



Research on Virtual Display of Characters in “Records of the Grand Historian” Based on Mobile AR Technology

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Abstract. Research the design method of mobile AR to display the culture of Records of the Historian and play a digital inheritance and protection role for the culture of Records of the Historian. Analyze the design principles of AR technology applied to the culture of Records of the Historian, take the highly famous character design as an example, and build the AR situation that is conducive to the learning of Records of the Historian through the 3D model of the character and the interactive design of the interface, combined with the Unity3D engine and Vuforia plug-in. Mobile AR display and virtual interaction enhance the learning interest of visitors, enhance the user's interactive experience, provide new ideas and technical support for traditional culture communication and education under the background of virtual and real interaction technology, and help the public to pay attention to and disseminate traditional history and culture.

Keywords: “Records of the Grand Historian” · mobile AR · Unity3D · Vuforia

1 Introduction

The Records of the Historian reflects historical events by recording characters' activities and has created many vivid characters [1]. These characters and deeds have become China's cultural heritage. In order to inherit the culture of Records of the Historian, it is necessary to protect and inherit it digitally. Mobile AR breaks through the limitation of space and time by overlaying the natural world and virtual environment. Applying mobile AR technology to the virtual display of the characters in the Records of History can help users better participate in and feel the connotation of the culture of the Records of History and gain entertainment and interactive experience. Research Status of AR Technology in Traditional Cultural Education.

2 Application Status of Mobile AR Technology in Traditional Culture

Augmented Reality (AR) is a technology that combines virtual and real-world environments, allowing data information to be presented more intuitively in reality [2]. Mobile AR is the application of AR technology on mobile devices and is a branch of AR technology. Mobile AR technology is mainly reflected in the application research of China's

cultural industry [3]. For example, the creation of mobile AR applications analyzes and summarizes the technical characteristics and creative methods and enhances the interactive experience of works through the augmented reality brought by AR technology, enriching the interactive expression of cultural display [4]; Using mobile AR technology to display cultural resources from multiple angles and angles [5]. AR technology can produce vivid and interesting interactive situational functions and a higher cultural transmission rate for Records of the Historian cultural display research.

3 The Design Principles of Mobile AR Technology Applied to “The Records of the Grand Historian”

3.1 Enhancing User Experience and Enriching Interactive Content

In this era of information diversity, users only have a preliminary understanding of traditional cultural heritage and soon lose interest in it. Therefore, users should have a more emotional experience with the mobile AR display for the first time. Then they need to simulate a more realistic scene with a more picturesque sense to bring users a sense of reality. The design and background music of the start page of the display should conform to the cultural atmosphere, create a specific atmosphere impression for users, and enrich their emotional experience.

3.2 Reducing User Operation Thresholds and Enriching Interaction Methods

Mobile AR has a simple human-computer interaction mode. Gestures, voice, and other operations allow users to interact with virtual information naturally. Display the initial guidance link in pictures, text, or video, bring users into the cultural scene, establish a preliminary understanding, set detailed novice guidance, and develop skip options for experienced users to jump. Use the way of combining pictures and text with voice and background music to set off the cultural atmosphere and guide users to gradually establish awareness of the culture before experiencing it. The gestures of the model should conform to the human body's activities under natural conditions, such as scaling, rotating, dragging, and dropping.

4 Design of Virtual Display of “The Records of the Grand Historian” Characters Based on Mobile AR Technology

This research will transform traditional cultural resources into interactive digital cultural content and overlay the character model of “Records of the Historian” into the actual scene by scanning the AR identification card.

4.1 Overall Framework

Unity 3D engine tools will be used for this study. Firstly, the designed three-dimensional character models will be imported into the scene, and the model size and display-related

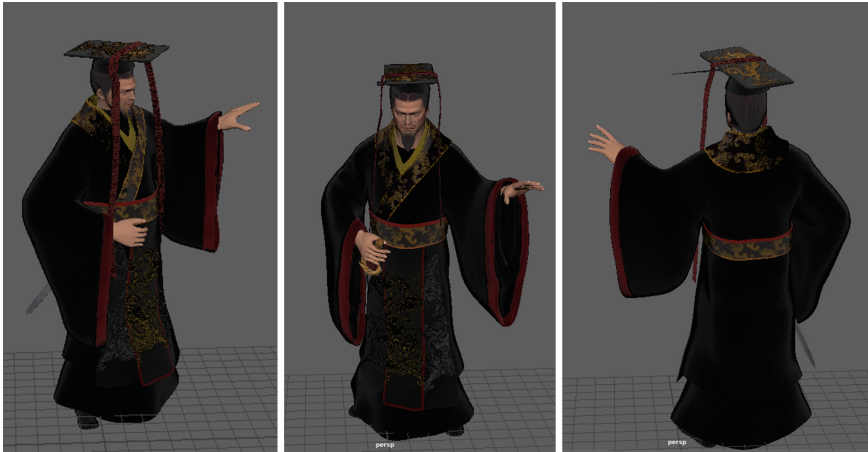


Fig. 1. Example of a Virtual Character Model. Source: Self-made.

scenes will be adjusted. Then, Vuforia engine technology will be applied to implement AR recognition scanning cards to display corresponding models, subtitles, introduction audio, and introduction videos. Finally, the program will be exported as an application package and run on the mobile device, with program inspection and debugging, and the application will be published.

4.2 Design of “The Records of the Grand Historian” Character Models

The character model needs to import into Unity3D in the later work, and the character 3D model is implemented by Maya modeling software.

This study selected the well-known figure in the “Records of the Historian” culture Qin Shi Huang [6], as an example of implementing three-dimensional character modeling. Because historical paintings cannot reflect the actual appearance of Qin Shi Huang in history, the characteristics of Qin Shi Huang’s character model are determined through user research, reference to historical sites, and the characters in movies and TV dramas. The texture and material should be as close as possible to the clothing of the Qin Dynasty at that time. Characterized by wearing a crown on the head, wearing a black crown under the jacket, hanging a sword on the side, etc. [7] highlighting the historical and cultural details of the ancient figure image and reflecting the simulation effect. The 3D model is shown in Fig. 1.

4.3 AR Recognition Card Design

The recognition cards needed for the “Records of the Grand Historian” AR virtual display scanning are mainly designed and produced using Photoshop and Adobe Illustrator software. The design process is as follows:

The design method of the AR virtual display scanning identification card of the characters in Historical Records is as follows (Fig. 2):

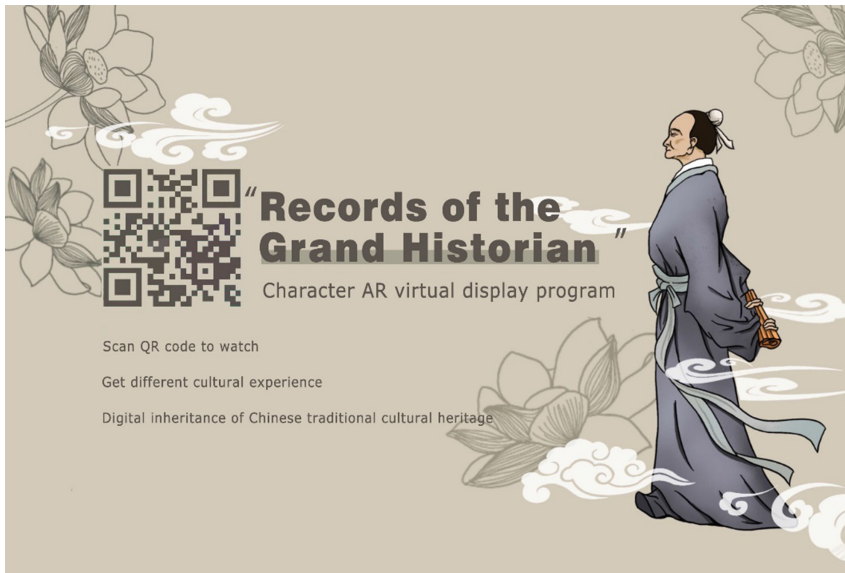


Fig. 2. Example of an AR scanning recognition card, source: self-drawn.

1) Survey design elements.

Collect the relevant documents and character image data of the Records of the Historian, and collect the image data that can represent the culture of the Records of the Historian as the design elements.

2) Establish the design idea and expression form.

With the image of Si Ma Qian as the critical point of the picture, it not only expresses the bookish spirit of ancient Chinese literati but also adds the lofty and broad-minded artistic conception of Si Ma Qian in his creation. Adopt the form of postcards to strengthen the commemorative significance and collection value.

3) Establish style and copywriting theme.

After understanding the traditional Chinese color, they all use the color of rice paper – fragrant leather [8] as the primary color, and the gray-white appears more primitive and natural. Select the word “Historical Records” in calligraphy and enlarge it to get a concise effect. The two sides of the picture are supplemented with cloud patterns and lotus patterns, symbolizing Si Ma Qian’s spiritual quality of moving out of the mud without being stained.

The Vuforia platform will evaluate according to the feature points of the recognition image. The higher the star rating, the more feature points of the recognition image, and the better the recognition effect. Figure 3 shows the star rating of the AR virtual display identification card of the characters in Historical Records.

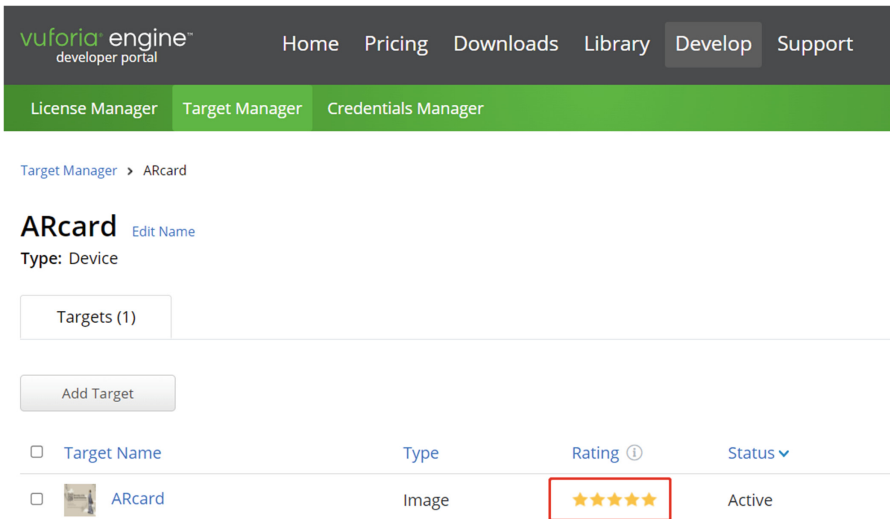


Fig. 3. Star rating evaluation of the AR recognition card uploaded on the Vuforia platform. Source: Screenshot from Vuforia 's official website.

5 Key Technology Analysis and Effect Display

5.1 Overall Framework

Vuforia is a development kit (SDK) for creating augmented reality applications, which enables mobile devices to recognize objects in reality through cameras and virtual overlay information [9]. The implementation steps of Vuforia are as follows:

Before AR project development, you must create a developer account on the Vuforia official website. Set up the built-in Vuforia component in Unity 3D, create the identification card, and download it to the project. The Vuforia engine will use this as a benchmark to identify the model. In addition, you need to create a UI interface to add virtual buttons, text, and pictures. Use Unity's script to write code, control the display and hiding of virtual information, and associate it with the recognized objects. Install the AR application on the mobile device and start the camera. The virtual information will be displayed on the screen when an object is identified.

5.2 Interaction Function Design

The cognitive interaction context helps users to generate positive emotions, such as pleasure, during the interactive process by its characteristic of "emotional and intellectual integration," enabling users to perceive and experience the learning content in the situation independently [10].

Based on the design principles summarized earlier, the interaction design of the AR virtual exhibition system of "Records of the Grand Historian" should focus on two significant issues [11]. From the perspective of human cognitive habits, users quickly lose interest in learning and cognition of traditional cultural heritage. Therefore, the design

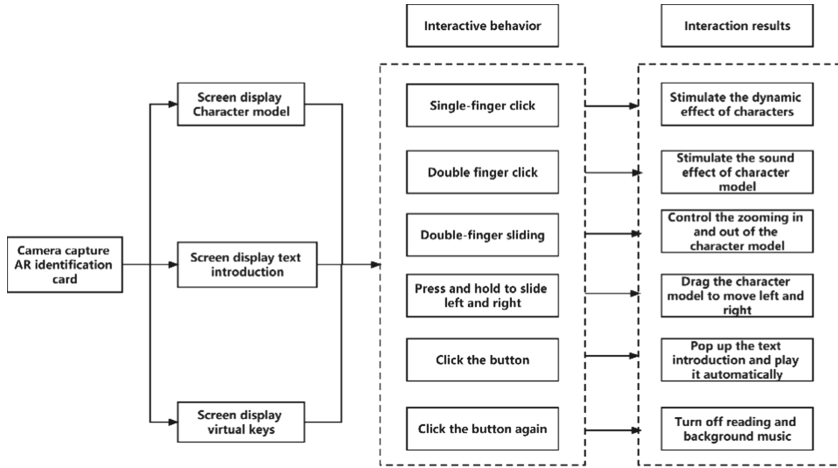


Fig. 4. Interaction behavior design. Source: Self-made.

should combine a specific cultural atmosphere, such as classical fonts and ancient-style background music. From the perspective of user behavior habits, the interactive mode should be simple and easy to understand. More complex functions that conform to human habits should be set, such as establishing a skip option to avoid excessive information and enlarging the effective area by clicking.

In summary, this design study proposes the following solution to construct the AR interactive situation, and the interactive behavior design can be seen in Fig. 4. Users can use touch operations to achieve the main functions such as clicking, scaling, rotating, and moving the model, and enrich the immersive experience by adding music, videos, and dynamic effects. Vuforia provides a virtual button function, which can achieve simple control and interaction by adding script components. In order to enhance the user experience, this design also includes the off-card process of AR recognition. The off-card function means that the model on the screen will not be hidden even when the AR recognition card disappears in the camera view, and users can continue with subsequent operations. Therefore, users do not need to keep their phones at the AR recognition card while using the program.

5.3 Application Effect

At this point, the mobile AR virtual exhibition system layout for the characters in “Records of the Grand Historian” has been roughly completed. After de-bugging on the computer, the AR program can be exported as an APK format and installed for testing on Android devices. After installing the program on the mobile device, users will see the homepage when opening the screen. By clicking the “Start” icon in order, the design instructions for this design step will be displayed with voiceover and background music (Fig. 5). Users can scan and recognize the QR code on the AR recognition card with the camera, obtain the virtual information of the characters in "Records of the Grand Historian" on the mobile end, and interact with the virtual characters in real time on the



Fig. 5. Interface design of the AR virtual exhibition for the characters in “Records of the Grand Historian.” Source: Self-designed.

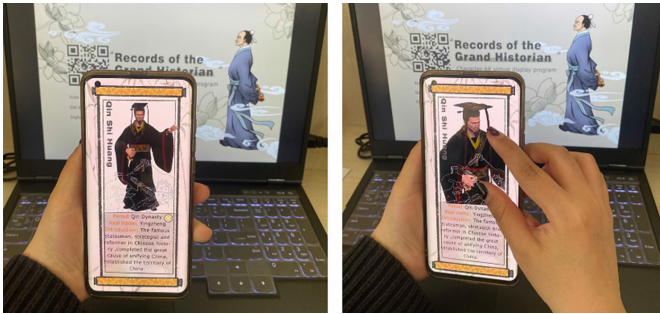


Fig. 6. Application scenarios for model enlargement and reduction. Source: Self-taken.

phone screen. The interactive effect of the virtual display program of the characters in Historical Records is shown in Fig. 6.

6 Conclusion

This design study designed a virtual display system of “Records of the Historian” based on mobile AR technology using Unity 3D and Vuforia plug-ins. The advantages of mobile AR applied to traditional cultural heritage, such as convenience, visualization, and interactivity. Have brought new development to artistic display and dissemination, transforming traditional single experience into a multi-dimensional experience. Helping users better understand and learn culture with novel and unique interactive experiences and realizing the purpose of digital inheritance.

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