Research on the Design and Production of Digital Animation Based on Unity3D - Centered on the Theme of the Idiom Story the Dream in the World of Lute

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Abstract. Digital media design, thanks to its unique interactivity, makes the display of cultural abundance rich and diversified. Stimulated by the policy of vigorously boosting the development of cultural and creative industries laid down by the country, the forms of digital media design have emerged in an endless stream. Digital media design, with the aim of serving the whole society, seeks the quintessence of Chinese traditional culture, explores the profound cultural abundance, and displays its cultural charm with humanistic feelings. This article, taking the Chinese idiom story as the basis of design, focuses on the design and production of traditional idiom stories, by means of the Unity3D engine. It, with the aid of the design and production of digital animation interactions, integrates cultural connotations into digital design and education service, and explores the ways to enrich the users’ digital interactive experience and to raise their cultural awareness.

1. Introduction
The “Belt and Road” Strategy, as a response to the unexhausted source of history and culture, serves as a “silent” bridge, through which people of all countries foster positive relations and strengthen friendships. It has created a supportive environment in which countries across the world work towards the same direction, and build up their consensus, thus establishing the pattern that economic and trade exchanges, and efforts in political diplomacy are complemented with “soft strength”. Also, the “Belt and Road” Strategy has brought new engines for the boost of Chinese traditional culture. [1] Under the guidance of the policy of vigorously boosting the development of cultural and creative industries laid down by the country, digital media design, benefiting from its unique interactivity, has infiltrated into all areas of mass life. For example, in the era of smart phones, APP creeps into every corner of urban life, and what’s more, the upgrade of VR, AR and other new interactive methods has brought the users’ interaction experience to a new height. Digital media technology, as a kind of cross-media technology, promotes the digitized information (as the main carrier) by means of such mass media as mobile phones and computers, and integrates a certain touch of interest, interactivity, diversity, and art abundance into the information accessible to users. Idioms, as the crystallization of literary ideas proposed by various masters in ancient China, reflects the unremitting efforts of ancient Chinese people in their exploration of truth and their spirit of seeking natural laws through objects surrounding them. Notwithstanding the ever-changing times, as well as languages and culture, idioms are still in use today, and they have a exerted far-reaching impact upon modern civilization, as well as people’s
mindset and patterns of behavior. Unity3D, as a multi-platform integrated tool aimed at the development of virtual reality, has been created by Unity Technologies. It allows users to easily create various kinds of interactive content, such as 3D visual simulation, building visualization, and real-time 3D animation, and so on. It is a professional virtual-reality engine which has been fully integrated. [2] The Unity3D engine demonstrates the philosophy of life in idiom stories, and as a result, more people, especially children, will, in a more intuitively manner, get a detailed picture of cultural abundance conveyed by Zhuang Zi, and build up a correct outlook on life and values. In the original work The Dream in the World of Lute, four idioms in Zhuang Zi have been selected. Based on the cultural abundance of the classic stories, the modes of animation and interaction are designed and produced, through which users will immerse into the cultural ambience of the idiom stories.

2. Case Study of Digital Interaction Design
The animation, applied in the interactive design, has a good effect of import, and interaction and even “empathy”, which is initiative, unique in personality, and full of vivid images. [3] The activities of human beings are characterized with direct manipulation in most areas, and directness means that users engage with the content in a direct manner, thus minimizing the intermediary links of interaction. [4] Take the puzzle-focused game Tengami as an example. The game has its simple instructions of operation and few hints. Therefore, players need to “feel for the stones when crossing the river”. Compared with the common puzzle-focused games featuring the access design of looking for buttons and hiding key entrance, Tengami presents players with a complete virtual world, where they should, at first, have a keen insight into the game environment and think about how to stand out in the game. The game prides itself upon its ingenious design of interaction. For instance, there are various parts, such as the puzzle-solving links required for sound symbols, and the units focusing on logical reasoning. Figure 1 below shows an interface in which players need to fetch items from the well to solve puzzles. In the game, the scene design, as an epitome of the ever-changing four seasons, is elegant and delicate, with the music to a proper extent. In terms of artistic expression, as for the design elements in the game, the form of paper folding has been adopted in a uniform way, which is concise and full of interest.

Figure 1. The scene of the game Tengami

Interactive technology, important as it is, seeks an effective design with several integrated elements by means of manual operation, environment, and behavior, and defines a behavior element. [5] Three-Dimensional Idioms is a digital APP with the characteristic of interactive experience. With the aid of this application, which focuses on idioms, a series of animation interactions have been worked out. Open this application, and enter the interface, where users can switch different idioms by sliding through the idiom card. Upon the selection of idioms, users can acquire the knowledge of idioms by watching the animation-oriented stories and participating in various interactive games. Since this application is designed for children, the design, which is filled with knowledge, is more interesting. As for the game link, the design focuses on the idiom stories. Figure 2 below shows the picture of the story “The Foolish Old Man Removes the Mountains”. Users who click the sliding image will have a commanding view of the mountain, and get a keen insight into the truth revealed by the story. [6]
3. The Design and Production of The Dream in the World of Lute

3.1. Work Creativity and Design

Zhuang Zi, a renowned writer in the mid-Warring States, is well reputed for his works which boasts both philosophical abundance in literature and literary richness in philosophical ideas. At the outset of subject planning, the work, based on a collection of such masterpieces as *Essay on the Uniformity of All Things* and *Wandering in Absolute Freedom* from the Classics of Zhuang Zi, has selected four idioms as its design target, namely, “Zhuangzhou dreams about butterflies” “lament one’s littleness before the vast ocean” “play the lute to an ox”, and “a summer insect discusses ice”. The idiom “lament one’s littleness before the vast ocean” comes from the Classics of Zhuang Zi ·Water in Autumn. It tells a story that Uncle River, as the river god of the Yellow River, had thought that the Yellow River was the largest river and he was the largest river god, before he saw the mighty North Sea. However, when he came to the North Sea, he found himself unable to embrace the whole range of the sea. Thus, he, with deep feelings, sighed that he himself, compared with great things, was so minor. Prior to the graphic design, the text was split and interpreted literally. “Yang” represents the “North Sea”, and “Look” means that Uncle River is looking to the North Sea. In the picture, the two elements - “North Sea” and “River God” should be included, and then there should be some kind of imaginations for the design of other elements. Figure 3 constitutes the hand-painted scene map of “lament one’s littleness before the vast ocean”.

The idiom “a summer insect discusses ice”, starting with its metaphor, takes the Su-style garden as its background. The lotus pond, creating an introductive ambience, has a folding-paper effect in its form. The scene focuses on dragonflies. Click the dragonflies, and you can see the animation of dancing dragonflies. The element of ice is captured with its specific emergence of snow-patterned particles; the scene, by means of the varied gray-scale value of lens, transforms itself from colorful to black and white. As for the music, the Chinese classical zither songs have been applied, thus creating an elegant Zen atmosphere. Figure 4 below shows the scene design of “a summer insect discusses ice”. As for the work, the representative words in the four idioms are selected, and then some efforts in the integration of meanings should be made. Eventually, the work is named *The Dream in the World of Lute*.

Figure 2. The scene of Three-Dimensional Idioms

Figure 3. The hand-painted scene map of “lament one’s littleness before the vast ocean”
3.2. Design and Realization of Animation and Interaction

All the tasks of production are performed by means of the Unity3D software; in Unity3D, the method featuring the comprehensive usage of collision detection and animation is applied for the interactive design. Besides, the particle system seeks to enrich special effects for the animation; with the aid of the adjusted parameters, a flat folding effect will be attained. Thus, the integrated use of different techniques of production paves the way for the interaction of various elements on the screen. [7]

3.2.1. Design and Production of 3D Book-folding Effect. The entire work is presented, just like “a three-dimensional book”, and each idiom is displayed by means of the pages of the 3D book. As for the production, first, we should understand the principle of image folding: On the folding pages, all the elements, set on their respective planes, are driven by the associated axes among them, so that each element in the entire scene gradually changes with to the opening and closing of the total page. In fact, the state of all elements (angles and positions of folding) is directly linked with the folding angle of the total pages; the method of straight-line difference is applied to “simulate”, to an appropriate extent, the mathematical process of page folding. During the process of production, there will be visual bugs, for instance, the interpenetrating paper sheets, which should be modified by some sorts of design adjustment, for example, employing some decorations or adding thickness to the pages. Figure 5 below shows the process of optimizing the folding angle in Unity 3D.

Both plane and cube objects are employed, in order to make the folding pages of demo. In the Demo scene, there are the left page, the right page, and several elements. First, create the mPage.cs script, so as to control the folding of all pages. The core floating-point variable serves as the angle at which the page is folded. According to this angle, the elements in all scenes have their respective folding angles. With the aid of mouse clicking and dragging, make use of raycast to perform the task of physical detection. Thus, the variable of angle will be obtained. The mCenter.cs script controls the changing angle of each element. For each element, create an empty object which serves as its axis, and adjust it to the position of the axis. Thus, the empty object is subordinate to the element. The scene is
aimed at displaying the expanded picture. Make use of mCenter, to keep a record of the current angle in Start, and then add a variable. Set the angle of the axis in a manual manner when the page is folded. In Update, the interpolation is achieved based on the fully-opened angle, the fully-closed angle, and the angle’s value of mPage. Thus, the proper angle of the current frame will be attained. As for folding creation, all the objects are located at the center of the two pages. Create a mid between the left and right pages; set all the elements as the subordinates of the mid and create the mid.cs script for the mid, with the result that the mid always roam at the half distance from each of the two pages. Figure 6 below shows the code of the collision detection of folding pages.

```csharp
if (Physics.Raycast(Camera.main.ScreenPointToRay(mouseLoc), out hit, 10000, bPage)) {
    smallPickedIndex = hit.collider.GetComponentInParent<PlayerPage>().index;
} else
if (Physics.Raycast(Camera.main.ScreenPointToRay(mouseLoc), out hit, 10000, aPage)) {
    if (mouseLoc.x > Screen.width * 0.6f) {
        pick = 1;
        step = (int)(angle / 90f);
    } else if (mouseLoc.x < Screen.width * 0.4f) {
        pick = 2;
        step = (int)(angle / 90f);
    } else {
        pick = 0;
    }
} else {
    pick = 0;
    mCam.fbo = (8f * Input.mousePosition.x / Screen.width) - 4f;
}
```

**Figure 6.** The code of the collision detection of folding pages, be it large and small.

Upon the scene setting, drag the left page by means of the mouse, so that each element changes as you drag. During the process of production, it is necessary to solve such problems as double-sided display and transparent channel of the plane, as well as how to control each element in the multi-page folding. Upon several tests, select Nature/Tree Soft Occlusion Leaf in the double-sided transparent channel, which is a kind of Shader, self-reliant as it is, applied on the leaves of the Unity 3D engine. In the process of multi-page folding, add a corresponding range for all elements. If the elements go beyond the specific range, the corresponding angles will no more change. Through the above-mentioned process of production, the most important scene will be created. Figure 7 below shows both the picture effect and the lighting effect in Unity3D. [8]

**Figure 7.** The drawing of lighting effect

### 3.2.2. Resource Import and Scene Setting.

Take the picture materials of the scene as a resource package, and, with the aid of the Photoshop software, create a two-dimensional scene, where all the elements are separated from the middle of the scene, with Unity3D imported at the left and the right respectively. Create the left and right pages, mid objects, and various joints in the scene. Then, create a plane on the joint. Drag the picture onto the plane, in order to create a chartlet. Replace the texture Shader with Nature/Tree Soft Occlusion Leaf, adjust the parameters, and set the size of the plane. Thus, the elements of a scene plane have been successfully imported. [9] Likewise, upon the import of all the plane elements, import the audio materials by means of Audio Source. Finally, a scene has been built up. In the scenes of the four idiom stories, as for mouse sliding and clicking, a special effect will
be created, so as to enrich the atmosphere the scene. As for the story of “Zhuangzhou dreams about butterflies”, click the elements, and the petals will fall off; as for the story of “lament one’s littleness before the vast ocean”, click the elements, and the bubbles will pop up.

3.2.3. Production of Interactive Effect. As for the interactive design, the scripting events are applied, in combination with the Animator State Device, the Animation Controller, and the Particle System. Animation, as a system similar to flash animation, will automatically generate the supplementary animated pictures, as long as the key frame is set. [10] Generally, by means of the event of OnMouseDown, create a supportive environment in which there are collision objects on a gaming subject, and the objects will be triggered once the mouse is clicked. When the angles of opening and closing reaches the specified range, for example, the situation in which the current page folding has not been triggered or no animation has been played, the clickable light spot will not appear before the requirement of triggering is met.

During the process of the production of “Zhuangzhou dreams about butterflies”, click the dead tree, and then, the animation of objects hung on the tree will be played: Light changes and flying petals (Animation), falling Sakura + glittered river (Particle System), and ripples on the river (Shader). Figure 8 below shows the animation code of the script fixed on the tree upon the clicking of the dead wood.

```cpp
void OnMouseDown(){
    mPage.page.angle = (mMax-mMin)/2;
    anim.Play("stars");
    GameObject.Instantiate (Resources.Load ("eff+Random.Range(0,4)"));
}
```

**Figure 8.** The script fixed on the tree upon the clicking of the dead wood

On the butterfly, add a preset body with an animated picture: The property of animation loop is ticked off, so that the single play does not circle. The butterflies, after roaming about the tree, have left, with the tail-dragging effects of Particle System and Railrender. The characters on the top right corner of the preset body can be gradually displayed and hidden by means of the Filed format, with the aid of UGUI’s image. Figure 9 below shows the animation code when the light spots are clicked.

```cpp
public string s;
public GameObject lemov;
public ShaderTest test;
void OnMouseDown(){
    GameObject.Instantiate (Resources.Load (s), Vector3.zero, Quaternion.identity);
    GameObject.Instantiate (Resources.Load ("eff+Random.Range(0,4)");
    if (lemov != null) {
        lemov.SetActive (true);
    }
    if(test!=null){
        test.gravityScale=0.1f;//heihei
    }
    gameobject.SetActive (false);
}
```

**Figure 9.** Generate the well-prepared preset body by means of OnMouseDown

The special effect of particles is set with the aid of Particle System. Its number and speed can be controlled by the adjusted parameters. The system is employed to create both the petal-flying effect of “Zhuangzhou dreams about butterflies” and the snow-falling effect of “a summer insect discusses ice”. Figure 10 below shows the petal-flying effect of “Zhuangzhou dreams about butterflies”.

```
figure 10. The parameter setting of Particle System
```
The idiom “lament one’s littleness before the vast ocean” comes from the Classics of Zhuang Zi · Water in Autumn. As for the production, click the sailboat, play the animation. The sailboats are unfolding. Then, make use of the LensFlare module to create the halo effect, to achieve the effect by means of its changing positions, and to display the previously hidden seabirds, which are allowed to fly out of mists and clouds. The seabirds, with the mBird script attached, constantly shift their positions, and flutter their wings every few seconds, in order to simulate the attitude of flying seagulls. Likewise, the function of “a jumping fish” has been activated, and the preset body of fish has been created, with both the animation of a jumping fish and the particle effect of splashes. Also, Uncle River is a preset body. The preset body enjoys a particle effect characterized with ever-rising mists and clouds. Uncle River and the characters form a gradually-displaying animation, by means of the Filled format of image. It’s worth noting that the emergence of Uncle River coincides with the rising of mists and clouds. The fish-jump script will generate a preset body of fish in the scene at irregular intervals. The animations and lifecycles on the preset body will be automatically deleted upon the playing of fish jump. Figure 11 shows the code for this section. Sunrise serves as the self-reliant Unity3D’s LensFlare (components of the halo effect). This component automatically generates a horizontal halo, according to the position between the halo components and the lens, as well as the parameter variables of halo intensity and position, based on the picture effect in the animation.

```csharp
1 using UnityEngine;
2 using System.Collections;
3
4 public class fishbird : MonoBehaviour {
5     float time=1;
6     void Update () {
7         time += Time.deltaTime;
8         if (time <= 0) {
9             float f = 0;
10            if (Random.value > 0.5f) {
11                f = 180;
12            }
13            GameObject gb;
14            Gameobject gb =
15                Gameobject.Instantiate ("SmallFish");
16                new Vector3 (Random.Range(-5.7f, 5.7f),1.5f, Random.Range(-1.2f, 3.1f)),
17                Quaternion.Euler(0,f,0) as Gameobject;
18            gb.transform.SetParent (transform);
19            time = Random.Range (3, 5);
20        }
21    }
22 }
23 }
```

Figure 11. The fish-Jump script

Likewise, as for the production of “play the lute to an ox”, mists and clouds, maids, the ox, notes, etc should be produced firstly. Click the mirror effect at the back of the pavilion, and thanks to the adjusted value in the resource, the sleeping status becomes. This value controls the mirror’s reflective accuracy. Here, the accuracy shifts from a low level to a high level, resulting in a mirror effect which is gradually clear. In the animation state, the mirror effect is activated and the precision of the mirror is changed from 0 to 1024. The higher the precision, the better the effect is. The effect in the animation is the process of clearing from the blur.

As for the lens becoming black and white upon the snow falling of “a summer insect discusses ice”, modify the gray-scale value of lens, and attach a resident script to the lens, so as to control the gray scale. 0 is a full set of colors, and 1 is a full set of black and white. By default, the gray scale changes at the rate of -1, that is to say, the gray scale is always decreasing. After the animation of wind and
snow is played, set the gray scale as a positive number, and the picture will gradually change to black and white within 10 seconds.

3.2.4 Display of Effect. In order to add a touch of interest of the work, the mode of map exploration has been worked out. For details, please refer to Figure 12 below. Integrate the pictures of the four idiom pictures on a map, and click the text buttons for the different sections. The, the title of idioms appears, and the section expands to the entire range of the screen. Thus, the interactive animation of idioms will be introduced. The map mode is characterized with both text buttons which match the map and animations which correspond to the scene. Click the character “butterfly” in “Zhuangzhou dreams about butterflies” displayed the map, and you will see flying butterflies; Click the character “ocean” in “lament one’s littleness before the vast ocean”, and you will see sailboats moving ahead. Click the character “ox” in “play the lute to an ox”, and you will see a row of oxen grazing with their heads bowed; Click the character “ice” in “a summer insect discusses ice”, and you will see a swimming fish in the lotus pond, which embodies the beauty of summer. The map design, full of interest, has paved the way for the following interactive animation. [11]

![Figure 12. The design of map](image1)

As for the picture of “Zhuangzhou dreams about butterflies”, the interactive animation and particle effect are accompanied by changes in lighting, as well as the emergence of sound effect, recitation, and texts. A dreamful scene, full of vivid freshness and romantic abundance is presented, as shown in Figure 13. Upon the completed interactive animation of idioms, the system will automatically return to the homepage of the map. Click the next section, and you will see the second idiom story. Figure 14 shows the effect of “lament one’s littleness before the vast ocean”. Upon the unfolding scene, an animated picture of dark clouds is displayed. Accompanied by the thunders and noise, the clouds are scattered, and the sunlight is scattered. The mists and clouds enjoy a glittering effect. Click the sailboat, and you will sea Uncle River. Then, you, immersed in the ambience of waves and seagulls, will hear the texts of “lament one’s littleness before the vast ocean”, and embrace the boundless, inclusive ocean. As for the design of “play the lute to an ox”, such factors as the mountain ranges in Guilin and the dynamics of ox and players have been included; together with the special effect of mists and clouds and the mirror effect, the picture is more artistic, as shown in Figure 15. Figure 16 shows the image of “a summer insect discusses ice”. The design refers to the Su-style garden, in which there are three parts: the lotus pond, the plum tree, and Su-style architecture.

![Figure 13. The image of “Zhuangzhou dreams about butterflies”](image2) ![Figure 14. The image of “lament one’s littleness before the vast ocean”](image3)
4. Conclusion
The digital design of intangible cultural heritage, as a part of the reconstruction of cultural abundance, is a move of “integration and innovation in terms of culture and technology”. The design of intangible cultural heritage, based on unity3d technology, integrates, in a real-time manner, the human’s unperceivable cultural experience into the practical reality with the intangible cultural heritage as the carrier, by means of digital information, and enhances the carrier’s cultural added value with the aid of enriched cultural experience. Digital production technology with the characteristics of animation and interaction provides enormous potential for the creative activities related to the design and display of traditional cultural heritage. The design of Chinese traditional idiom stories, based on the digital production technology, helps users have a better understanding of cultural significance of the idiom stories. With the development of network technology, digital interaction has enjoyed huge popularity in daily life, and the user-centered interactive experience is more demanding than ever before. Thanks to this, the research on the digital design and display of traditional cultural abundance will be more systematic and perfect.

References
[1] Gong Zhe, The Role of new media in the “Go Global” of Cultural Heritage in the context of the “Belt and Road” Strategy, New Media Study, 2017(12), pp46-47
[2] Xiu Chunhua, Sun Xiujuan, Miao Po, Che Defu, The design and realization of virtual mine roaming simulation system based on Unity3D, Metal Mine, 2015(04), pp262-266
[3] Chen Yuanjuan, an Initial discussion on interactive design of digital animation, Journal of Nanjing University of the Arts (Art & Design Edition), 2011(06), pp187-190
[4] Wu Weihe, Wang Yiqiang, Wang Wentao, Chen Meijuan, A research on natural interaction design of digital media, Art and Design (Theory), 2010(04), pp22-24
[5] Shi Ruifang, The impact of interactive design upon the development of digital media technology, Computer Information and Technology, Vol. 24, Issue. 6, 2016(12), PP62-64
[6] Li Jing, Li Shiguo. Explore the emotional connections between human beings and products from the perspective of interaction design, Packaging Engineering, 2008, 29(9), pp151-153
[7] Liu Yongxiang, A research on human-machine interface interaction design based on product availability, Packaging Engineering, 2008, 29(4), pp81-83
[8] S Izadi, D Kim, O Hilliges, D Molyneaux, R Newcombe, Kinectfusion: real-time3D reconstruction and interaction using a moving depth camera, Proc Uist, 2011, pp559--568
[9] Rajesh Elara Mohana, Ning Tanb, Katrine Tjoelsenc, Ricardo Sosad, Digital, Communications and Networks, Volume 1, Issue 4, November 2015, pp267--274
[10] Wu Leying, Application and Study of Shadow Art in Animation Design, Popular Literature, Issue 17, 2010, pp47-48
[11] Yang Fangqi, Luo Weiliang, Reflection on Digital Development of Shadow Play of Shaanxi East Mansion, Value Engineering, Issue 35, 2010, pp121-123