient city gates	87.1	In line with the goal of research to enhance public cultural awareness
Interactive experience	The platform is easy to operate and provides effective instant feedback	79.4	The interaction process is smooth, which enhances users' willingness to continue using the product.

Source: Author (2025)

The system's backend behavioral data also reflects public preferences in component selection: double-eaved hipped roofs and double-eaved gable roofs are the most popular, the combination of vermilion columns and yellow glazed tiles is the most popular, and trapezoidal and "Three-passaged Gate" gate openings are the most popular [Table 15](#). These

preferences reflect that the public's aesthetic preferences still retain a strong visual memory of traditional hierarchical structures and provide data support for subsequent personalized recommendation functions.

**Table 15**

Table 15 Top Five User Component Selection Rates and Their Cultural Significance				
Ranking	Component Type	Coding Example	Selection rate (%)	Summary of Cultural Significance
1	Roof: Double-eaved hip-roofed	A2	34.8	Commonly used in royal ritual buildings, symbolizing dignity and authority
2	Roof: Double-eaved gable and hip-roofed	A4	28.6	Commonly found in high-level palaces and city gates, it is delicate and flexible.
3	Color combination: Vermilion columns + yellow glazed tiles	M+RY	25.4	It symbolizes authority and joy, and has a strong visual impact.
4	Gate Opening: Trapezoidal Gate Opening	C1	21.7	It embodies calmness and simplicity, and has a strong cultural connotation
5	Number of Gate passages: Three-passaged Gate	D3	19.5	Combines defense and ceremonial functions to enhance solemnity

Source: Author (2025)

In summary, the platform validation results demonstrate that the interactive framework proposed in this study can stimulate public enthusiasm for creation and cultural expression while maintaining cultural authenticity. Both questionnaire feedback and behavioral data demonstrate the platform's strong cognitive guidance and dissemination potential, laying the foundation for subsequent application on a larger scale and in cross-cultural contexts.

## 6. CONCLUSIONS

Compared to existing research that has focused on site-specific technology applications or contextualized engagement mechanisms [Ng et al. \(2024\)](#), [Mantzou et al. \(2023\)](#), this study proposes an interactive framework centered on structured visual encoding, systematically integrating cultural semantics, interactive logic, and public expression pathways, expanding the theoretical depth and practical breadth of cultural heritage digital platforms. The TUMEN platform's design, including component selection, naming mechanisms, and feedback logic, achieves a "cultural content-driven interactive pathway construction." This not only echoes [Maietti \(2023\)](#) principle of "technology serving cultural semantics" but also explores the dynamic balance between cultural identity generation and personalized design. While the platform has yet to be fully deployed in physical public spaces, its "graphic re-creation" logic and co-creation philosophy are already transferable, providing a viable path for the future integration of offline public art and digital platforms.

The three-stage framework constructed in this study establishes a close connection between the structuring of graphic elements and mechanisms for public engagement, transforming visual symbols from cultural abstractions into operational objects for interactive experiences. The platform's embedded "free combination + naming + real-time feedback" mechanism not only enhances user immersion and expressiveness, but also provides a new paradigm for the dissemination of traditional heritage. This process not only recreates the form of historical buildings but also reconstructs cultural semantics, enabling the dynamic updating of symbolic systems within a digital context. This shift from "redesign" to "reinterpretation" reflects the structural reshaping of digital platforms within the cultural dissemination model. The platform's instant generation and export capabilities also enable the rapid dissemination of creative outputs through social media or virtual exhibitions, stimulating cross-regional cultural interaction and resonance among the public.

On a theoretical level, the greatest contribution of this interactive framework lies in its proposed methodological logic of "structured encoding - cultural semantic binding - co-creation and generation," which demonstrates strong cross-media and cross-cultural adaptability. By breaking down cultural graphic elements into combinable building blocks, the platform not only lowers the cognitive threshold but also expands the scope of participation in heritage digital creation. Preliminary validation results indicate that users generally appreciate the visual aesthetics and cultural identity of the platform's components, and their naming and collage behaviors demonstrate an aesthetic preference for traditional

hierarchies and construction logic. While the current data sample is primarily preliminary and requires further validation with a wider population, the platform's construction logic already possesses strong universality. This achievement not only provides a replicable tool for cultural institutions, designers, and educators, but also provides both theoretical and operational support for urban renewal, public art dissemination, and cultural education practices.

## 7. DISCUSSIONS

This study focuses on the graphic heritage of Luoyang's ancient city gates and constructs a three-stage path of "symbolic decoding - digital translation - public co-creation". Through the prototype design and verification of the TUMEN platform, it verifies the operability and interactive value of this model in cultural communication.

Research results demonstrate that the platform is able to enhance public recognition of the visual symbols of the ancient city gates while maintaining historical authenticity and promoting engagement in their creation. User behavioral data reveals a preference for high-grade architectural components and specific color combinations, while questionnaire responses indicate high recognition of the platform in terms of aesthetic perception, cultural symbolism, and interactive experience. These findings demonstrate the potential of digital interactive design in promoting cultural identity and communication.

The framework proposed in this study demonstrates methodological transferability, particularly in its dual aspects of structured encoding and cultural meaning-making, providing a scalable model for the digital translation of cultural heritage. While this study is based on the graphic heritage of Luoyang's ancient city gates, future research will require validation of its applicability across multiple heritage types and within broader cultural contexts. The findings can provide sustainable theoretical and technical support for research in digital humanities, urban image reconstruction, and cultural participation mechanisms.

## CONFLICT OF INTERESTS

None.

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