

Virtual Reality Technology: An Essential Way of Remediation for Luoshan Shadow Puppet

Taotao Xu*, Musdi Shanat, Jian Chen, Bingqian Zhou, Qiu Jin Zhao

- ¹ Faculty of Applied and Creative Arts, Universiti Malaysia Sarawak (UNIMAS), Kota Samarahan, Sarawak, Malaysia
² Faculty of Economics and Business, Universiti Malaysia Sarawak (UNIMAS), Kota Samarahan, Sarawak, Malaysia
³ School of Fine Arts and Design, Xinyang College, Xinyang, China

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ABSTRACT

Virtual reality (VR) technology offers a promising avenue for enhancing the remediation of Luoshan shadow puppets, providing a richer and more immersive viewing experience, that supports the preservation of traditional cultural heritage and expands educational and promotional opportunities. This paper analyzes the remediation process of Luoshan shadow puppets through the lens of modern communication and innovative proposes a remediation strategy based on virtual reality technology (VR). This strategy leverages fundamental principles of computer image processing, using a simulation platform to simulate, digitize, visualize, and interpret this traditional shadow art form. The study explores a VR-driven approach to remediating Luoshan shadow puppets, assessing current communication, practices, analyzing remediation characteristics, and proposing a specific VR-based methods. The findings highlight significant challenges in the remediation process, noting the rarity of VR applications for Luoshan shadow puppets and facing obstacles such as technical complexity, cost considerations, cultural adaptation, and user acceptance. Despite these challenges, the study underscores the crucial role of VR technology in the remediation of Luoshan shadow puppets, facilitating innovative performance forms, enhancing interactivity, and enabling digital preservation and communication efforts. Ultimately, the research demonstrates that VR-based remediation methods can introduce new creative possibilities and innovative elements for folklore artists as well as designers who preserve and revitalise cultural heritage.

1. Introduction

Media convergence is increasingly pivotal in contemporary media practice due to the continuous evolution of new media technologies and the amalgamation of multiple media within the same contexts [1]. Remediation plays a crucial role in safeguarding and communicating intangible cultural heritage, particularly in light of rapid digital advancements. In the context of Luoshan shadow puppets, remediation involves transforming this traditional art form into a digital and networked

* Corresponding Author.
E-mail address: xutaotao@xmedus.cn

creative expression to align with modern communication methods and audience expectations. The goal of remediation is to fuse traditional art forms with modern media technology to enrich audience engagement, expand communication channels, and promote the continuity of traditional cultural practices. Through remediation, Luoshan shadow puppets can be comprehended, appreciated, and transmitted to a broader audience.

Digital heritage initiatives contribute to decision-making regarding the circulation of digital cultural assets, underscoring the complexity of heritage preservation in the digital era [2]. Remediation serves as an effective way to kindle interest in traditional arts, leveraging multi-sensory digital media to foster historical understanding and cultural appreciation [3]. The application of virtual reality (VR) technology in cultural heritage exhibits eight significant trends, encompassing 3D artifact reconstruction, digital heritage preservation, virtual museum creation, enhanced user experiences, educational enhancements, cultural tourism development, intangible cultural heritage preservation and dissemination, as well as augmented interaction and participation through gamification [4]. These trends not only enhance the presentation of cultural heritage, but also offer innovative solutions for its preservation and transmission.

It is crucial that "remediation" must be approached through developmental safeguarding, respecting the unique qualities of intangible cultural heritage while harnessing the potential of digital mediums [5]. VR technology facilitates immersive experiences where users can engage with Luoshan shadow puppet performances through virtual reality devices, enhancing their immersion in the narrative and aesthetic experience. Augmented reality and virtual environments further enhance interactivity and realism, surpassing traditional media's limitations [6]. New media, including social platforms and video-sharing networks, play pivotal roles in recording and disseminating performances, enabling broader audiences to access and appreciate Luoshan shadow puppetry.

Moreover, new media plays an essential role in the remediation and communication of Luoshan shadow puppets. New media technologies enable the modeling and performance of this art to be recorded and shared through creative channels such as the Internet. Folk artists can record their performances and share them via social media, video-sharing platforms, allowing more people to enjoy Luoshan shadow performances. This is because a synergistic storytelling effect embedded in a virtual reconstructed environment has a high audience appeal. A 360° video presented through virtual reality can further help to immerse a user in its application to safeguard Intangible Cultural Heritage (ICH) [7]. For example, headmounted (HMD) immersive VR technology suits digital exhibitions at ICH. It can reduce the limitations of time and space, realizing a complete virtual world within the system [8]. Digital mobile display technology, with its unique charm and solid competitive advantage, gradually changed traditional display habits. It utilises advanced mobile devices and interactive technologies to provide a more flexible and lively presentation, enabling viewers to access information and experience more personalised and immersive content anytime, anywhere. It has the potential to be a very useful tool for many applications and in various fields [9]. Virtual visualization and digital display technologies can enhance the artistic research value of intangible cultural heritage, meet all information age demands, and spread their spirit [10].

Although these studies have succeeded in highlighting the importance of using virtual reality technology in ICH, more specific and in-depth considerations are needed to explore how virtual reality can be utilized for the remediation of Luoshan shadow. In this sense, this paper explores the concept of Luoshan shadow remediation, focusing on how virtual reality technology is used in its remediation. This paper ultimately aims to suggest the potential utility of virtual reality in the remediation of Luoshan shadow and to encourage interdisciplinary research on this subject.

2. Process and Method of Remediation of Luoshan Shadow Based on Virtual Reality Technology

2.1 Process of Remediation of Luoshan Shadow Based on Virtual Reality Technology

The remediation of Luoshan shadow using virtual reality (VR) technology integrates its traditional artistry with modern innovations to offer users with a more immersive and diverse viewing experience, thereby promoting its traditional cultural heritage and development. Embedding traditional culture within a 3D virtual environment enhances its consumer appeal and educational value [11]. Users can engage with and appreciate the unique allure of Luoshan shadow performances in virtual space by recreating the theatrical scenes using three-dimensional technology. This approach faithfully reproduces shadow theatre's intricacies and dynamics and enables users to explore its historical context, cultural significance, and performing arts through interactive experiences. During the implementation phase of remediation, an experimental approach was adopted. Using Unity3D development tools, researchers digitally Luoshan shadow into a virtual imagery. Specific methods and processes are detailed as follows (Figure 1).

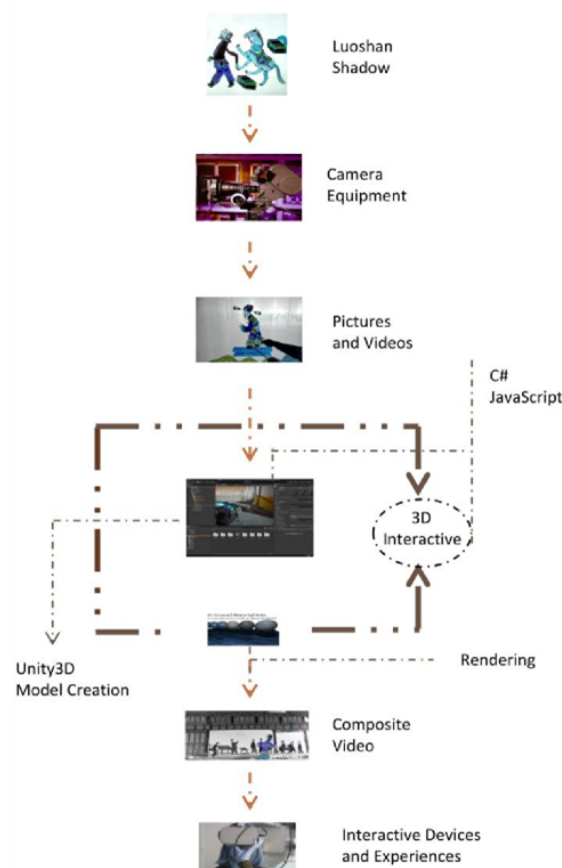


Fig. 1. The Path of Luoshan Shadow Remediation Through Virtual Reality

Firstly, digital equipment was utilized to gather information on the movements and structure of Luoshan shadow characters, which underwent initial processing and storage. This included collecting various materials such as movies, audio recordings, and images related to these shadow performances. For the preservation of intangible cultural heritage, like Luoshan shadow, diverse objects and instruments used in music or crafts were also gathered or reconstructed. Cameras were employed to collect a range of data types including images, video footage, text, audio recordings, and 3D models [12].

Researchers employed 3D reconstruction techniques to capture the intricate movements of the shadow figures accurately. The captured movement data were stored and recorded in real time using digital devices. These processed movement data in a database or cloud storage system, facilitating the subsequent creation of the relevant Luoshan shadow virtual space for Luoshan shadow. Additionally, the researcher used 3D modelling software was used to create models of characters, props, and other elements specific to Luoshan shadow, designed based on their actual appearance and characteristics of Luoshan shadow.

Next, all materials obtained from the shadow performances were compiled into a database. Image scanning equipment was used to generate raw image data files, ensuring comprehensive documentation of the shadow figures. The scanning process included denoising using image processing algorithms covering all components of the theatrical scenes. Simultaneously, data captured by the motion capture devices were categorized into identity, movement, node, and depth information, subsequently optimized and integrated into the shadow database. This database enabled users to search, browse, and comment on the collected data, supporting further data analysis and statistical purposes to advance and preserve Luoshan shadow remediation.

Finally, a virtual presentation of the Luoshan shadow play was realized. Researchers processed the collected character movement data to enhance the fidelity of traditional shadow movements, emphasizing gravity and authenticity. Employing skeletal animation technology, traditional shadow figures were transformed into three-dimensional models, and then programmed to control all aspects of their movements, thereby achieving a variety of complex and engaging motion movement effects [13]. Virtual reality devices, such as head-mounted displays and joysticks, enabled audiences to immerse themselves in virtual reality scenes and experience Luoshan shadow performances firsthand. The virtual reality experience was tailored with appropriate interfaces and optimizations specific to the devices used, enhancing user immersion and interaction.

2.2 Method of Remediation of Luoshan Shadow Based on Virtual Reality Technology

This paper utilized virtual reality (VR) technology as a technical tool to interactively present the essence and performance of Luoshan shadow puppets, exploring remediation methods through virtual reality technology. Following the methodology outlined in this study, the researchers developed a remediation design for traditional art form.

The researchers employed Unity3D's editor to construct a virtual reality environment simulating a Luoshan shadow puppet performance venue. This included designing elements typical of a real performance setting such as the stage, backdrop, and lighting. Materials gathered, such as videos, audio recordings, and 3D models, were imported and managed using Unity3D's managed using its Explorer feature [14]. The scene editor in Unity was utilized to configure the virtual reality environment for Luoshan shadow, incorporating backgrounds and positioning shadow characters accordingly.

Subsequently, Unity3D's animation editor was utilized to incorporate animation effects into the shadow puppet models. These animations were tailored to reflect the movement and performance characteristics specific to Luoshan shadow puppets. Additionally, scripts were written to govern the character movement and interaction. A segment of the code is presented below:

```
using System. Collection;  
using System. Collections. Generic;  
using UnityEngine;
```

```
public class Object Movement: Mono Behaviour
{
    private float move Speed = 1.0f;

    void Update()
    {
        // float horizontal = Input.GetAxis ("Horizontal");
        float vertical = Input.GetAxis("Vertical");

        // Vector3 movement = new Vector3(horizontal, 0, vertical);

        //movement = Camera.main.transform. Transform Direction (movement); movement.y = 0;

        //transform.position+=movement*Time.deltaTime * move Speed;

    }
}
//headTransform=UnityEngine.XR.XRNode CenterEye;
Rotation = UnityEngine.XR.InputTracking.GetLocal Rotation (headTransform);
}
```

In Unity3D, coding is done using C#, primarily responsible for defining scene logic and behaviour [15]. The following code defines the class for Luoshan shadow operations class, encompassing functions for object movement, movement speed, position, and head tracking. The head tracking code ensures accurate VR environment viewing by applying head rotation data.

Upon completing the coding, the researchers used Unity3D's Special Effects Editor to enhance scenes and characters with immersive effects. For instance, adding sound effects created a more realistic ambiance for shadow performances. Interactive features were subsequently integrated to allow users with shadow characters via touch, gestures, or controllers. For example, users could select a shadow figure and initiate actions or dialogue.

Finally, the virtual reality experience was tailored to specific VR devices like head-mounted displays (VR headsets) and joysticks, optimizing them according to device characteristics as well as requirements.

To validate the implementation, the researchers conducted a preliminary test of virtual reality technology, assessing the virtual environment design and operational processes. Two participants were invited to interact with virtual characters using VR controllers, evaluating touch, grasping, and movement operations. Results indicated that the participants through VR headsets, experienced a realistic shadow theatre stage, background, and props, feeling immersed in the virtual environment. These models exhibited realistic behaviors in a virtual reality environment, allowing the user to interact with accurate shadow figures [16]. The shadow figures exhibited lifelike behaviors, enhancing interaction and realism.

Virtual reality remediation of Luoshan shadow can bring this traditional art into the digital realm, offering near-authentic shadow theatre experiences with immersive stages, backgrounds, and props. It safeguards and promotes Luoshan shadow as a cultural heritage, enabling broader audiences to understand, experience, and appreciate its unique charm.

3. Results Analysis and Discussion

After the two participants completed their testing, the researchers gathered feedback on their experiences after using the virtual reality (VR) device, focusing on aspects such as visuals, interactivity, adaptability, and overall impression. Analyzing this feedback helps the research team identify any issues and ensure that VR technology better meets user expectations for Luoshan shadow.

Both participants expressed that they achieved high immersion and realism using the VR devices. They could clearly observe various details of the shadow figures and appreciated the realistic lighting and shadow effects. The researchers noted that both participants were attentive and highly engaged throughout the test, indicating that VR technology captivates and guides users effectively. Overall, the experience in the VR environment was significantly more engaging than traditional performances of Luoshan shadow puppet performances. The immersive and interactive advantages provided by VR technology yielded superior results in communicating of Luoshan shadow.

Previous studies have highlighted that audio-visual interaction is pivotal in how people engage with virtual reality devices. Reflecting on the outcomes of this practice and validating the VR-based remediation of Luoshan shadow, this research experience serves as a testament to its effectiveness in communication and preservation. The suitability of the adopted methodology and process for VR-based remediation is further discussed based on these results.

3.1 Virtual Reality Technology as a Medium for Remediation and Communication of Luoshan Shadow

The study's findings demonstrate that VR virtual visualization technology significantly enhances the high-definition digital mobile display of Luoshan shadow puppet theatre, enriching its artistic impact as well as visual experience. Digital mobile display technology has revolutionized traditional methods, offering greater opportunities and developmental prospects for showcasing intangible cultural heritage (ICH) in high-definition digital formats [17]. VR technology transports various elements and narratives of Luoshan shadow into diverse settings, fostering creative storytelling experiences and novel communication methods for audiences. Multimedia productions leveraging digital technologies for documenting, sharing, and revitalizing intangible heritage effectively promote and express local cultures [18].

In practical terms, integrating Luoshan shadow into a virtual reality (VR) environment involves several stages: 3D modeling, animation, scene design, program development and integration (Figure 2). This process necessitates close collaboration among virtual reality developers, artists, cultural custodians, and other stakeholders. It can be seen that VR technology offers a platform for learning and transmitting the production techniques, historical context, and cultural significance of Luoshan shadow. Audiences can utilize VR learning tools to engage in activities such as selecting and crafting shadow figures, while also gaining insights into its historical origins and cultural implications.

Comparatively, VR-based communication proves more effective than traditional performance methods in conveying traditional arts, addressing common challenges in digital communication efficacy. Therefore, this study advocates prioritizing immersive experiences, enhanced interaction and participation, education, and heritage preservation in the application of VR technology for remediating Luoshan shadow puppets. This approach aims to elevate audience engagement, enrich viewing experiences, and maximize communication impact.

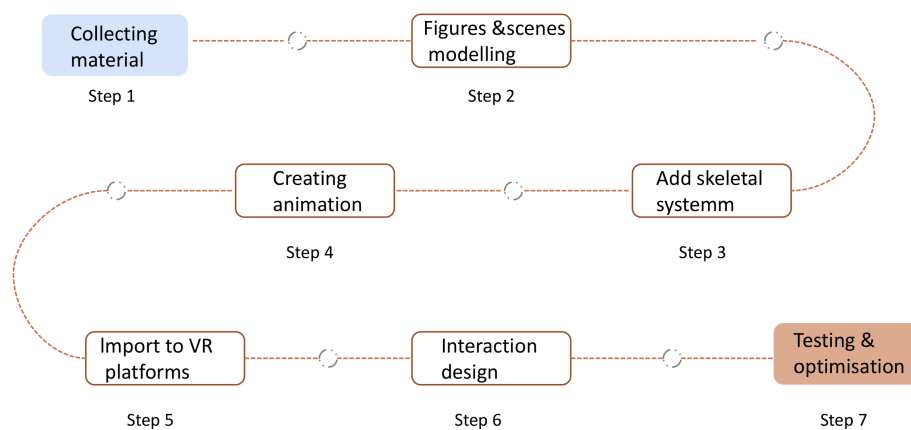


Fig. 2. Steps of Making Luoshan Shadow Virtual Reality

Folklore artists leveraging virtual reality (VR) technology as a medium for communicating Luoshan shadow effectively convey the essence of this traditional art. VR technology enables shadow figures to transcend traditional limitations, offering them more expressive and dynamic qualities that appeal to diverse viewers (Figure 3). This approach provides artists with an expanded platform to showcase their work and attract new audiences.

Through VR, audiences can engage with Luoshan shadow performances via the internet and digital platforms without physically attending a venue, using only virtual reality device. For instance, in a virtual shadow puppet-making module, users can follow a step-by-step process including drawing, carving, coloring, and assembling, with progress indicators for each stage. Once completed, these virtual puppets can be operated and performed on a virtual shadow puppet theatre, overcoming geographical constraints and facilitating the spread of this art to spread to a broader audience. VR technology bridges the gap in communication Luoshan shadow, Luoshan shadow, allowing its scenarios to be shared online or through apps, thereby enabling people can enjoy and experience this art on a larger scale. This innovative use of technology not only preserves the cultural heritage of Luoshan shadow, but also introduces new avenues for its transmission and development in contemporary society.



Fig. 3. Shadow Figure Structures Created Using Virtual Reality Technology

3.2 Virtual Reality Technology Can Enrich Users' Virtual Experience

Virtual reality (VR) is an immersive technology that offers users with a highly responsive and fully immersive experience [19]. The realistic reproduction of environments and interactive functionalities provided by VR technology enhance audience immersion and participation, enabling users to experience the artistic charm of Luoshan shadow puppets in a deeply engaging environment. Utilizing high-resolution VR headsets and advanced graphics processing technology enables the lifelike replication of Luoshan shadow puppets stages, characters, and backgrounds, including precise rendering of colors, textures, and lighting effects. In other words, VR technology facilitates a more realistic, interactive, and customizable experience of Luoshan shadow delivering a novel virtual encounter to users. Users not only receive information but also become active participants in information communication. Moreover, VR technology facilitates more direct and convenient information dissemination through platforms such as micro-blogging, We-Chat, short videos, and live broadcasting platforms [20]. It allows audiences to enter VR environments via VR devices to closely observe and interact with Luoshan shadow performances, fostering a heightened sense of immersion and realism. Audiences can watch and experience the three-dimensional effects, changes in light and shadow, and detailed character elements up close, enhancing their immersive viewing experience. For instance, users can interact with virtual characters through handles and gesture recognition, enabling actions like touching, grasping, moving, and more (Figure 4). This interactive engagement promotes audience participation and enriches the viewing experience, making it more dynamic and personalized.

Furthermore, VR technology empowers users to personalize and adjust settings according to their preferences and needs. They can select shadow characters, scenes, background music, and other elements to craft a virtual Luoshan shadow experience tailored to their liking. This customization allows audiences to delve deeper into and appreciate this traditional art form in a richer and more personalized manner, fostering a deeper understanding and connection.



Fig. 4. Luoshan Shadow Virtual Reality Experience

Researchers can utilize virtual reality (VR) technology to create diverse virtual stages and environments for Luoshan shadow puppets, enhancing their performances creatively. VR technology simulates the experience of attending a Luoshan shadow theatre performance by delivering a realistic visual and auditory experience [21]. It engages users through high-resolution displays, lifelike graphic rendering, and stereo audio-visual effects. This immersive visual experience encompasses intricate shadow details, vibrant stage settings, and authentic lighting effects.

Moreover, VR technology allows users to freely move their heads and bodies within the virtual environment, enabling an interactive perspective. This freedom enhances the natural viewing experience of shadow performances, intensifying virtual scenarios' realism. The interactive capabilities of VR, such as adjusting viewpoints, selecting different stage elements, or interacting with virtual characters, enable users to actively participate in real-time virtual shadow puppet theatre scenes. In summary, these features of VR technology provide users with a heightened sense of

immersion and realism in experiencing Luoshan shadow puppets, effectively transporting them into the heart of the performance scene.

3.3 Ethical Reflections on Applying Virtual Reality Technology to the Remediation of Luoshan Shadow

Designers must respect the subjectivity of the original culture and refrain from treating it as something that can be altered arbitrarily for the sake of a virtual experience. It is essential to uphold the authenticity and creativity inherent in traditional culture when employing virtual reality (VR) technology to remediate Luoshan shadow puppets. In other words, important traditional art forms and technological components are preserved while adopting new technologies. This approach ensures that tacit knowledge is effectively preserved and integrated into new technology contexts, thereby safeguarding traditional art forms and facilitating their potential for growth in modern environments.

Furthermore, in the creation of VR scenarios and characters, cultural accuracy and fidelity to the performances and narratives of Luoshan shadow must be prioritized. VR-based remediation of traditional art should align with its authentic performance style, visual aesthetics, and cultural context to avoid misrepresenting or distorting its cultural significance. VR technology should be viewed as an enabler rather than a replacement for traditional values and meanings associated with Luoshan shadow. While VR technology can introduce new artistic elements and innovations to Luoshan shadow puppets, it is crucial to strike a balance that respects traditional techniques and artistic integrity during innovation processes. This balanced approach ensures that the use of VR technology contributes positively without undermining the essence of traditional art forms [22]. Additionally, user privacy and data security are paramount when employing VR for remediation purposes. Safeguarding users' personal information and virtual experience reality data is essential to prevent breaches and uphold ethical standards.

Ethical reflection on the application of VR technology in Luoshan shadow puppets remediation is critical due to its implications for respecting and preserving intangible cultural heritage. The adoption of VR technology should be guided by principles of cultural respect and preservation ensuring that presentations are authentic and accurate and enhance public appreciation and respect for Luoshan shadow. It is imperative to uphold participants' rights to information and privacy to prevent any form of cultural misrepresentation or harm [23]. Ultimately, responsible development and deployment of VR technology should adhere to ethical and social responsibility standards, mitigating potential risks of cultural violations and ensuring a harmonious integration of technology with cultural values.

4. Conclusions

Virtual reality (VR) technology plays a pivotal role in digitally preserving and propagating the traditional art form of Luoshan shadow puppets, ensuring its continuity and accessibility to a wider audience. By leveraging VR, the boundaries of performance and skills associated with Luoshan shadow can be extended beyond geographical limitations, enabling more people globally to understand and appreciate this cultural heritage. Moreover, VR introduces new artistic dimensions and innovations to Luoshan shadow, merging traditional art with modern technological advancements to foster a richer and more diversified artistic expression. The interactive capabilities of VR technology enhance audience engagement through real-time special effects and immersive experiences, significantly enhancing the viewing experience and artistic possibilities [24]. Research findings underscore that VR-based remediation of Luoshan shadow achieves superior experiential effects and meets anticipated expectations, making VR a fitting choice for creating immersive displays

and interactive encounters with intangible cultural heritage, which provides better technical support for their remediation. Furthermore, VR facilitates the global promotion of Luoshan shadow via digital platforms and the internet, enabling audiences worldwide to engage with performances virtually, transcending geographical constraints and broadening cultural appreciation.

However, despite the successes observed in Luoshan shadow's VR-based remediation, several critical research areas remain to be addressed. Firstly, there is a pressing need to explore methods for accurately conveying cultural elements through VR while preserving their original essence and authenticity. Secondly, safeguarding cultural heritage and intellectual property rights associated with Luoshan shadow in the context of VR applications requires robust frameworks to prevent cultural misappropriation and misuse.

In conclusion, while VR technology presents promising avenues for the remediation of Luoshan shadow, its effective realization and sustainable development hinge on comprehensive technical, cultural, and legal considerations. Addressing these complexities will ensure that VR continues to serve as a powerful tool for preserving, promoting, and innovating upon traditional cultural forms like Luoshan shadow puppets.

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