Smart Heritage

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Abstract

The "Smart Heritage Project" is a digital initiative aimed at addressing the threats posed by modernization, the aging of craftsmen, and the declining interest of the younger generation to intangible cultural heritage (such as the craftsmanship of Chinese wooden arch bridge construction and Malaysian batik).

This project has developed a comprehensive platform for preserving, displaying, and promoting traditional crafts from China, Malaysia, and other regions. The platform adopts a 12-month incremental development model and has built a centralized digital archive, which includes multimedia content (videos, images, tutorials), interactive functions (virtual workshops, real-time demonstrations), and AI-driven personalized recommendations. It is built based on the scalable Vue 3 front-end and Spring Boot back-end and supports bilingual languages (Chinese and English).

User testing through black-box testing shows that the platform's advantages lie in its user-friendly interface and high content quality, but there are problems such as slow loading on mobile devices and unclear workshop time zones. It is planned to improve accessibility through optimization.

The project integrates multimedia, VR/AR, and AI into a cross-cultural platform with cultural specificity, filling the gaps in existing research, promoting global participation, and providing an scalable model for sustainable digital heritage protection.

Kata kunci： Intangible cultural heritage; digital preservation; Smart Heritage Platform; multimedia archives; AI personalization; cross-cultural communication

Abstract

The "Smart Heritage Project" focuses on the digital survival of traditional crafts. Aiming at the inheritance crisis faced by techniques such as wooden arch bridge construction and batik, it has built a digital platform integrating archiving, display, and interaction. Adopting incremental development as its methodology, the project completes the iteration of core functions in 6 phases, including requirement analysis, database design, UI development,

multimedia integration, test optimization, and final launch. The technical architecture adopts a layered design: the front-end is based on Vue 3 and the Element Plus component library; the back-end uses the Spring Boot framework and follows RESTful API specifications; and the database layer realizes the structured storage of traditional craft data. The core functions of the platform are verified through black-box testing, with user tasks covering registration and login, craft search, multimedia learning, virtual workshop registration, and feedback submission. The results show that the platform performs outstandingly in terms of usability and content quality, but there is a need to optimize mobile performance and time zone display. This project not only provides digital solutions for traditional crafts in China and Malaysia but also promotes the cognition and exchange of cultural heritage worldwide through cross-cultural display and interactive functions..

Keywords： *Traditional craftsmanship; incremental development; layered architecture; user testing; digital archiving; technical inheritance.*

1.0 INTRODUCTION

Intangible cultural heritage, including traditional crafts such as the craftsmanship of Chinese wooden arch bridge construction and Malaysian batik, embodies hundreds of years of historical, artistic, and cultural knowledge. These techniques serve as vital bonds for national identity and community memory. However, the rapid advancement of economic modernization, the aging of skilled craftsmen, and the declining interest of the younger generation in intangible cultural heritage pose significant threats to the inheritance of these traditions. Without effective protection strategies, these heritages may disappear permanently.

To address these challenges, the "Smart Heritage Project" has emerged, aiming to develop a comprehensive digital platform for protecting and promoting traditional crafts in China and Malaysia. The project adopts an interdisciplinary approach, combining digital technology with cultural research to document endangered crafts and make them accessible to a global audience. The platform integrates multimedia content, virtual workshops, and artificial intelligence (AI)-driven personalized features to enhance user engagement and facilitate educational promotion.

The platform architecture is based on modern web development principles: the front-end is implemented using Vue 3, following a separation of front-end and back-end model to improve scalability and maintainability, with Element Plus as the UI component library and Tailwind

CSS for custom style design; the back-end follows the RESTful API design pattern, built on Spring Boot, supplemented by Spring Security and Spring Data JPA to ensure secure and efficient data management. The platform supports both Chinese and English, and provides separate interfaces for end-users and administrators, enabling multiple functions such as content display, cultural interaction, and system management.

To evaluate the platform's effectiveness in achieving its core goals (i.e., usability, accessibility, and content quality), the research team conducted structured user testing. The tests simulated real usage scenarios, provided in-depth insights into user experience, identified the system's strengths and limitations, and offered feedback to guide iterative improvements. The results from the testing phase have provided a basis for platform optimization and highlighted its potential as a scalable tool for intangible cultural heritage protection.

2.0 LITERATURE REVIE

Smith, J. (2021). Preserving cultural heritage through technology. Heritage Press.
This literature points out that multimedia (such as high-quality video tutorials and visual step-by-step guides) can make traditional crafts more accessible and appealing, with particularly significant effects on young audiences. It also emphasizes the role of high-quality videos, 3D models, and interactive guides in recording and preserving cultural heritage, but notes their limitations in terms of interactivity and user engagement.

Liew, C., & Ng, J. (2020). Digital preservation of cultural heritage in Asia: A review of existing technologies and future trends. Digital Scholarship in the Humanities, 35(2), 239-258.
The article mentions that platforms such as Google Arts & Culture and Europeana have highlighted the potential of digital archives to popularize heritage resources globally, promoting cross-cultural cognition and communication. These platforms are important resources for disseminating rare cultural materials, demonstrating the educational and archiving value of digital preservation work.

Roussou, M., & Katifori, A. (2018). Flow, staging, wayfinding, personalization: Evaluating user experience in virtual museums. International Journal of Human-Computer Studies, 114, 57-68.
The study found that VR experiences significantly enhance user engagement by providing a sense of presence that traditional media cannot replicate. It also proposes an interactive VR application that allows users to explore simulated cultural environments, demonstrating the

potential of VR and AR to overcome geographical barriers. However, it also points out that VR has issues such as high equipment costs and technical barriers.

Graham, B., & Cook, S. (2015). Rethinking curating: Art after new media. MIT Press.
This work indicates that AI-based recommendations have significantly improved user interaction and retention rates in heritage applications. It also introduces a model that uses AI to analyze user preferences and generate personalized recommendations, enabling the platform to adapt to the interests and learning styles of different users. However, this method has problems such as relying on large datasets, raising concerns about user data privacy, and having high requirements for the technical infrastructure of small cultural institutions or projects.

3.0 METHODOLOGY

Using the **Incremental Development** model, the project will be completed in progressive stages, where core features are built and tested in increments. This model allows each functional part of the platform to be delivered, tested, and improved before fully integrating all elements. Below is a detailed approach based on this model:

Incremental Development Stages

Increment 1: **Requirements Analysis and Prototype Developmen**t

Timeline: Months 1–2

Activities:

Conduct in-depth requirements analysis to determine platform needs, including database structure, user interface (UI) elements, and multimedia archiving methods.

Develop a low-fidelity prototype to visualize the platform layout and primary functionalities, such as content archiving and search features. Define the types of content required for archiving traditional crafts, including video, images, and tutorials.

Increment 2: Database and Content Structure Development

Timeline: Months 3–4

Activities:

4Design and implement the back-end database to store content, including craft information, multimedia files, and metadata for search and categorization.

Structure a scalable and secure database to accommodate future additions of new crafts and content types.

Begin initial data collection from artisans and cultural experts for the first 10 crafts, uploading content to test database capabilities.

Increment 3: Initial User Interface (UI) and Core Functionalities

Timeline: Months 5–6**Activities**:

Develop the primary UI elements, focusing on intuitive navigation for browsing, searching, and viewing craft content.

Implement core functionalities, including user registration, content browsing, and a multilingual feature for accessibility.

Perform initial testing with small user groups to gather feedback on navigation, accessibility, and ease of use.

Increment 4: Multimedia and Interactive Features

Timeline: Months 7–8

Activities:

Integrate multimedia functions for video streaming, image galleries, and interactive tutorials to enhance the learning experience.

Develop features for live streaming and workshop registration, enabling users to attend virtual events or watch demonstrations in real-time.

Expand the content archive to include an additional 20 crafts with rich multimedia elements.

Increment 5: Testing, User Feedback, and Optimization

Timeline: Months 9–10

Activities:

Conduct comprehensive testing, including performance, functionality, and user experience testing across devices (web and mobile).

Expand user testing groups to artisans, students, and craft enthusiasts, gathering feedback on the usability and content quality.

5Optimize the platform based on testing feedback, adjusting any technical or content-related issues.

Increment 6: Final Content Integration and Platform Launch

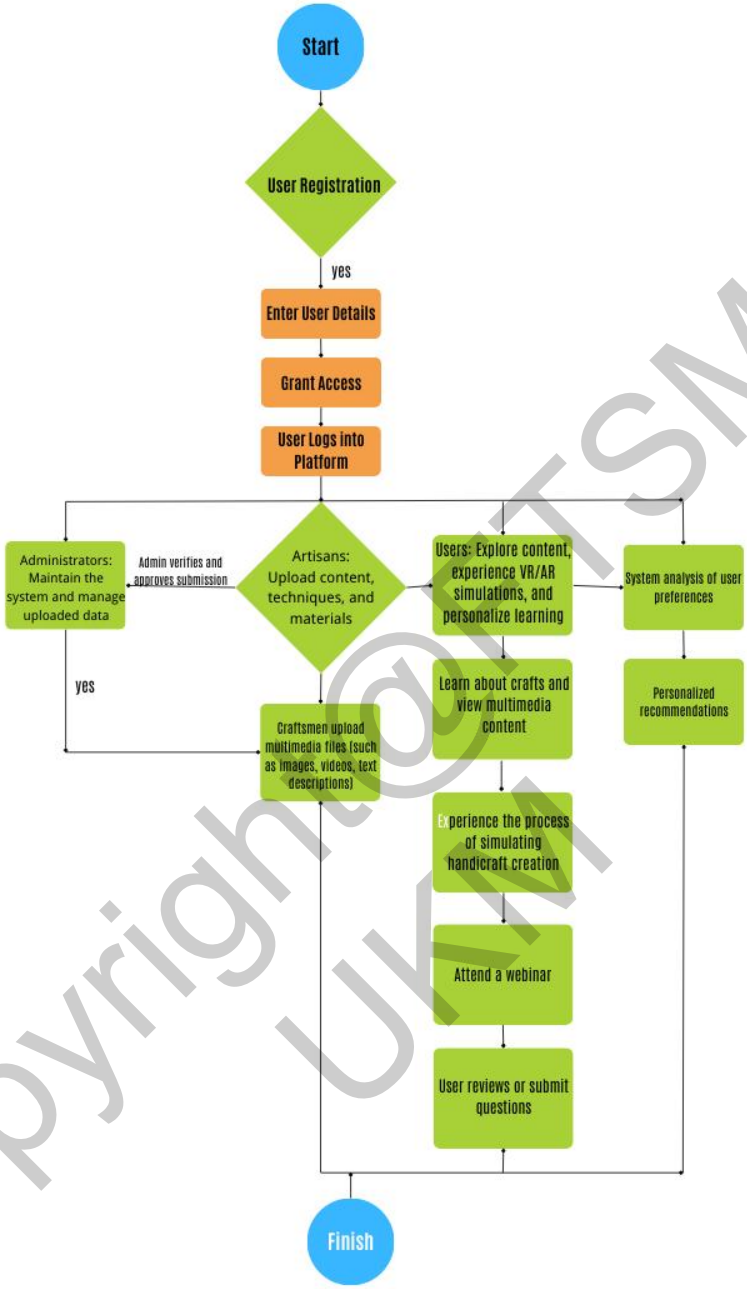
Timeline: Months 11–12

Activities:

Finalize the integration of all features and the complete archive of 50 traditional crafts, ensuring content is high-quality and well-organized.

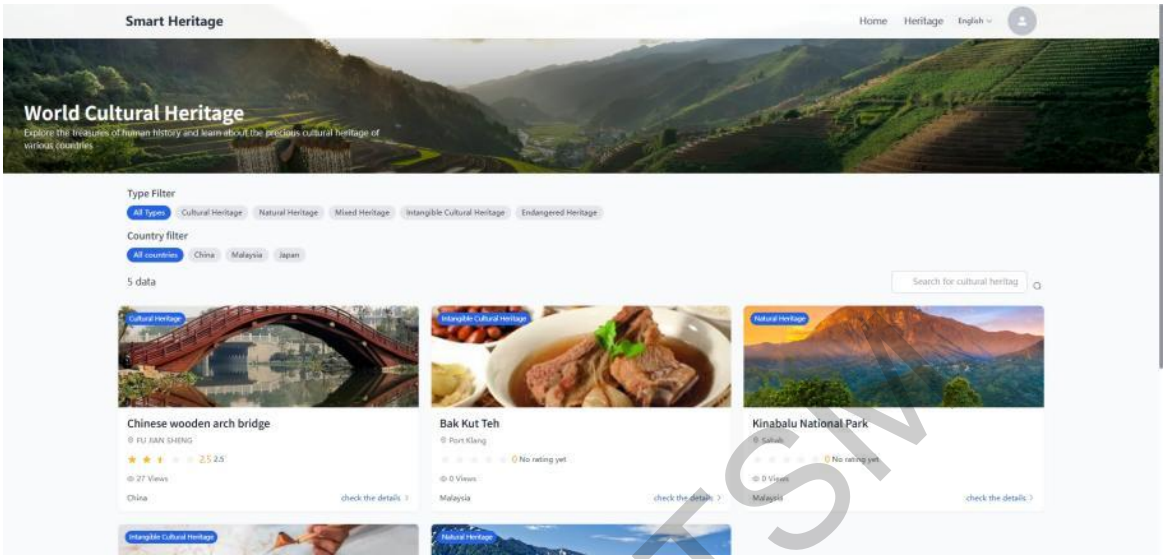
Prepare for platform launch, including final security checks, promotional outreach, and support infrastructure (e.g., helpdesk, FAQs).

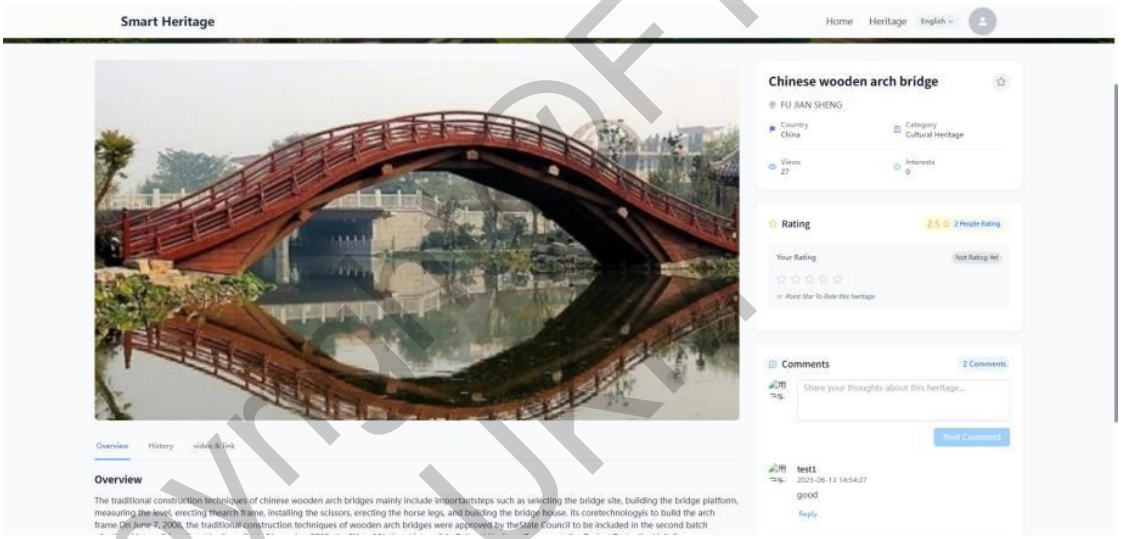
Initiate the launch phase, making the platform available to the public and encouraging sign-ups from the target audience.



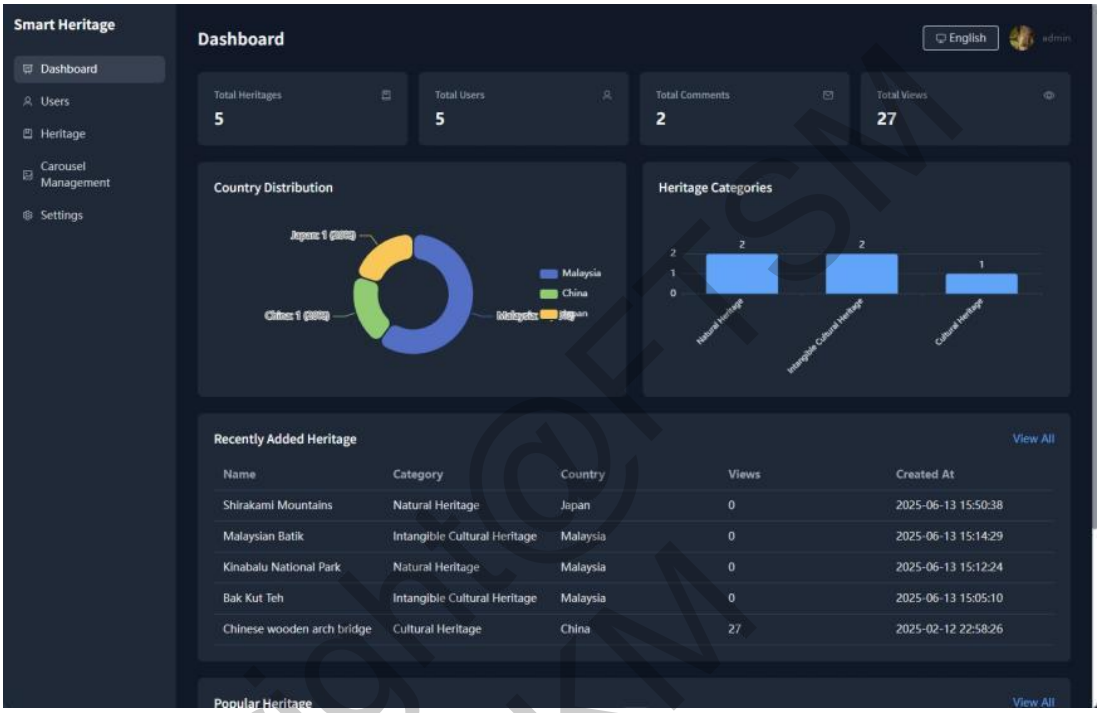
4.0 RESULTS

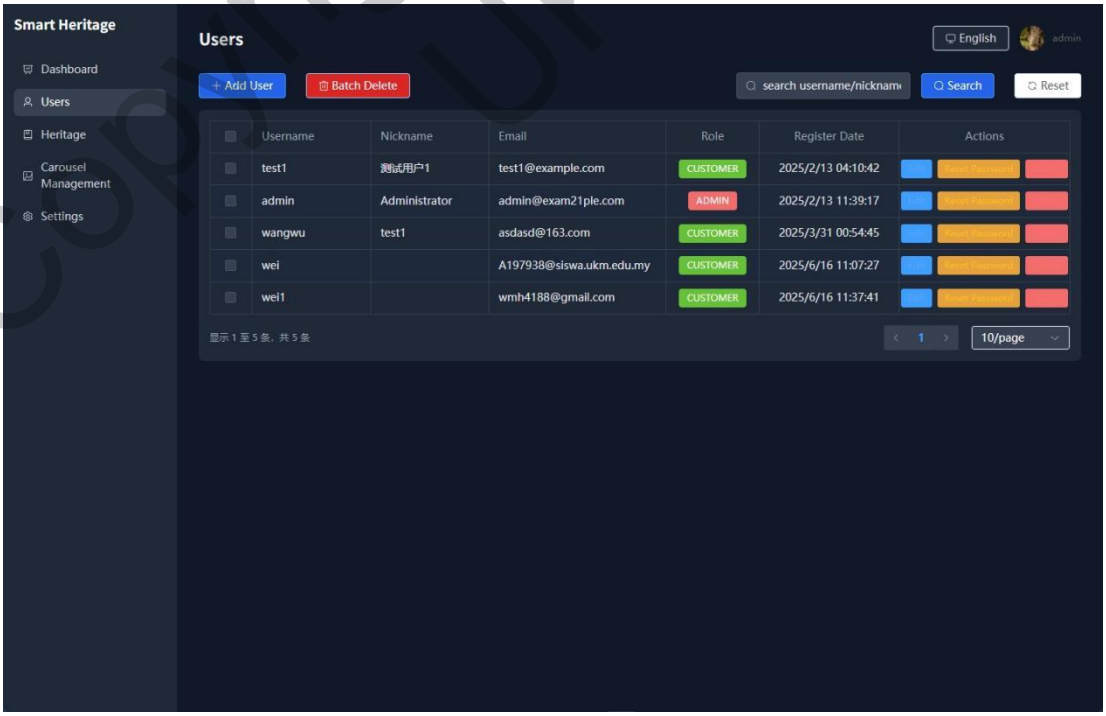
This is the main page of the system, where all relevant content is displayed. It features a bilingual design with a concise and attractive interface. By integrating pictures, videos, and related historical documents, it enables users to gain a more intuitive understanding of cultural heritage. Additionally, the ability to watch on-site intangible cultural production processes via video conferences further arouses users' interest.

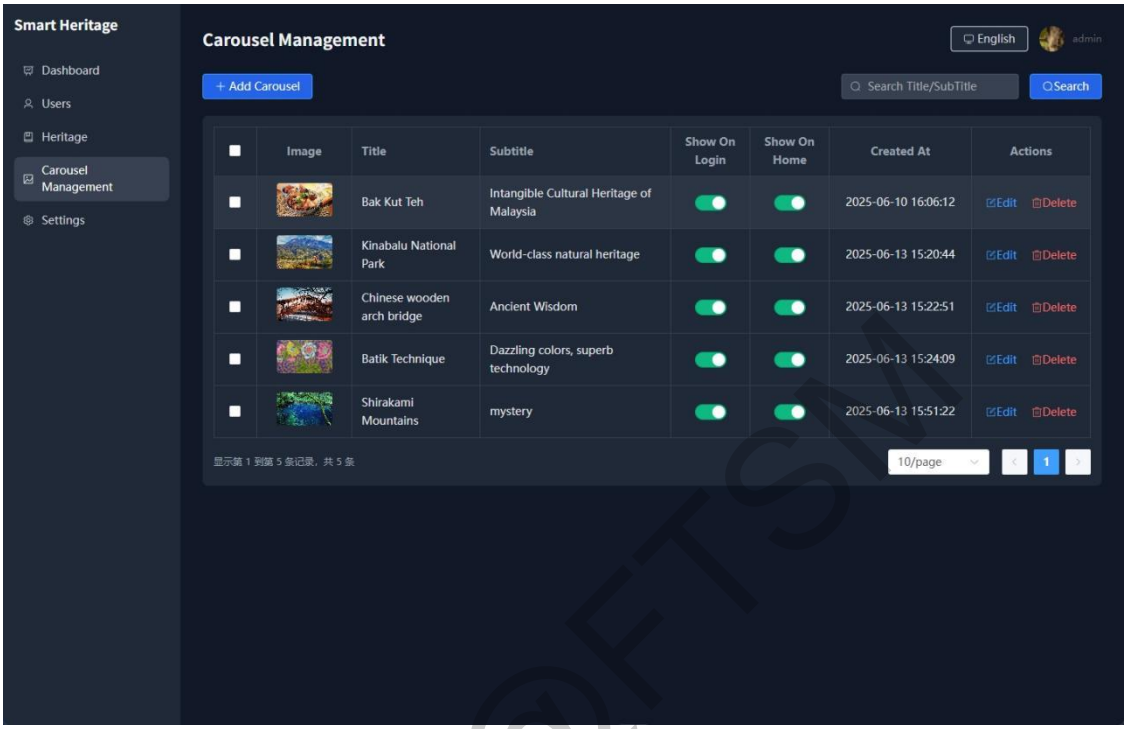




Dual-system management is implemented here, and this is the administrator system. Through this page, administrators can design and add content related to cultural heritage, as well as view all data information, including user registrations. They can also design and add carousel images on the homepage, update content regularly, and continuously expand and enrich the content. This allows users to learn more about cultural heritage and facilitate its dissemination.







5.0 CONCLUSION

In summary, the "Smart Heritage Project" proposes an innovative solution integrating digital technologies to address the threats faced by intangible cultural heritage (such as the craftsmanship of Chinese wooden arch bridge construction and Malaysian batik), including the impact of modernization, the aging of craftsmen, and the declining interest of the younger generation.

By building a comprehensive platform based on the Vue 3 front-end and Spring Boot back-end, the project integrates multimedia archives (videos, images, tutorials), VR/AR immersive experiences, and AI-driven personalized functions to realize the digital archiving, cross-cultural display, and interactive dissemination of traditional crafts. It adopts an incremental development model to advance in phases, ensuring the platform's scalability and cultural adaptability. Through black-box testing, its core values have been verified — the user-friendly interface and high-quality content significantly enhance user engagement, but issues such as slow mobile loading speed and ambiguous display of workshop time zones still need optimization.

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