



Research On the Integration of Virtual Reality with Chinese Cultural Heritage and Traditional Art: A Focus on Virtual Simulation

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Abstract: This type of folk art has been around for a long time in China. We need to accept and protect this one-of-a-kind, hidden form of traditional culture work that uses virtual reality. This study brings together the digital tools of glove theatre to meet the needs of people who want to act. A cloud-based virtual reality glove theatre that more than one person can use was made for this study. In general, it makes hand puppets work better. Everyone can use the virtual world from afar and see it in their own way. People and computers are both used in this way to send and receive data. It also explains how glove toys are made and how to play with them. Virtual reality is a cool new way to have fun for everyone. Someone asked thirty people who played this game how it works and how they felt about it. The study found that the suggested cloud-based VR system is not only simple to use, but it also helps pass on traditions that people can't see or touch. Our work can be used a lot in schools and can also help glove toys stay important. The cloud-based virtual reality method we use gives us a new way to share and protect cultural material that isn't easy to see.

Keywords: Intangible Cultural Heritage; Glove Puppetry; Virtual Reality; Human-Computer Interaction; Cloud Network

1. Introduction

Virtual reality (VR) and augmented reality (AR) are two technologies that could be very useful for museums and other places that preserve cultural artefacts. More and more, museums [1, 2, 3, 4, 5, 6], art galleries [7], cultural heritage sites [8, 9, 10], and urban heritage sites [11, 12] are using them to improve the experience of tourists. Most of the time, VR/AR is used in these areas for business, then for training, and finally to make the tourist experience better [13]. There are several ways that visitors can gain from using VR and AR in these places. Some of the things they learn are better understanding and knowledge, skills, and imagination. They are also usually happy with the experience and feel good feelings like pleasure and happiness [1].

1.1 Tasks That Museums Do to Teach

Museums' main goals are to teach, which is good for society's growth, and to gather and keep cultural items safe [14]. According to the International Council of Museums (ICOM) [15], museums "operate and communicate ethically, professionally, and with the participation of communities, offering a wide range of experiences for learning, enjoyment, reflection, and sharing of knowledge." The description makes this focus on teaching stand out.

Visitors can have an involved virtual experience with both VR and AR, which can help them learn more during their museum stay. These tools can be used to get to artefacts that aren't in the museum or to give more information



and details about ones that are [16]. These technologies can also be used to give people access to places or things that are normally locked down or not available [17].

1.2 Museums That Use VR To Teach Visitors

One use of VR is to put people in a computer-made world where they can interact with it right now [18]. Because of how it's done, users can't picture the real world while they're in the experience.

There are many times when VR technology can be useful. School is one of the most important goals for this study. There are lots of great ways to use virtual worlds to teach and make learning more fun [19]. There is rising interest in using VR in schools because it seems to help students learn when they are immersed and present in virtual worlds [20]. But the technology isn't really used in school yet, and it isn't something that happens all the time in the classroom. Most of the research that has been done on its use in higher education so far has been done in controlled situations as part of an experiment [21].

VR can be used to teach in the same way that it can be used in museums. VR can sometimes take you to parts of the museum that are hard to get to, especially for older people or people with disabilities. This method was used in the deep pits of the Geevor Tin Mine Museum [22].

1.3 Experiences In Museums That Use AR To Teach

With AR, you can add fake things to real scenes in real time [23]. With this one, you can see parts of the real world while you're in the experience. AR doesn't change what's going on around you like VR does. Instead, it adds to truth by adding extra data that is built into the 3D real world. Additions to the real world can be made possible by technology in this case. These can be anything from written accounts of shows to pictures, 3D models, or videos [24].

Most augmented reality experiences use movable devices like smartphones or tablets. When you put the app on these devices, the 3D content shows up on top of the real world on the screen. Because so many people have smartphones, it's possible to get more people to visit AR sites and make the experience unique for each guest [25]. As it turns out, mobile gadgets like smartphones and computers are the ones most often used in museums [26]. AR head-mounted screens, like the Hololens (Microsoft, Redmond, DC, USA), have been used in some situations to make them more realistic [27].

1.4 Museums at Universities

It's even more important to learn at university museums than at other types of museums because they are part of schools and universities. This is because educational libraries are part of places where people go to learn and study. Young people in high school and college can learn about museums through universities. They picked out the books in their libraries with care so that they would help students learn more about certain subjects [28].

In its report, the University Museums and Materials Committee (UMAC), which is part of the International Council of Museums (ICOM), made it clear how important digital and new technologies are for making museum materials easier for more people to get to. In some university museums, like the one at Roma Tre University that has a show on Tito Rossini all the time [29], AR was already being used. A group of 14 students who used an Android web app to test the system gave it a good total score. But not much research has been done on how to use VR/AR tools in college museums yet, and the little that has been done is mostly about art shows. It hasn't been studied before how technology can be used to help people learn more about the different kinds of museum objects and things.

1.5 Goals

The goal of this study is to find out if VR and AR can be used to make learning more fun at university museums of technological history. Two things about these places make them special. A lot of the time, you can't break these things to show how they work. It is possible to show more about how the objects were used, though, through



pictures, films, and models made possible by VR/AR technology. There is a lot of hope that VR/AR technology can help people learn better and keep artefacts safe.

2. Background Work

This part talks about the basics of using games to learn about cultural history and VR as a medium. It also shows how VR games can be used to learn about the subject and gives examples of games that are useful.

2.1 Games as A Way to Learn About Cultural Heritage

Digital games and video games are both kinds of games that use computers [30]. People play audio video games with stories that are either based on real events or on characters from fantasy worlds. When people write about digital games [30, 31], they mostly talk about the game itself, its story, how people connect with it, and how they play it. You can also call them "serious games," and a lot of people think they are fun ways to learn about other cultures. In Cultural Heritage, gaming techniques are used to turn dull information into a fun game. By adding game-like features and strategies to things that aren't really games, you can "gamify" them [32].

2.2 VR As a Way to Show Cultural Heritage

Most important things about VR is that glasses block out all other vision, making the user feel like they are somewhere else. When playing games, virtual reality (VR) replaces the real world and takes the player to other places where being there isn't important. Because of these features, VR games about cultural heritage can go to a lot of different places, real or imagined, in time and space, and let the player experience things from different times in history or even the future. When you deal with VR, you have to deal with immersion, which is the feeling of being a part of the virtual world. Immersion can be found in other forms as well, like books and movies, but in VR it can be more than just mental. It could also be physical. In this case, it feels like you're really in the virtual world, though this depends on how good the VR setting is and how it's set up [33].

Because they use the real world, AR games for cultural goods might be easier to make than VR games. This is because VR games have to create whole worlds. Also, for AR, you might only need a smartphone, but for VR, you need a headset [34].

2.3 Learning Experiences with VR Games

Most people now agree that games can greatly improve learning about cultural history because they keep people interested and motivated [35]. Researchers have looked at different aspects of VR games that can help them be better learning tools for various groups of people, such as those of different genders [35]. With VR, people who are just visiting can become involved learners. Virtual reality (VR) doesn't take away from the value of real things; in fact, it can help people understand them better because it lets them interact with and change them [36]. It goes into more detail about how important games and "gamification" are to cultural history by looking at current trends.

Learning is something that can be done alone or with other people. The important results of this study went into the Mixed Reality Museum Co-Visit Theory, which encourages people to work together in cultural heritage settings and improves learning [37].

3. Design For Glove Puppetry

A show, a hand goes into the glove puppet outfit. In the puppet show, the frontcourt is also the stage for the theatre. The way glove puppet stages are made has changed over time, just like people's ideals and habits have. People usually saw puppet shows in churches, town parks, and markets. In the early days of puppets, there wasn't a set stage. There is a small stage that can be used for shows. During the Qing Dynasty, someone came up with the "four-corner shed," a portable puppet stage. Later, the form of the stage was changed to a bright hexagonal shed.

3.1 Stage Design

The Seden Puppet Theatre Foundation's stage gave us ideas for our own (Figure 1a,b). This triangular shed looks like a temple because it is covered in fancy gold leaf and maps that are painted very precisely. There are three parts to the stage: the top cover, the base, and the screen column. The roof is the top cover, which is held up by dragon-shaped poles. Window frames are in the base. Two floors make up the stage. Each floor has three doors and three windows. The name of the school is beautifully etched on a plate that is set into the upper floor.



Figure 1: Seden has a puppet show. a) The puppet theatre in Seden. b) More about the puppet theatre in Seden.

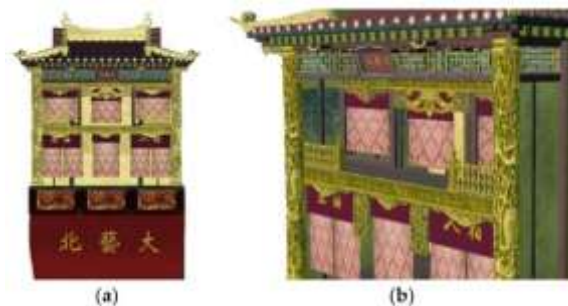


Figure 2: Getting ready for a VR puppet show in the cloud. We came up with the idea for the stage. (b) More information about the stage idea.

3.2 Glove Puppet Design

There are different types of glove puppet figures, such as the main character (man or female), the painted face, the clown, the child, the beast, and others. Heroic figures often have striking traits, like high foreheads and a royal look. Bad guys usually have thick eyebrows, eyes that are set far apart, cheeks that stand out, and big lips. A man lead and a painting face can be seen in Figure 3. Male heroes are often very good-looking and interesting. Different character traits are shown by their colours and face emotions, such as loyalty, betrayal, kindness, clown, evil, and so on.



Figure 3: Design For Glove Puppets. (A) Main Character Is a Man. Faces That Were Painted.

3.3 Putting on Clothes

A puppet shows to work, it's important to make the glove puppet move better by simulating the dynamic movements of clothes. Every finger on the hand can move the doll. A Leap Motion device records the puppeteer's movements and sends them to the puppet's hands and head.

Realistic movement was simulated with the help of the dynamic joints. Figure 4 shows the arrangement of the skeleton and the chains that move the joints. Joint bands that move can move the hands. The joints let two stiff things that are linked move and rotate. The puppeteer can now move their hands to make the outfit swing up and down.



Figure 4: Glove Puppet Skeleton with Dynamic Joint Chain.

4. Virtual Reality System That Runs in The Cloud

This study builds a joint virtual reality system in the cloud for glove dolls. To protect cultural property that can't be seen, the system will be used to put on a live show in real time. Our VR system in the cloud is based on Unity. Adding 3D data to an HTC Vive head-mounted display is possible when you connect a Leap Motion mouse to it. Other changes we made were to improve core technologies and add features that let more than one person use the system at the same time. The puppeteers can see each other and how their models are moving so they can act out how the virtual object moves.

The Leap Motion devices send data to our system, which sends it through the VR peripheral network. In Figure 5, you can see how the VR glove puppeteer device is put together. It is the job of the network translation component to change data over a network. Here's how the process works:

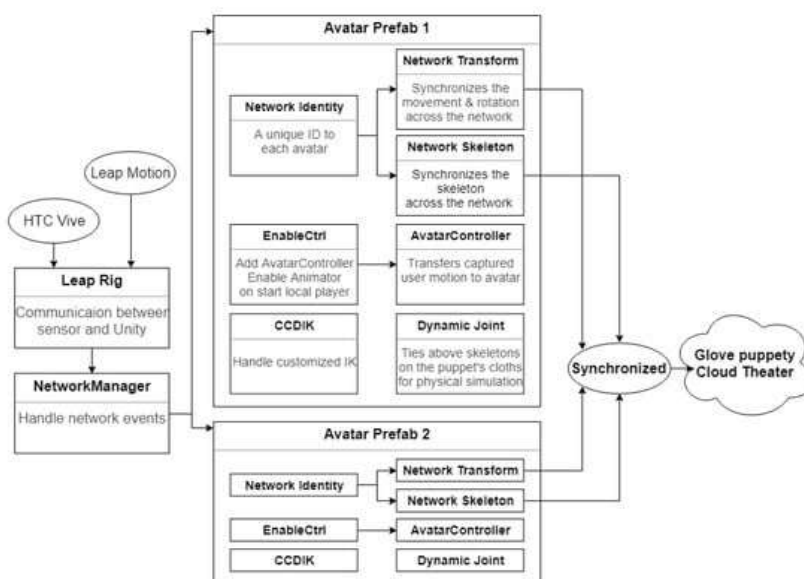


Figure 5: VR Glove Puppetry System Architecture.

They are Users A and B. They go to the system and log in. Sensors gather data about people who are physically present. For example, the HTC Vive VR headset and the Leap Motion controller both keep track of where and how the user moves. Things from the camera are sent to Unity by the Leap Rig.

To handle things that happen on the network, a network manager is made.

- Puppet avatars: When a glove puppet character is put together, three jobs are created: "Network Identity," "Enable Ctrl," and "CCDIK." Each character is given a unique ID by Network Identity. Adding "Avatar Controller" with Ctrl on turns on movement when the native player starts up. Inverse kinematics for custom models is taken care of by CCDIK (Cyclic Coordinate Descent Inverse Kinematics).
- The avatar device sends the user's movements to the image. To make the animation feel more real, the hand bones on the avatar's clothes are joined together with dynamic joints.
- Network morph and network skeleton: The client can't talk to the server directly in the Unity network design. The computer is the only one who can sync things up. The network transform makes sure that a player's hands and head move and turn at the same time. Each puppet's skeleton data is kept in sync by the network skeleton.

To talk to other people in the virtual world, people need to know what the other person thinks and has been through.

5. Results

5.1 Setting Up a Virtual Model of The Fuliang Red Pagoda

Once the old pagoda has been modelled, the architectural features can be made bigger or smaller indefinitely. This makes it easy to see the shape of the building. Figure 6 shows that this process has also been able to bring back the old pagoda's structure and shape.



Figure 6: The State of The Building and The Computer Copy Are Compared.

5.2 Show of Fuliang Red Pagoda's VR Effect

As seen in Figure 7, the 3D model of the house is shown on the computer as a VR mode. In the virtual reality (VR) world, you can see real-time information about the building from different angles and directions. You can also browse and interact with it in a way that makes sense and makes it easy to see how flat the building is overall. The VR world can be used online. With the help of other interactive programmes, more operation methods can be created, such as separating, moving, and joining building parts. This can effectively restore the Fuliang Red Pagoda's structural characteristics and texture information, reduce the amount of damage that remains, and make digital protection of ancient architectural heritage possible.



Figure 7: In VR, This Is How the Red Pagoda Looks.

6. Conclusions

The goal of this study is to find ways that VR technology can be used to help protect historic buildings. The Fuliang Red Pagoda in Jingdezhen, Jiangxi Province, is used as an example of an old building to study and go into more depth about how VR technology can be used to protect this property. This is achieved by gathering data, examining it, and processing it. The Fuliang Red Pagoda is also modelled in three dimensions and shown in virtual reality. The results of the study show that VR technology is a great way to protect old buildings. It can faithfully duplicate features and add other performance effects. It can also do a lot of digital repair and restoration work without changing the shape of the building. It is now possible to digitally protect old architectural heritage. This also opens up new study areas and technical ways to protect architectural heritage.

A lot of people still don't use digital security for old buildings, and even the most mature and well-developed digital security methods have some flaws. But the tools and scanner techniques that were used in the study are still not good enough. One technology choice that needs to be looked into and tried is professional photography drones. Another is software that can get information about design points. What's next in the study? This is the next step to keep looking into the direction of the research and study.

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