RESEARCH ON THE APPLICATION OF VIRTUAL REALITY INTERGENERATIONAL GAMES TO TRADITIONAL GLOVE PUPPETRY CULTURE

Ya-Fang Chen, Wen-Huei Chou and Yi-Chun Li
National Yunlin University of Science and Technology, Taiwan

ABSTRACT
Appropriate intergenerational programs can effectively remove communication barriers between generations. The application of the latest technology can introduce traditional cultural elements, and the cultural spirit of the older generation can be passed on to the next generations. Moreover, with the help of young people, the elderly can get on track with the latest technology, while young people can pass on the cultural memory and knowledge of the elderly. In addition, with the vigorous development and advancement of science and technology, the existing traditional culture has been buried under latest technologies when undergoing changes and evolutions through different generations. Therefore, severe cultural differences and estrangements between different generations arise. In order to pass on the traditional cultures that are about to be lost, the connection and exchange of emotions and history should be emphasized. Traditional glove puppetry is taken as the pillar of the game proposed in this study, while “The Legend of the White Snake,” one of the China’s four major folk stories, is considered as its theme. The historical and cultural knowledge of the elderly become the guiding indicators in the game, allowing the elderly to gain sufficient self-confidence and increase their curiosity in learning modern technology through game interactions. Furthermore, young generations can acquire relevant cultural knowledge of glove puppetry. In the past, the development of virtual reality games did not consider and value the needs of intergenerational communication. If the evaluations and designs of intergenerational programs can be made based on such needs, it is believed it would benefit the elderly and young people in the evolution of generations. This research applies traditional culture to virtual reality and plan an intergenerational game that can be played by two people, promote cultural experience between generations, and make the two sides have an emotional connection with each other’s cultural background.

KEYWORDS
Traditional Culture, Virtual Reality, Intergenerational Games, Intergenerational Communication, Glove Puppetry

1. INTRODUCTION
Taiwan has witnessed changes in its family structures. The research report of the National Development Council, “Family Structure Development Projection of Our Country” (National Development Council, 2017) predicted that the number of households will increase in the future, but the average family size will decrease. Family structures changes including couple family, solitaire, single parent family, or skipped-generation family will grow significantly, and the changes also decrease the intergenerational bond of the elderly and young. The prevention of mental health problems of the elderly is an important global issue; however, if the solution to the problem is developed in a mature way, it may generate great economic and health benefits (Leggett & Zarit, 2014). Well-designed digital media technology can enhance the positive psychological development of the elderly, but the problems of digital divide linger.

At time when exquisiteness is pursued in most aspects, puppets with the traditional features of glove puppetry fail to attract the attention of the present generation. In order to pass on the legacies of traditional culture, many declining traditional skills have brought the young generations closer to our country’s cultural history through the application and dissemination power of the latest technology.

The technological development of virtual reality (VR) has matured in recent years, and it has now been applied to many academic disciplines such as medicine and entertainment. Through the application of sensors and multidimensional scenes as well as visual processing and control of sound distances, users can immerse themselves in a view, as if they were actually in the scene. One of the major purposes of integrating VR and
the traditional cultural industries is to preserve cultural heritage. VR has long played an important role in the historical relationship between humans and images (Tseng, 2018). Ji Fang, consultant of the China Ethnic Cultural Relics Protection Association, believes that with the combination of VR technology and the protection of cultural heritage as well as large-scale display methods of cultural relics and cultural heritage that are highly precise, highly interactive, and cover wide audiences can be materialized. Such methods include digital preservation, virtual restoration, publicity and display, virtual walkthroughs, and digital museums, and they can solve the traditional problems in the protection of cultural heritage (Chan et al., 2016).

This research has the following purposes:
1. To reproduce the traditional glove puppetry (Yetai drama) from the 1940s to the 1950s through VR. The interactive game, which mainly involves puppet manipulation and performance, will encourage the young generations’ exposure to the culture of glove puppetry
2. To apply intergenerational programs to game design for the elderly and young generations
3. To increase the willingness of the elderly to learn new technologies through VR interactive games.

2. LITERATURE REVIEW

In this section, the traditional culture of glove puppetry is discussed to understand the historical background and principles of traditional culture. The second part involves digital games for the elderly as well as the restrictions. By clarifying the difficulties that the elderly may encounter in the application of technology, basic rules for making interactive games are formulated. The third part involves the application of digital games to intergenerational communication. The literature review uncovers appropriate intergenerational programs and the ways to apply these programs to interaction games, so that people of different generations can interact and communicate in the process.

2.1 Traditional Culture of Glove Puppetry

Traditional glove puppetry was a smash hit in the 1940s and 1950s. Apart from setting up a stage in the temple square and performing in the form of Yetai, glove puppetry has cultural significance that involves religious ceremonies such as the birth of gods, votive offerings, the Jiao rituals, and expressing gratitude for peace (Workshop for Taiwan Folk Culture, 2000). At the time, no scripts were written for the performance of ordinary folk theater troupes. A storyteller would describe the outlines, and the performance solely relied on the actors’ improvisation. The actors needed to have a wealth of stage experience to be competent in the performance of such “live dramas,” but such acting methods led to loosen plots and rough performance. “Yetai drama” means “open-air theater”: the performance of the drama is combined with temple ceremonies and become the sign of Taiwan’s traditional culture, while watching dramas at a temple entrance is a cultural memory in the 1940s to 1950s.

The earliest form of glove puppetry in Taiwan was inherited from China. However, with the development of Taiwanese thinking toward prosperity, glove puppetry evolved into an artistic image that carried unique Taiwanese folklore style against the local social, economic, cultural, and political background. Glove puppetry was introduced from the Fujian Province, China, and was divided into three genres: Nanguan (southern pipes), Baizi (local language) Opera, and ChaoTiao (Chaozhou Tunes) (Casca, 2019).

The characteristics of glove puppetry are mainly divided into: (1) Koubai (spoken script): The main elements to appreciate glove puppetry are Koubai and puppet manipulation. Usually, one person dubs the Koubai of all characters in a performance (Chiang, 1996). The focuses of the main characters’ Koubai include distinctive expressions of the five tones and clear enunciations, while the changes in the tones of the characters should allow the audience to understand their personal traits and distinguish between the protagonists and the antagonists. (2) Debut poetry: The debut poem highlights the personal traits of different characters, creating a unique atmosphere for the character’s debut. (3) Puppet manipulation: Traditional puppet manipulation starts from putting a hand into the pocket. The index finger controls the head while the thumb controls one hand, and the middle finger, ring finger, and little finger are brought together to control the puppet’s other hand. But when the puppets have to walk, the puppeteer will use the other hand to assist the movements. In addition to their physical performance, the characters’ happiness, anger, sorrow, and joy are expressed through various gestures. The professional skills of the puppeteers are simultaneously reflected in such operations. (4) Music: In order
to lift the atmosphere on stage, glove puppetry shows need to be set off by music. Traditional glove puppetry shows that originated in Quanzhou introduced Nanguan as background music, and when the show was brought to Taiwan, Nanguan music was also played. The main instruments of Nanguan music include pipa, dôngxiao, erxian, and sanxian, and its performance involves singing and playing the instrument along with the use of ancient Quanzhou accents to express rich emotions (Chen, 2004).

“The Legend of the White Snake,” which is the theme of the game, and is one of the four major Chinese folk stories. It is also called “Xu Xian and the White Lady.” The story was set in Hangzhou, Suzhou, and relevant regions during the Song Dynasty. And mainly spread by word of mouth in the early days, which was a model of collective creation of folk tales in China; therefore, different versions and details were also derived. However, in all of the versions, classic plotlines such as “borrowing an umbrella,” “stealing the miracle plant,” and “Leifeng Pagoda” prevailed. After Feng Menglong’s “Volume 28 of Stories to Caution the World, White Lady is Kept Forever under the Leifeng Pagoda” was published, it was recognized by scholars as a relatively complete version of “The Legend of the White Snake” as it retained the best original structure of the story (Chen, 2012).

The game developed in this research has two characteristics: Koubai and puppet manipulation. Furthermore, a debut poem is recited by a character as they first appear on stage. As the excerpt used in the game is the ending of “The Legend of the White Snake,” the element of debut poetry is not included in the game content. Regarding the music, professional orchestras are crucial to the restoration of the corresponding plot music. Therefore, the game uses the basic music of glove puppetry, which is applied according to the ups and downs of the plot.

2.2 Digital Games for the Elderly as Well as the Restrictions

As VR technology matures, through proper design can allow users to have comfortable technological experiences. In contrast, VR games may also lead to problems such as dizziness, headaches, nausea, and uncomfortable feelings. Furthermore, as physiological functions deteriorate and the lack of familiarity with technological equipment may frustrate the elderly as they fail to control the system, especially when the long-term use of VR brings about visual fatigue (such as when watching a 3D movie), they may suffer from visual discomfort or asthenopia (Aznar-Casanova et al., 2017), loss of spatial consciousness, dizziness, disorientation, epilepsy, or nausea. Ali et al. (2015) suggest that, compared with users who watch the games, VR users are more likely to have a higher heart rate and signs of dizziness and vomiting. The negative effects of VR have gradually gained public attention.

Visual decline is a common phenomenon in the elderly, and the font size and changes in the games’ windows will affect their degree of comfort when playing the game. It is not appropriate to design the game with excessively complicated and difficult content; rather, the design should be easy to understand and elderly-friendly. First, in consideration of the actions’ restrictions and countereffects (such as nausea), as well as the issues of sense of existence, navigation, and synchronous interaction in the immersive environment, the time of conversation should be reduced, and the intensity and agility of the actions should be changed (Paliokas et al., 2010), while the degree of comfort of visual perception should be adjusted (Iachini et al., 2009). Second, the elderly enjoy new experiences but feel more comfortable in a known or familiar environment; thus, the interface design requirements must be specially designed considering age-related cognitive changes, process of attention, working memory, and search methods (Dionisio & Gilbert, 2013; Segkouli et al., 2015). Third, the elderly do not know much about digital games and fear the complexity of installing and playing games (Mahmud et al., 2010); therefore, when no one leads them, they may struggle to play games. Fourth, 3D environmental audio effects that can stimulate immersive feelings (Silva et al., 2019) and other factors can have equal opportunities for development, in order to produce greater application benefits in ensuring the needs of the elderly, which were ignored in the previous development and application processes of VR.

2.3 Applying Digital Games to Intergenerational Communication

Intergenerational communication refers to communication between different generations. Human beings are horizontally interconnected and interdependent in the intergenerational chain. Many important emotional and historical connections have been made in the lives of our different generations (Viswanathan et al., 2000; Kaplan et al., 2017). Intergenerational communication shows the degree of interaction and dialogue between
the elderly and young people. It focuses on all levels of intergenerational communication and relationships, while the quality of communication performance will also become an important social issue (Keaton & McCann, 2017).

Appropriate programs can promote intergenerational communication, eliminate mutual stereotypes, and not only allow the people of different generations to learn from each other, also to stimulate the motivation and interest in the process of learning. The application of intergenerational games is an effective way to encourage intergenerational learning among different generations. The benefits of intergenerational digital games include strengthening family relationships, strengthening mutual learning, deepening intergenerational understanding, and reducing social anxiety. When designing intergenerational digital games, both aspects of player-centered and game-centered should be considered (Cucinelli et al., 2018; De la Hera et al., 2017).

Digital games can facilitate intergenerational interaction by promoting personal happiness, prosocial behavior, and knowledge sharing; promoting common activities by enhancing social interaction between different generations; and balancing the skills and challenges of users (Costa & Veloso, 2017). By playing intergenerational games, different generations can spend time together, connect, and talk to each other, while bridging the gap between generations. It also enables the elderly to have a sense of self-identity and happiness as well as a sense of accomplishment in mastering new technologies, enhancing their mental and physical abilities, and promoting successful aging (Osmanovic & Pecchioni, 2016).

However, when designing intergenerational games, it is necessary to consider how to achieve the inheritance of traditional culture through the design of game content, so that the younger generations can be immersed in the experience and background of the older generations. It also helps younger generations to eliminate the stereotypes regarding the elderly and achieve the purposes of mutual understanding and co-creating memories. Through the booming methods in technological experiencing, mutual support and learning between different generations can be achieved, and the sustainable development of the interactive relationship between the two generations can be promoted. The main purpose of games is to stimulate the motivation to participate through the integration of elements that are echoed by different generations. Furthermore, with interactive games, they can gain a sense of accomplishment as they beat the levels and build connections by cooperation in the process of participating. The benefits of different game processes are gained as they go through the game content (Agate et al., 2018).

3. DESIGN PRACTICE

The purpose of this research is to design a VR interactive game that can enhance communication between different generations. Therefore, the design process is divided into four parts. The first part involves the function planning of glove puppetry; through the integration of puppet show and VR, suitable game functions are planned. The second part involves the game outline and features, understanding the story content and historical background of “The Legend of the White Snake,” and integrate the features into the game content. The third part involves the design of intergenerational communication and game flow; through the design of interactive game flow, interaction and communication between different generations are enhanced. The fourth part involves the description of the game interface, explaining each UI and UX content in the game.

3.1 Glove Puppetry VR Function Planning

The main purpose of this research is to enable the elderly to relive the old memories of traditional culture through the application of new media and to pass on these cultural memories to the younger generations. The design plan of the interactive game is based on glove puppetry in the form of Yetai drama, while its game functions are as shown in Table 1.
Table 1. The plan for game functions

<table>
<thead>
<tr>
<th>Function</th>
<th>Plan of function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enter the game</td>
<td>1. One player needs to create a game room first and is then joined by another player.</td>
</tr>
</tbody>
</table>
| Selections      | 1. Glove puppetry is mainly based on the actions of the hands, so the selections and control of the game contents are all done by hand.  
                      2. After the elderly make their choices, corresponding feedback will be provided so that they can notice whether the operation is successful.  
                      3. After selections are done by pressing the buttons, selections for the second time are not allowed. |
| Beginner’s guide| 1. Clear guidelines of the game should be provided to lead the elderly through clicking operations |
| Start the Game  | 1. Speed of reading the text  
                      2. Switching between characters  
                      3. According to different segments, switching to corresponding scenes and music  
                      4. According to the instructions of the segment, props can be given to another player  
                      5. At the end of the game, performance scores and feedback will be provided to the players |

3.2 Game Outline and Features

“The Legend of the White Snake,” a story is taken as the background of the game’s story. “Kept Forever under the Leifeng Pagoda” is a highlight of the contemporary version of the story and is performed as an excerpt in many dramas and operas. In the game play, the tests play the story with words and connect with the story with which they are familiar.

“Kept Forever under the Leifeng Pagoda” is about the twists and turns of the love story between Xu Xian and White Lady. Xu Xian would like to offer incense at the Jinshan Temple with his friend. As White Lady could not stop him from going, she asked him to make three promises: (1) that he would not enter the Jinshan Temple; (2) that he would not talk to the monks; (3) that he would come home right after burning the incense and not stay any longer. However, Xu Xian forgot the demands of White Lady. Fahai, the monk, instantly noticed that Xu Xian had entered the temple. Xu Xian, who had doubts about White Lady, obeyed Fahai’s words and was convinced that White Lady was a demon turned human. Too afraid to go home, Xu Xian immediately asked for Fahai’s help, borrowing from him a golden bowl to subdue the demon. Fahai ignored White Lady’s plea and turned her back into a little white snake. Her handmaiden, Xiaoqing (the green snake), was also subdued by Fahai. Fahai took the bowl that sealed White Lady and Xiaoqing to Jinshan Temple and built a tower to suppress it. Later, Xu Xian became a monk and build a seven-story pagoda, Leifeng Pagoda, based on the tower. He then practiced as a monk in it.

The characters in this game are mainly based on the core characters in “The Legend of the White Snake,” while the historical background is based on the Song Dynasty, during which the story originated. The appearances of the puppet characters are designed according to the costumes of the Song Dynasty, and the 3D designs of the characters are as shown in Figure 1. Figure 2 shows the appearance of the theater in the game.

Figure 1. Designs of puppets
This game is based on the outdoor Yetai drama in the 1950s and the characters in the game are designed according to the prototypes of wooden puppets in traditional glove puppetry. Users can immerse themselves in the scene with a VR game and experience the setting of traditional glove puppetry.

### 3.3 Design of Intergenerational Communication and Game Flow

According to the literature, a good intergenerational program can effectively promote communication between different generations. In particular, the main concern of the game developed in this research is the communication and interaction between different generations; therefore, the interactivity of the game constitutes the crucial design core. Three types of connections are facilitated by this game, including the teamwork, teaching, and communication.

Figure 3 introduces the game flow and design of intergenerational communication points in the research game. Intergenerational communication points are generated in the following parts: (1) start of the game: at the beginning of the game, one party must first establish the game room and is joined by another party. **Communication** between the two parties is necessary. (2) Tutorial: when the elderly go through the tutorial, they may raise doubts about difficulties in operating the game; at this time, young people must **teach** and **communicate** to guide them through the basic operations. (3) Operation practice: it helps the players revise after consulting the guide for beginners. In this process, the two players can **discuss** and **learn from each other** and perform **teamwork** to conduct interactive exercises together. (4) Story outline: the story outline process explains the excerpts of “The Legend of the White Snake”; after reading the story, the two players can have a **discussion**. (5) Going on stage: **teamwork** is necessary for the two players to run the story to the end. Therefore, in order to coordinate switching characters, **communication** is essential. When the other party faces difficulties in operations, immediate **teaching** will allow the game to progress smoothly. (6) Counting the scores and evaluation feedback: when the game is over, the scores of the two players in the game are revealed, and feedback is given based on the performance of the two players; further, players can **discuss** their respective performance with their partners.

![Game Flow and Design of Intergenerational Communication Points](image-url)
3.4 Introduction to Game Scene Designs

The elderly experience physical decline as they age. Especially the changes in visual function are the most obvious. Therefore, color configuration must first be considered when designing the interface. And avoid bringing visual confusion. In the game, the main button is red, and the secondary button is black. The brightness of the color red not only attracts the attention of elderly persons but also carries a certain guiding function. Feedback is provided when the elderly click on the objects, so that they may notice whether the click was successful. The interface design of the game is explained in Table 2:

<table>
<thead>
<tr>
<th>Interface name</th>
<th>Interface</th>
<th>Introduction to the interface</th>
<th>Interface name</th>
<th>Interface</th>
<th>Introduction to the interface</th>
</tr>
</thead>
<tbody>
<tr>
<td>Front Page</td>
<td>![Image]</td>
<td>Strong contrasting colors are used in the buttons of this interface. The color of the main button is bright, and the button is placed in a position that can be easily reached by the dominant hand.</td>
<td>Story outline:</td>
<td>![Image]</td>
<td>The interface should consider the respective positions of the two, and its design should: (1) avoid using small fonts in the content; (2) avoid using colors with similar chromas; (3) place the scene in the center for maximum readability.</td>
</tr>
<tr>
<td>Getting on stage</td>
<td>![Image]</td>
<td>In the interface, the players are separately placed in two positions to avoid excessive overlaps of the movable ranges when they are operating.</td>
<td>Tutorial</td>
<td>![Image]</td>
<td>The interface after entering the game, buttons on this interface are not main buttons of the game, so they are placed on the left. When the player turns to the left to select the buttons, it is more convenient for them to use their right hands for selection.</td>
</tr>
<tr>
<td>Counting the scores</td>
<td>![Image]</td>
<td>This interface displays the scores and performance of the two players. The scene is placed in the center for maximum readability.</td>
<td>Performance practice</td>
<td>![Image]</td>
<td>The characters will be placed directly in front of the players, reducing the hindrance of the operation. The players are able to reach out and touch the characters that they want to choose at a glance.</td>
</tr>
</tbody>
</table>

In the game, two players act as the characters on stage at the same time. In addition to completing the performance, corresponding scores and evaluation feedback will be provided each time they pass a level, to enhance the sense of accomplishment. It is hoped that VR interactive games that have glove puppetry as their theme will stimulate the elderly and young people’s willingness to play and reduce the distance between the cultural backgrounds of different generations. In this way, the elderly may experience new technology and equipment, while young people can be exposed to traditional culture while playing games. Figure 5 shows the scene of an elderly person and a young person playing the VR game together.
4. RESULT

The Unity 3D game engine is used in this research to complete the production of the game, while Blender and MYAY are used for the 3D modeling of the character models. The function buttons displayed are drawn with Adobe Illustrator. In addition, the VR device used in this research is the product of Oculus Quest which can translate actions into VR through the built-in sensor without the setup of base stations, while the actions are directly tracked by gestures. The functions fit the elements of puppet manipulations by hands. According to the literature, the elderly are constrained by the deterioration of their visual ability, and long-term use may cause physical discomfort. Therefore, from entering the game to the end of the game, the playing time about 15–20 minutes, and it is recommended to take 10 minutes of visual rest after a single play. This is to prevent the elderly from having unpleasant feelings while operating the VR, which would reduce their willingness to experience the latest technologies. In the future, this research will recruit test objects to examine whether the culture of traditional glove puppetry is suitable for applying to VR for the design of intergenerational games, and whether it enables people of different generations to interact and communicate more closely.

REFERENCES

Chen C., 2004. Folklore in the Memories—The Disappearing Living Culture of Common People.


